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THE

JOURNAL OF THE SOCIETY OF ARTS.

VOLUME XXV.

FROM NOVEMBER 17, 1876, TO NOVEMBER 16, 1877.

ROYAL SOCIETY OF EDINBURGH

LONDON:
PUBLISHED FOR THE SOCIETY BY GEORGE BELL AND SONS,
4, 5, & 6, YORK-STREET, COVENT-GARDEN.

1877.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,252] FRIDAY, NOVEMBER 17, 1876. [Vol. XXV.

ONE HUNDRED AND TWENTY-THIRD SESSION, 1876-77.

Council.

H.R.H. THE PRINCE OF WALES, K.G., *President of the Society.*

Lord Alfred S. Churchill, *Vice-Pres., and Chairman of Council.*

H.R.H. the Duke of Edinburgh, K.G., *Vice-Pres.*
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H. T. Wood, B.A.

Educational Officer.
Charles Critchett, B.A.

Cashier.
Howard H. Room.

Auditor.
J. Oldfield Chadwick.

Arrangements for the Session.

The following is the Calendar for the Session 1876-77. It is subject to any necessary alterations :—

	CANTOR LECTURES.				AFRICAN MEETINGS.				ORDINARY MEETINGS.					CHEMICAL MEETINGS.				INDIAN MEETINGS.			
	Mondays.				Tuesdays.				Wednesdays.					Thursdays.				Fridays.			
1876.																					
November	—	—	20	27	—	—	—	—	—	—	15	22	29	—	—	—	—	—	—	—	—
December	4	11	18	—	—	—	—	—	—	6	13	20	—	—	—	—	—	—	—	—	—
1877.																					
January	—	—	—	—	—	—	23	—	—	—	17	24	31	—	—	—	—	—	—	—	—
February	—	—	—	—	—	13	—	—	—	7	14	21	28	8	—	22	—	2	—	16	—
March	5	12	19	26	—	13	—	—	—	7	14	21	—	8	—	—	—	2	—	16	—
April	—	16	23	30	10	—	24	—	—	4	11	18	25	—	12	—	26	—	—	20	—
May	7	14	—	—	8	—	—	—	2	9	16	23	30	—	10	—	—	4	—	—	—

The Chair will be taken at Eight o'clock at each of the above Meetings.

The Annual General Meeting will be held on June 27th, 1877, at four o'clock.

The Society of Arts.

The Society of Arts was founded in 1754, and incorporated by Royal Charter in 1847, for "The Encouragement of the Arts, Manufactures, and Commerce of the Country, by bestowing rewards for such productions, inventions, or improvements as tend to the employment of the poor, to the increase of trade, and to the riches and honour of the kingdom; and for meritorious works in the various departments of the Fine Arts; for Discoveries, Inventions, and Improvements in Agriculture, Chemistry, Mechanics, Manufactures, and other useful Arts; for the application of such natural and artificial products, whether of Home, Colonial, or Foreign growth and manufacture, as may appear likely to afford fresh objects of industry, and to increase the trade of the realm by extending the sphere of British commerce; and generally to assist in the advancement, development, and practical application of every department of science in connection with the Arts, Manufactures, and Commerce of this country."

Since its incorporation it has worked steadily in the direction indicated by its Charter. Its action has indeed been so varied, that it is not easy to select any typical instances of the results of its labours. By holding smaller Industrial Exhibitions, the Society prepared the way for the first Great International Exhibition, held in 1851, which was originated by the Society under the presidency of his Royal Highness the Prince Consort. The Society at first entered into an agreement with contractors to carry out the undertaking, but subsequently applied to Her Majesty to issue a Royal Commission, a petition which was graciously acceded to. The International Exhibition of 1862 was also originated by the Society. It raised a Guarantee Fund of £450,000, to meet the expenses of the undertaking, and nominated the Commissioners, who were afterwards appointed by Her Majesty. The Artistic Copyright Act of 1862 was prepared and carried through Parliament by a committee of the Society, thus providing for the first time a copyright in Works of Art. More recently the National Training School for Music has been established through the exertions of the Society, and it is hoped that this Institution may do for Music in England what has been accomplished in other countries by the numerous *conservatoires* existing on the Continent. During the last Session a successful Conference on the Health and Sewage of Towns was held, numerously attended by representatives from various localities in the kingdom, and it is proposed to hold a second Conference of a similar character in the ensuing spring.

The regular work of the Society may be arranged under the following heads:—

First, the promotion of such important public objects as those instanced above, which is effected principally by the Council and by Committees specially nominated as required.

Secondly, the introduction and discussion of new subjects by papers read at evening meetings, or by lectures delivered before the Society. The utility of such proceedings is shown by the necessity which the Society has been under of founding in succession an "Indian," "African," and "Chemical" Section, for the holding of meetings in addition to the long established Ordinary Evening Meetings of the Society.

Thirdly, the Society's system of Examinations. Here, as in all its proceedings, it is endeavouring to open fresh ground, retiring from that which is occupied by other agencies. Leaving the more general Local Examinations it originally started to be carried on by the Universities, who are naturally better able to undertake the fast increasing work, the Society has set on foot a fresh scheme, which comprises Examinations in Commercial Knowledge, the Technology of Arts and Manufactures, Fine Arts applied to Industry, Domestic Economy, and Music.

Such instances as these may serve to show the wide scope which it is endeavoured to give to the proceedings of the Society of Arts. From time to time, as Science has progressed, numerous Societies have sprung up, each devoted to a special branch of investigation, and as often as this has happened the Society of Arts has left to such special workers the researches it had in the first instance taken up. Thus the objects and interests of the Society are perpetually changing, its efforts being as far as possible to discover fresh modes of applying its influence to the promotion of the objects enumerated in its Charter.

Proceedings of the Society.

THE SESSION.—The Session commences in November and ends in June. The number of Meetings held during the past Session (1875-6) was 76.

ORDINARY MEETINGS.—At the Wednesday Evening Meetings during the Session, papers on subjects relating to inventions, improvements, discoveries, and other matters connected with the Arts, Manufactures, and Commerce of the Country are read and discussed.

INDIAN SECTION.—This Section was established in 1869, for the discussion of subjects connected with our Indian Empire. Six or more Meetings are held during the Session.

AFRICAN SECTION.—This Section was formed in 1874, for the discussion of subjects connected with the Continent of Africa. Six or more Meetings are held during the Session.

CHEMICAL SECTION.—This Section was formed in 1874, for the discussion of subjects connected with Practical Chemistry and its application to the Arts and Manufactures. Six or more Meetings are held during the Session.

CANTOR LECTURES.—These Lectures originated, in 1863, with a bequest by the late Dr. Cantor. There are three courses every Session, and each course consists generally of from Four to Six Lectures.

JUVENILE LECTURES.—A short Course of Lectures, suited for a Juvenile audience, is delivered to the Children of Members during the Christmas Holidays. For these Lectures special tickets will be issued.

ADMISSIONS TO MEETINGS.—Members have the right of attending the above Meetings and Lectures. They require no tickets (except for the Juvenile Lectures), but are admitted on signing their names. Every Member can admit *two* friends to the Ordinary and Sectional Meetings, and *one* friend to the Cantor Lectures. Books of tickets for the purpose are supplied to the Members, but admission can also be obtained on the personal introduction of a Member.

JOURNAL OF THE SOCIETY OF ARTS.—The *Journal*, which is sent free to Members, is published weekly, and contains full Reports of all the Society's Proceedings, as well as a variety of information connected with Arts, Manufactures, and Commerce.

LIBRARY AND READING ROOM.—The Library and Reading Room are open to Members, who are also entitled to borrow books.

CONVERSAZIONI are held, to which the Members are invited, each Member receiving a card for himself and a lady.

MEMBERSHIP.—The Society numbers at present nearly four thousand members. Gentlemen desirous of becoming Members should communicate with the Secretary. The Annual Subscription is Two Guineas, or a Life Subscription of Twenty Guineas may be paid.

The following are the arrangements for the Meetings previous to Christmas :—

Ordinary Meetings.

Wednesday Evenings, at Eight o'clock. The following Papers will be read :—

November 22.—"Collapsible Boats; their Peculiarities and Advantages," by the Rev. E. L. Berthon. On this evening Lord Alfred Churchill will preside.

November 29.—"The Construction of House Drains," by Major-General F. C. Cotton, C.S.I. On this evening Robert Rawlinson, Esq., C.B., will preside.

December 6.—"Street Tramways," by Captain Douglas Galton, R.E., C.B., F.R.S.

December 13.—"A New Process of Printing a Number of Colours at One Impression," by E. Meyerstein, Esq.

December 20.—"The Philadelphia Exhibition," by Professor Archer.

Cantor Lectures.

Monday Evenings, at Eight o'clock. First Course, on "The History of the Art of Coach Building," by George A. Thrupp, Esq.

Lecture I.—November 20.—Carriages of the ancient world; Egypt, Syria, Greece, and Rome, and native carriages of Hindustan.

Lecture II.—November 27.—Carriages of the Middle Ages, and introduction of coaches into England, France, Italy, and Germany. State coaches of the time of Louis XV.

Lecture III.—December 4.—Carriages from 1770 to the present time.

Lecture IV.—December 11.—Ancient and modern travelling, and public carriages of Europe.

Lecture V.—December 18.—Rules of coach building and theories applicable to the carriages of the future.

The Lectures will be Illustrated with many Diagrams of Carriages.

The remaining Courses are on "The Chemistry of Gas Manufacture," by A. Vernon Harcourt, Esq., F.R.S., and "The Connection of Greek and Roman Art with the Teaching of the Classics," by Sidney Colvin, Esq., M.A., Slade Professor of Fine Art at the University of Cambridge.

The First and Second Courses have been arranged with special reference to the Society's Technological Examinations.

Juvenile Lectures.

This Course will consist of Two Lectures, by R. A. Proctor, Esq., F.R.A.S.

Lecture I.—January 3rd.—"The Sun and his Family."

Lecture II.—January 10th.—"Comets, Meteors, and the Stars."

Special Tickets will be issued for these Lectures.

PROCEEDINGS OF THE SOCIETY.

THE LATE DR. CRACE CALVERT.

A portrait of the late Dr. Crace Calvert has been presented by Mrs. Calvert to the Society, and has been accepted by the Council. The thanks of the Council were voted to Mrs. Calvert at their last meeting.

CANTOR LECTURES.

In future, no special tickets will be issued for these lectures. Books of tickets for the Ordinary and Sectional meetings, and for the Cantor Lectures, have already been issued to the members.

FIRST ORDINARY MEETING.

Wednesday, Nov. 15th, 1876, Lord Alfred S. Churchill, Chairman of the Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Abbott, Arthur Robert, B.A., Grove-house, Tottenham.
Abell, George E., The Cross, Worcester.
Andrew, Frank, Apsley-place, Ashton-under-Lyne.
Bacon, Rev. James, B.D., Warden of St. Thomas's College, Colombo, Ceylon.
Balmer, Peter, Ormskirk.
Barr, William Henry, L.R.C.P., L.R.C.S., L.A.H., Manchester-road, Bury, Lancashire.
Beningfield, T. F., Grafton-cottage, Hornsey-road, Holloway, N.
Benson, James Levett, Ph.D., 115, West-parade, Off Spring-bank, Hull.
Bickerton, Joseph, Alderman, J.P., Oldham
Biddle, Frank, 68, Finchley-road, N.W.
Bird, Richard, F.R.G.S., St. John's, Fulham, S.W.
Blaine, Henry, 2, Cleveland-road, Ealing, W.
Blair, George Young, J.P., Stockton-on-Tees.
Booker, Edward John, Edmonton, Middlesex.
Boulton, William, Aberdeen.
Brereton, Andrew Jones, Mold, Flintshire.
Brooke, Col. John Cheap, Llanidloes, Montgomeryshire.
Bruce, George Barclay, 2, Westminster-chambers, S.W.
Burbidge, George Thompson, M.C.P., 70, Roman-road, Barnsbury, N.
Burrell, Alexander, 2, Jermyn-street, S.W.
Carrington, William Edward, Cale-green, Stockport.
Chomsai, Prisdany, 40, Sackville-street, W.
Clarke, Henry, Bulmershe-lodge, Erleigh, Reading.
Cotton, William Gordon Lynch, Eton-villa, Shanklin, Isle of Wight.
Denny, Thomas Anthony, 7, Connaught-place, W., and Budingwood, Horsham
Dering, George Edward, Lockleys, Welwyn, Herts.
Ellis, John Edward, The Park, Nottingham.
Ellis, Richard, 16, Mark-lane, and 1, The Grove, Hackney.
Espinos y Julia, Senor Don Modesto, 2, Seething-lane, E.C.
Feast, A. R., 6, Ingleby-road, Holloway, N.
Feist, Carl Ernest, 26, Crutched Friars, E.C.
Forster, Thomas, Sparrow-hall, Streatham, S.W.
Foulis, William, Engineer's-office, Town-hall, Glasgow.
Galton, Francis, F.R.S., 42, Rutland-gate, S.W.
Gill, Robert, Delia, Sicily.
Glover, Robert Reaveley, 22, Great St. Helen's, E.C., and Allendale, Green-lanes, Finsbury-park.
Gough, Foster, LL.D., Groiseley, Wolverhampton.
Graham, John Cameron, B.Sc. Ballewan, Strathblane, Stirlingshire.
Gray, Matthew, 14, St. John's-park, Blackheath.
Green, George, Glanton-house, Sydenham-rise, S.E.
Griffiths, Thomas, Silverdale, Oxton, Birkenhead.
Halford, James Valentine, Gothic-house, Queen's-road, Clapham, S.W.
Hankey, Ernest A., Elmhyrst, Bickley-park, Kent.
Harris, Lewis, 154, Piccadilly, and The Ferns, Maida-hill West, W.
Harte, John, Home-office, Whitehall, S.W.
Haywood, George Harris, 95, Upper Thames-street, and Rotherham.
Heathcote, Frederick Arthur, 1, Northfield, Ryde, Isle of Wight.
Heys, William E., The Barton Arcade, Manchester.
Hoare, Hamilton, 37, Fleet-street, E.C.
Holmes, Everard Britten, 73, Queen's-crescent, Haverstock-hill, N.W.
Humby, W. R., 48, Little Britain, E.C.
Hunt, E. H., Cheyne-house, Chelsham-road, Clapham, S.W.
Hyde, Colonel, R.E., India-office, S.W.
Jackson, Dr. James R., 15, Pembridge-crescent, Bayswater, W.
Jacques, Walter, 2, Fenchurch-buildings, Fenchurch-street, E.C.
Johnson, Henry Alfred, 67, Lower Thames-street, E.C., and 286, Dalston-lane, Hackney.
Jolivet, Eugène Charles, 11, Victoria-terrace, Surbiton.
Jones, George Horatio, 57, Great Russell-street, W.C.
Kuhl, George R., 1, Hanover-street, Hanover-square, W.
Langman, Andrew William Fenton, School of Art, Coalbrookdale, Shropshire.
Leon, Frank Philip, 79, Gloucester-place, Portman-square, W.
Loyd, William Jones, 16, Grosvenor-place, and Langleybury, Watford.
Mackie, Charles Hastings, 23, Yonge-park, Holloway, N.
McKerrow, Alexander, 5, Victoria-street, Westminster, S.W.
Madocks, John, Warfleet, Dartmouth.
Mann, Godfrey Oates, Atherton-house, Orrell, near Wigan.
Martin, E. B., C.E., Stourbridge.
Moore, John, West Coker, Yeovil.
Morrieson, Colonel Robert, Oriental Club, Hanover-square, and 30, Windsor-road, Ealing, W.
Murray, David, Paisley.
Paget, Joseph, J.P., Stuffynwood-hall, Mansfield.
Parker, Arthur James, Shrubbery-lodge, Dulwich, S.E.
Pemberton, Charles Seaton, Grove-house, Hampton, Middlesex.
Porter, John Henderson, Lavenham, Suffolk.
Prince, John S., 25, Savage-gardens, E.C., and 34, Craven-hill-gardens, W.
Reynolds, Frederick W., 73, Southwark-street, S.E., and Sydenham.
Rowland, Frederick Arthur Alexander, 178, Strand, and Hampton, Middlesex.
Sadler, Thomas, 39, Chester-terrace, Regent's-park, N.W.
Serena, Arthur, 20, Ladbroke-gardens, W.
Smith, Basil Woodd, Branch-hill-lodge, Hampstead-heath, N.W.
Smith, George Fereday, M.A., F.G.S., J.P., Grovehurst, Tunbridge Wells.
Smith, Henry, 30, Tressillyan-road, St. John's, S.E.
Sterry, William, Union Club, Trafalgar-square, S.W.
Stirling, John Carolus, 79½, Gracechurch-street, E.C.
Sturman, Rev. Mark Cephas Tutet, B.A., T.A.K.C., Heston-house, 54, Talfourd-road, Camberwell, S.E.
Swinburne, Charles Alfred, 4 Upper Hamilton-terrace, St. John's-wood, N.W.
Tanner, Benjamin, 160, North Strand, Dublin.

Thurman, Edward, 6 and 7, Frederick-place, Weymouth, Dorset.
Trathan, James Jenkin, Liskeard, Cornwall.
Turner, Ernest, 44, Bedford-row, W.C.
Vizer, Robert Robinson, 2, Flora-terrace, Albion-road, Stoke Newington, N.
Walbroth, Frederick Anthony, Sunbury-lodge, Sunbury.
Webb, Henry, Redstone-lodge, Redhill.
Wickham, Rev. Edward Charles, Wellington College, Sandhurst, Wokingham.
Williams, Frederick J., B.A., 1, Carlton-place, Cheltenham.
Wise, Alfred, 16, West Kensington-gardens, W.
Wood, James W., Northampton.

AND AS HONORARY CORRESPONDING MEMBERS.

Galiano, Señor Don Antonio Alcalá, Governor of the Province of Guadalajara, Spain.
Kramers, Dr. J. G., Delft, Holland.

The CHAIRMAN delivered the following—

ADDRESS.

1. By the laws of our Society, the Chairman of the Council is bound, at the opening meeting of the Session, to deliver an address to the members; and in compliance with that regulation, I now beg leave to lay before you the following remarks. In theory, the Chairman's address is supposed to bring before the members the action contemplated by the Council during the coming Session. I say in theory, because in practice subjects constantly turn up during the year for treatment by the Society which modify largely the anticipations indulged in on the opening night. I shall, however, on the present occasion, confine myself to a few topics only. It has been usual, before entering on the general matter of the Address, to call attention to the losses which the Society has sustained by death among the members, and at one time it was customary to give short biographical notices of the deceased; but inasmuch as obituary articles have already appeared in the Society's *Journal*, it would be out of place to repeat them on the present occasion to this audience. I will, therefore, content myself with simply naming those of mark whose loss we deplore. Death has, I am happy to say, dealt lightly with our lists in point of numbers, but those who are gone have left vacancies which it will not be easy to fill with suitable successors. Among our more distinguished members who have died are Charles Blacker Vignoles, Lord Lyttelton, Samuel Redgrave, and Colonel Alexander Strange, all of whom will be remembered in this room as having done good service to the Society. In adding to the list the name of your late esteemed and long-tried officer, Mr. S. T. Davenport, I am pleased to record the liberal response made by the members to the appeal on behalf of his family. Dr. Letheby, though not a member of the Society, was well known in this room, and too distinguished among public men to be passd over in silence.

HEALTH AND SEWAGE OF TOWNS.

2. In drawing attention to some of the topics which I may fairly expect will occupy the deliberations of the Society during the Session, I must be permitted, at the risk of repeating to some extent what has already appeared in the Council's report at the close of the Session, to refer to our proceedings of late, inasmuch as, doubtless, our action of the past must be continued in the present Session. In May last, a Conference was held in these rooms on the Health and Sewage of Towns. It was numerously attended, representatives from all parts of the kingdom were present, and the interchange of the experience and opinions which then took place created much interest. The Society's report of the proceedings forms a valuable contribution towards the elucidation of the subject. The sewage question still remains a problem for solution, notwithstanding all that has been done for nearly a quarter of a century. How to deal with our sewage, and how to get rid of the nuisance at the smallest possible cost, and with the greatest advantage to health, is a difficulty which still confronts us. Exaggerated notions at one time prevailed as to the fertilising value of the sewage, and there was a popular belief that, in lieu of a burden on the ratepayer, it would become a source of wealth to each town. Scheme after scheme was propounded on this supposition, but only disappointment followed. Chemical analysis, it is true, showed certain valuable fertilising constituents and fostered delusion, no account being taken of the cost at which they could be secured, even if any process had been discovered by which they could be made available. Experience, however, has led to the entertainment of more sober views, and the public are now beginning to learn that profit must not be looked for. Our health and comfort demand that the nuisance must be got rid of in some way or other, and at any reasonable cost; and if by some method of treatment a return can be obtained to diminish this cost, so much the better. We are no longer permitted to pollute our streams with it, and other means must be adopted for the removal of, and dealing with, our sewage. Experience would seem to show, and our Conference enforced this lesson, that perhaps a profitable, as well as healthful, way of dealing with sewage, is to apply it to the land; but, unfortunately, it is not every locality that can supply, at a reasonable price, land suited for the purpose, either in soil or position. There are, doubtless, various processes for treatment of the sewage, chemically and by precipitation, which result in the production of a good effluent, generally sufficient to meet the requirements of the Rivers Pollution Act, passed last Session, but the precipitant, sludge or solid matter, produced, is but of little value, and must not be reckoned upon as giving a return in money covering the outlay for works and cost of carrying out the process. At Leeds, I understand, where, probably, a larger amount of practical experience has been obtained on an extended large scale than in any other town, the difficulty has been to get rid of this sludge or solid matter; and it is only within the last few weeks that arrangements have been made with a contractor to purchase it and take it away at 12s. per ton, a sum totally inadequate to defray the cost of treatment. All that can be looked for in any case, wherever the water-carried sewage is applied to land, or treated by any known process, is that, under the most favourable conditions, some small return may be obtained in diminution of the necessary cost of getting rid of the nuisance.

3. While I am on the subject of sewage, there is

another point of very considerable importance to which attention was drawn at the Conference, viz., the construction of house drains, and their connection with the sewers. It is of little avail that we spend our money on an admirable system of main sewers, so long as but little care is bestowed on the means for taking advantage of them. Indeed, these very sewers themselves thus become a source of annoyance and disease. Under the Metropolis Management Act, and other Acts of Parliament, the Vestries and District Boards of Works have powers to a great extent over these house drains, and in reference to all houses built, or re-built on old sites, since the passing of that Act in 1855, the plans for the house drainage must be previously approved by these authorities. It is obvious that, except in the outskirts of the metropolis, where extension is going on, but little practical supervision can thus take place in reference to house drains. Even in these cases the supervision in many instances does not extend beyond approving the plans, the construction of the work takes place, without any notice to the Vestry or Board of Works, even had they a staff who could be continually employed in watching each individual case of construction. Plans in these cases are deposited, and are accessible to the ratepayers. In the vast majority, however, of the houses in the metropolis there is no clue whatever to the course of the drains—no plans are forthcoming. The unfortunate householder who desires to amend the unhealthy condition of his dwelling has no resource but to submit to a thorough search, and this means total upset of all the lower portions of his house, with its concomitant disagreeables and long bill. Take the parish in which our Society of Arts stands; there are, I understand, about 2,320 houses, and the Vestry have accumulated, since 1855, plans of the drainage of 320 only, and this from no fault of the Vestry, or its active and intelligent officers. In an old and central parish like St. Martin's, it is obvious there is little or no amount of new building going on except on the sites of old buildings. It is only on the occasion of rebuilding, or on complaints made of nuisance, or on a report of the medical officer, or private application on the part of an owner, that any action of the Vestry takes place. In the case of rebuilding, a notice is sent from the Vestry-office requiring a plan of the proposed drainage to be sent in, and the sanction of the plan by the Vestry, guided by their surveyor, is imperative. This plan is retained, and filed at the office for reference. In case of complaint or report by the medical officer, the drains are inspected by the surveyor, on his report an order is made for their being put into proper condition, to the satisfaction of the surveyor, and a plan is then deposited. In this way, since 1855, the 320 plans above referred to have been obtained. As regards the remaining 2,000 houses, the Vestry have no information whatever as to the house drainage. The Vestry have plans and particulars of all the sewers within the parish, and their surveyor is ready at all times to give every information to parties on this point, in order to facilitate the arrangements of the house drainage, and its proper junction with the neighbouring sewer. Here, however, the action of the Vestry ends, The plan or arrangement of the drains may be perfect, but the execution may be and frequently is faulty, and all the evils of imperfect drainage still remain. There is no guarantee that the work will be properly effected. The work is covered in, and all defects are thus concealed; and when, after a time, these are discovered, it is too late to get any satisfactory remedy or compensation against the builder or his men, the former probably believing in good faith that the work has been properly constructed.

4. To undertake the actual supervision of the execution of approved works of house drainage would involve an increase in the surveyor's staff, and a consequent increase of charge on the ratepayers, but the benefit in return would over and over again repay the cost. How far it would be practicable to get plans of the drainage of all the remaining 2,000 houses is a question not easy of solution. That such a deposit of plans should be made imperative by Act of Parliament is demanded in the interest of health and comfort on the part of occupants. Such a measure is greatly needed, and in the end the expense and trouble incurred would be well compensated for by the improved comfort and improved health to the population which would ensue. In these 2,000 houses about whose drainage we have no information, it may fairly be estimated that, in the majority of cases, the drainage is of an antiquated character, and consists of the old-fashioned square brick drain, ill-adapted for its purpose. At our Conference the other day, Dr. Whitmore, the Medical Officer for Marylebone, gave some remarkable instances of the imperfection in drainage which had occurred in Marylebone, and especially in Harley-street, and which, under direction of the Vestry, had been remedied. There was scarcely a single house in that street that was perfect, as regarded its connection with the sewer, and notices were served on 28 or 30 houses which were found wholly unconnected with the sewers. It was, however, only the occasion of a new sewer being made which brought these defects to light, and enabled the Vestry, through the vigilance of its able officer, to take cognisance of them. While speaking of the old square brick drain, let me point out a defect in our metropolitan drainage which I am informed is still existing in many parts, notwithstanding all that has been done. We have, at a heavy cost, constructed a magnificent and complete system of main sewers. The District Boards of Works have supplemented them in their various localities by subsidiary sewers, also of approved construction, to enable advantage to be taken of the main sewers; but there still remain many districts in which the houses can only avail themselves of these works through a net-work of the old square brick drain sewers working into them. It is needless to point out the imperfect character of these latter drains, which, from their shape and material, are necessarily most inefficient. The district in which we now stand is an instance of this. The house drains of this building empty themselves into a small square brick drain belonging to the parish, at the back of the premises, which, by some means or other, following a somewhat circuitous course, at last comes round to the great main sewer running under the Thames Embankment. If I am rightly informed, such a state of things is by no means uncommon in many parts of the metropolis. I throw this out for consideration. But, to return

to the house drains. I will not enter here into how far the law confers powers on the Vestries or District Boards, to secure a perfect house drainage. We know that under Acts of Parliament they are large, but whether sufficiently extensive for their purpose I must leave to the learned to discuss. We do, however, know this, that whether sufficiently large or not, the great bulk of the house drainage is practically under no effective supervision. At a Conference lately held in these rooms, when many of the medical officers of health and district surveyors were good enough to attend on the invitation of the Sewage Committee, there appeared to be a large confirmation of the existence of these evils, in many districts at all events, notwithstanding that very extensive powers, it was stated, existed; but it was admitted on all hands that the practice of the Vestries in availing themselves of these powers varied in every district; that whilst in some districts a great deal was done to remedy the mischief, in others the practice was lax, and the law all but a dead letter. It was the unanimous feeling of those assembled at the Conference that some steps should be taken to ensure the enforcement of the law and secure uniformity of action. I know it will be said that to attempt to deal with existing houses would lead to an interference with the proverbial Englishman's castle which would never be tolerated, and that a system of centralisation would be set up only worthy of Continental despotism. Whilst I am no advocate for centralisation or undue interference with individual action, yet it must be admitted that there are numerous cases constantly arising in which individual action is practically inadequate to procure those comforts and conveniences essential to the well-being of society. Day by day, as civilisation progresses, so does individual action become less and less competent to deal with the complex problems of society. Combined action and restraint on the individual necessarily follow. If we look back but a few years we see how largely this system has now become interwoven with our daily life. Compulsory vaccination and the Building Acts are noticeable instances. In Health matters especially, the law and the inspectors are perpetually at work, but nevertheless more is needed. In this matter of drainage we already do much, and in the interest of public health much is demanded. If the Englishman will persist in individual action, and build his "castle" in contravention of the laws of sanitary science, it is time that the law should step in, and that Government should secure, so far as lies in its power, a sound and healthy population. Public health is, after all, public property. It is all very well to say, as some do, that the duty of the parish vestry, or other public authority, should extend to the external wall of the house, and no further, and that then all further responsibility should fall upon the occupant. But how is the occupant to be assured that all the internal arrangements are of a suitable and effective character? The occupant is at the mercy of those who own and those who build houses. Can it be expected that a tenant, finding his house defective in these arrangements, is to be at the expense of putting all these defects right? Surely it is not unreasonable to ask that some competent public authority should insist on certain sanitary arrangements being carried out. We have a Building Act—whether sufficiently stringent or not may be a question—which, in the interests of public security, compels the constructors of our houses to comply with certain conditions, enforces the building of party walls, and such like, as a safeguard against the spread of fire. Surely, in the interest of public health there is nothing unreasonable in suggesting that the internal sanitary arrangements of our houses should equally be under competent supervision. An intending occupant would then have some security that, in taking a house, he was not incurring the risk of himself and family being subjected to suffering and disease. On this subject the Council propose to continue its labours, and it is confidently expected that the second Conference on Health and Sewage of Towns, intended to be held in the course of the spring, will be as successful as the first.

5. Whilst speaking on sanitary matters I must not omit to draw special attention to the enlightened action of the King of the Belgians in relation to this subject, the more especially as it affects one of the objects early treated by the Society, viz., the improvement of the dwellings of the wage classes. His Majesty offers, to be awarded at the next International Sanitary Congress, "a gold cup, of the value of five thousand francs, to that municipal or local authority, or to that private association, which by its improvement of the dwellings of the wage classes shall effect the greatest reduction of their death-rates at the lowest cost."

6. This is an international prize, which may be said to be new in principle, great in itself, and capable of extended application; it is new in this respect, as proposing a competition, not between individuals, but between collective communities. To the ratepayers and to the shareholders, whose money is being expended, it will be of value, and should be promoted by them; and, indeed, it should be required by them of those who expend their money, that they should avail themselves of the great opportunity of proving their competence.

7. It will be for the Council to consider in what way they may in England contribute to the attainment of his Majesty's wise and beneficent object, by calling local attention to it, and supplying suggestions of means for its attainment.

WATER SUPPLY.

8. Most nearly allied to the foregoing is the water supply of this metropolis. A metropolitan member, Mr. Ritchie, moved for the appointment of a Committee of the House of Commons to inquire into some grievances of the Metropolitan Fire Brigade, as administered by the Metropolitan Board of Works. At the instance of Mr. Cross, the Home Secretary, the functions of the committee were extended to an inquiry, not only into the grievances of the fire brigade, but into the grievances of the whole of the population of the metropolis from the losses of life and property by fire, including the question as to the defective arrangements for the application of water for its extinction. Exception might be taken to the composition of the committee, as comprising the representation of interests not

identical with those of the public, namely, of directors of the water companies, and also of the chairman of the Metropolitan Board of Works. But, under the chairmanship of Sir H. Selwin-Ibbetson, the inquiry appears to have been fairly and impartially conducted, so far as it has gone. So far, however, as it has gone, its action has been in close identity with that of the Select Committee of this Society, and there will be little doubt in the public mind that the conclusions of the Society's Committee have been corroborated, advanced, and established. The Committee of the House of Commons have had before it the irrefragable evidence of the examples of Manchester and Liverpool, where by the constant system of supply on a public footing, and by hydrants constantly ready for the immediate application of water, the loss of life and property has been reduced more than two-thirds. It is to be hoped that the evidence obtained under this inquiry will hasten the performance of the promises made by the present Government, of dealing with the question of the water supply of the metropolis. This can only be done by placing it on a public footing as recommended by Royal Commission after Royal Commission, and proved by the examples cited of the great provincial cities.

Surplus of the Exhibition of 1851.

9. This is another subject which will continue to receive the careful attention of the Council, who have already entered into friendly communication with her Majesty's Commissioners upon it. Looking to the origin of the Exhibition with the Society of Arts, and the continuous labours of the Society since the Exhibition took place, in promoting a knowledge of science and art as applied to productive industry, the Council feel that it is its duty to give its best assistance to the Commissioners in following the course sanctioned by the Prince Consort in 1852, of promoting inquiries throughout the country for ascertaining the most useful mode of using the surplus. At present the available surplus is only £350,000, being but a part of the large property which the Commissioners possess; the whole being of a value in round numbers of £1,500,000. Members will find in the *Journal* of the 9th June, 1876, a copy of an article in the *Times*, which declared the mode in which the Commissioners proposed to apply the £350,000, and this was to do work, in part at least, which is already being fully done by the Government. Subsequently Mr. Cross made a declaration in the House of Commons which materially changed the first announcement, and it may be doubtful how far any plan is definitely settled. Since Mr. Cross's statement in the House of Commons (See *Journal*, p. 809) the subject has been discussed at the meeting of Institutes at the Society, and lately Birmingham, Manchester, Leeds, and other places have signified their intention of putting in claims for some hare in the surplus, which are worthy of attention.

10. The amount of local contributions to the Exhibition of 1851 would seem to offer the means of determining the proportion of the surplus which might properly be awarded to localities. Putting aside the large amounts contributed in the metropolis, the following places may be named as having paid to the Commissioners in 1850 the net sums stated:—

	£	s.	d.
Birmingham	500	0	0
Blackburn	680	0	0
Bolton (Lancashire)	664	11	4
Bradford (Yorkshire)	1,100	0	0
Bristol	650	0	0
Glasgow	2,483	11	1
Halifax	608	10	3
Huddersfield	700	0	0
Leeds	1,600	0	0
Liverpool	555	0	0
Manchester	4,075	5	4
Sheffield	500	0	0

It may be mentioned that the contribution of the Society itself, from its own members, was upwards of £1,086.

11. It may be assumed, as a matter of course, that the Commissioners will first discharge any liabilities connected with the institutions which have been fostered by them on their own estate, and thus act in the spirit which the Prince Consort would have shown towards objects started by him. Also we may be permitted to hope that they will not devote their funds to doing that work which has already been begun by the Government, and now belongs to the functions of the State. The next just claimants would seem to be localities, and if the Commissioners gave to each large place five or even ten times the net amount subscribed by large places where Institutions of Science and Art have been started, no better or more popular distribution of the funds could be made, but it seems quite clear to me that the subject ought to be fully inquired into, and that no decision should be made hastily. It might seem best, as the Government administration of Science and Art is much connected with the subject, that there should be a Committee of the House of Commons, but if the Commissioners should prefer that the inquiry should be private, and do not conduct one itself, the Society will be ready to institute one. In any case the best attention of the Council will continue to be given to the subject.

Food.

12. I will now turn to another subject. For some years past, there has been lying in the hands of the Society of Arts the sum of £100, placed there by Sir Walter Trevelyan, for the encouragement of the importation of fresh raw meat into this country from abroad; to this offer the Society adds its Gold Medal. Up to the present time no one has been in a condition to make a valid claim to it. Various methods of preserving meat have been brought before the Society's Food Committee, but nothing has hitherto been found of sufficient efficacy to justify the Committee in recommending the bestowal of the prize offered.

13. The preserved meats have done and are doing good service, but they are excluded by the terms of the offer, which, although asking for fresh meat, excludes that which is cooked. They have become a recognised article of household consumption, but, unfortunately, the supply has of late diminished, not from any lack of demand, but from commercial causes affecting the supply of live cattle in the Australian colonies. The follow-

ing figures are taken from the Board of Trade returns:—

Value of Meat Preserved otherwise than by Salting.

	Imports from Australia.		Total Imports.
1871	£481,093	..	£610,228
1872	657,945	..	816,463
1873	557,552	..	733,331
1874	509,698	..	757,001
1875	249,611	..	592,196

14. A large importer of these meats informs me that in his opinion the falling off which is, as will be seen, principally from Australia, may be accounted for in this way. The prices obtained during the Franco-German War stimulated an excessive manufacture. Many new companies were started, and, by competing with each other in buying sheep and cattle, raised the prices against themselves, while heavy stocks accumulated here, and were sold at unremunerative prices. Then, one by one, the companies became heavy losers, and ceased operations, until now there are only five companies working in Australia. A diminished supply has led to the gradual absorption of stocks and some advance in prices, so that, unless once more the manufacture is unduly increased, the meats imported will, as at present, find a market at prices which will pay the manufacturer. It is believed that the actual consumption of preserved meats in families and in large institutions is larger now than at any time since its introduction in 1866. Beef, which has considerably advanced in price in Australia, is now being tinned in both North and South America on a considerable scale. At Chicago, during this year, compressed corned beef, in conical tins, has been manufactured upon a very large scale, and the demand at present for it is greater than the supply. One factory at Paysandu, Uruguay, has been in operation for three years, preserving ox-tongues, and the demand has encouraged the proprietors to establish a second at Frey Bentos. Altogether the prospects of preserved meat importation may now be regarded to be now more favourable than they have been for some years. There is a good demand, and a supply which about keeps pace with it.

15. Some years since, Messrs. Schröder made some very successful experiments, on a somewhat extensive scale, for the importation of meat, game, and fowls from Transylvania. These were packed in boxes, surrounded by outer cases, with a layer of ice, the provisions thus packed arrived in excellent condition, after a transit of about three weeks, and there seemed every prospect of commercial success. It is true this importation took place in the colder months of the year. Before, however, the warm season arrived for a further testing the feasibility of the scheme, it was abandoned, but from what cause I do not know. Ever since the commencement of the present year, successful attempts have been made to bring dead meat from the United States of America, and also from Canada, into Liverpool for the London market; and also into Glasgow. Besides this, live cattle have also been imported into Glasgow. It is, however, especially to the former (the dead meat importation) that I would desire to call attention. Nearly every week since the commencement of the year, a consignment of dead meat from New York has found its way to our metropolitan markets as well as to Glasgow, and this, not only during the colder months of the year, but during the whole of last summer, which, it will be remembered, was at one period exceptionally hot; and I am assured by Messrs. Bowyer and Sons, the well-known salesmen, that it has arrived during that time in good condition, and that the consignments are increasing in extent. Some of this meat has been tasted by the Society's Food Committee, and pronounced to be of the highest quality and in excellent condition. The following extract from the *Dundee Advertiser*, of August last, gives some highly interesting details:—

"Last week 154 American cattle were sold in Glasgow, and brought on average £33 each. The admission is general that a finer lot was never exhibited by any one person, and never in the Glasgow market did a lot realise so much on the average. As to dead meat, the first sale was held on the 5th June, when 100 carcases of beef and 72 of mutton were disposed of. Since then there has never been a smaller supply, and on the average about 150 carcases have been sold weekly. Last week 210 carcases were sold, and on Wednesday evening there were no fewer than 33 lorries, each laden with three tons of butchers' meat. The freight paid for carriage to Glasgow, Liverpool, and London last week amounted to £1,900. Altogether, since the importation began, a million and a quarter pounds of dead meat have been sold in Glasgow. About 1,000 cattle were last week exposed in Glasgow market, and of these 365 (dead and alive) were imported by the Messrs. Bell from America. At this season sheep cannot be had in America of sufficient quality to compete with home-reared, but 150 brought some time ago realised on an average 9d. per lb. The result of this importation has been a reduction in retail prices of 1d. per lb., instead of an increase in price, which must have taken place without the increased supply. The oxen are collected chiefly in the States of Illinois and Kentucky. They are there reared in enormous numbers on the prairies. Before they reach New York they are driven over railway for fully a thousand miles. Those animals, the carcases of which are to be sent to this country, are killed the day before the departure of the steamer. As soon as the carcases are dressed they are put into a cooling room capable of containing 500, and subject to a constant current of cold air, supplied by means of a 25 horse-power engine. This sets the beef and extracts the animal heat. Each carcase is next cut into quarters, and these are sewn up in canvas, and during the night transferred on board the vessel. Six of the Anchor Line mail steamers have been fitted up with refrigeration compartments, constructed on a patented principle, specially for the conveyance of the meat. After the quarters have been hung up in the room the door is closed hermetically. Adjoining the compartment is a chamber filled with ice. Air tubes are connected with the beef-room, and through them the animal heat ascends, and by means of a powerful engine it is blown across the ice and returned to the beef-room in a cold state. A temperature of about 38 degrees is thus maintained in the beef-room. If it were to get so low as 32 degrees—freezing point—the meat would be seriously injured. The heat is, therefore regulated by a themometer, and when the temperature gets too low, the speed of the engine is slackened, the normal degree of cold being thus maintained almost without variation during the voyage. Cattle killed on Thursday in New York are sold that day fortnight in Glasgow. In the course of a month or so the importation of live cattle will cease; but arrangements are being made for increasing the dead meat supply, and it is expected to be not less all winter than 200 carcases per week. Indeed, when the weather gets colder it is exceedingly probable that a great number of carcases will be brought weekly; but even in winter the refrigeration process will be necessary, although to a much less extent than during the summer months. The living cattle have stalls in the hold of the ship. Last week 100 were brought in one vessel, and there was no death. Since the trade in living cattle commenced, however, there has been a considerable death-rate, and this is not surprising. The voyage is a long one and, not uncommonly, rough weather is experienced. The cattle have never probably been in stalls before, and, having no exercise, constipation occurs, and almost invariably terminates fatally. On one occasion the deaths were in proportion of 50 per cent. of the entire shipment. The freight is from £8 to £10 a-head; food, fittings, attendance, &c., being paid for over and above. The carriage of the dead meat is so much per ton, and is variable, owing to the periodical changes in the rates.

16. It is highly gratifying to note the great promise of success which this principle of refrigeration for the importation of meat holds out, and there would seem no reason why it should be confined to the United States nor be extended to embrace supplies of dead meat from all parts of the Continent of Europe. Surely if this can be done, it seems more reasonable to take our supply in dead meat rather than the cumbered form of live cattle.

17. If these proceedings continue, I think we may soon have a claimant for the offered prize.

SILK.

18. The silk industry has at all times been a matter of interest to this Society, and even down so late as 1846, this Society gave an honorary testimonial to Mrs. Whitby, of Lymington, Hampshire, for her persevering exertions in rearing the silkworm. She, it appeared, imported from Turin, and planted in Hampshire, 100 standard and 1,000 dwarf mulberry trees. The endeavour, however, on her part, as well as of others, to rear worms, and produce silk in this country, though in certain exceptional seasons giving fair promise of success, has failed. In some of our colonies it has been found that the climate is thoroughly suitable, and satisfactory experiments have been made in the Cape of Good Hope and in Australia, which show that in those parts there probably is a great future for a supply of silk to Europe. To Mr. Charles Chubb, the Council, in 1871, awarded the Society's gold medal, for the importation into this country of silk cocoons grown in Queensland. These cocoons were reeled, spun, and woven into scarves in Macclesfield, where the Chamber of Commerce pronounced a most favourable judgment on their quality. To Dr. Hiddingh, in 1873, the Society gave its gold medal for his successful exertions for the promoting the cultivation and reeling of silk in the Cape Colony. The disease, which for some years has attacked the silk worm, and brought deep anxiety to the silk-producers in Italy and France, is too well known for me to dwell upon here. Science has sought in vain for a satisfactory antidote, and although the labours and researches of Pasteur have done somewhat to mitigate the extent of the evil, and perhaps postpone for a time the full development of its ravages, the growers both in France and in Italy have sought to introduce from time to time a sound stock, which should be free from this disease, and large importations are made yearly of the eggs, or "grain" as it is termed, from Japan and China. Notwithstanding all their endeavours, the production of silk has met with increasing difficulty, this year culminating in an enormous deficiency, and a consequently heavy increase in price. The great fluctuations that have occurred during the present year in the value of this article, consequent upon the partial failure of the European crop, deserve our attention. In an article of such high value and general use, suddenly increased cost cannot fail to have a marked effect, both upon our commercial relations with the different producing countries and the manufactures connected with it. When it is considered that China alone will receive about 6½ millions sterling in payment for silk this year, some idea of the money value involved in this industry may be formed. In France (this year) at least three-fourths of the entire crop has failed. In Italy one-third of the whole has been lost. The effect of these deficits has been that the prices of the more useful raw silks have doubled since the commencement of the year, and in some cases, such as the better classes of Japan silks which supply to some extent the place of Italians, the price has risen from 14s. per lb. to 35s., or 150 per cent. In Bengal, in a like manner, the rise in value has been over 100 per cent. from the lowest point at the commencement of the year. For some years past the stocks of silk held in this country have been steadily reduced. The facility afforded by the telegraph to renew them has had the effect of making one-fourth answer all the purposes of the old stock of 40,000 bales, and in the beginning of the present year this had been reduced to 6,000 bales of unsold silk. The result then, of a deficiency which is about the equivalent of 65,000 bales (of 47 kilos each), has been the advance to which I have referred.

19. The heavy losses sustained this year by cultivators, especially in France, combined with the high price of good grain, makes it extremely improbable that the quantity of grain set for rearing next year will be much more than half the average quantity of the last ten years, and a golden opportunity is now given for our colonies to take part in this valuable industry. The unsold stock of silk in the warehouses on the 1st October, 1876, was 2,495 bales, as against 14,884 bales in 1875. Thus we find a scarcity of silk, and a want of good grain at the same time, conditions which could not possibly be more favourable to the development of this industry in our southern colonies, almost all of which have been proved to be admirably adapted to silk rearing, as already shown in the pages of the *Journal* of the Society. It behoves those in the silk manufacture, both in this country and in Italy and in France, to turn their attention to new sources of supply, and some of our colonies, we have seen, appear to present peculiar facilities for aiding in this great industry, though of course time is needed for its development. What is needed, in the first instance, is a good supply of sound grain; and Mrs. Neill, whose indefatigable energy and perseverance are not unknown to you—for she read a paper on the subject during the last Session, detailing, in a very interesting manner, the steps she has been taking to introduce this industry into one of our Australian

colonies—deserves our hearty sympathy. She has incontestably shown that Australia has a climate and conditions which can ensure the production of a healthy and sound grain, as well as a good quality of silk. Mrs. Neill, a year or two since, was furtunate enough to meet with M. Roland, a Swiss gentleman, who, by a series of investigations and experiments extending over many years, has discovered a treatment of the worm by which a sound stock can be produced. A detailed account of M. Roland's labours is given in the *Journal*, Vol. xxi, p. 414. The main feature of the plan is, to use the words of M. Roland, that the silkworm is hatched, lives, and cocoons in the cool climate of Switzerland; produces its chrysalis and moth, laying its eggs on the tree, in open air, where, in the coming spring, they are hatched. The grain remains there during the winter, exposed to all the changes and chances of the climate. In spring the grain is hatched perfectly, and vigorous silkworms are the result. Mrs. Neill having secured some of this grain, took it with her last year to Australia, and, returning here, has shewn us that she has succeeded in raising sound grain and also a good quality of silk. She has lately returned to Australia, after visiting the principal seats of the silk industries of France and Italy. She is full of hope that by next season she will be able to furnish a supply of sound grain, and also export to us some bales of good silk. She is carrying out her undertaking in Australia, not merely on an experimental, but on a truly commercial scale. The Society will watch with much interest the results of her endeavours.

PATENT LAWS.

20. The reform of the Patent-laws is a subject which has ever been of interest to the Society of Arts, as it is one in connection with which the Society may fairly claim for itself no small degree of credit. The system of patent legislation founded in 1852, a system which supplied the basis for the Patent-laws not only of our own but of many other countries, was, to a great extent, elaborated by the Society; while, even apart from this, the Patent-law is, of all branches of legislation, perhaps the one most closely connected with those objects for the promotion of which our Society was founded. It is, therefore, needless to say that the recent attempts to alter the existing Patent system have been carefully watched by the Council, and if they have not asked the Society to join them in considering the proposed alterations, it is only because they believe that, by the reports of successive Commissions, as well as the discussions which have taken place at the numerous meetings which have been held during the last few years here and elsewhere, the subject has been so thoroughly ventilated that no real good can result from any further discussion. It has become tolerably evident that there are several parties, holding distinct and often irreconcilable views on the Patent-laws, and this encumbers the question with fresh difficulties. It is obviously impossible to satisfy at once the man who demands the abolition of all Patent-laws whatever, and his adversary who holds that a patent should give him an indefeasible right of property in his invention. It is hopeless to attempt to reconcile the views of the capitalist, who would have the number of patents lessened by heavy fees, with those of the "poor inventor," who would like to patent his ideas as fast as they issue from his prolific brain, at the cheapest possible rate.

21. Among the various demands of would-be patent reformers, it is no wonder if our puzzled legislators incline to the rude Gordian method of solution, by the abolition of all Patent-law, for such, it may fairly be assumed, would be the ultimate result of a measure which has twice come before Parliament, but found few friends except among those avowedly hostile to patents. But, numerous as are the objectors, and loud as are their complaints, it yet remains to be shown that any pressing necessity for reform—that is to say, legislative reform—exists at all. That there is room for much improvement in the administration of the Patent-office is beyond a doubt, but the main cause of this is that, in all the twenty-four years that the system has been at work, it has never yet been tried in its integrity, as it was intended to be by its founders.

22. One of the most important clauses in the original Patent-law Amendment Act of 1852 has never been put into force, the clause which provided that with the *ex-officio* Commissioners of Patents, who are the chief legal functionaries of the Crown, there should be associated other persons, to be appointed under the Royal Sign Manual, such as her Majesty "may think fit to be Commissioners of Patents." At present the government of the Patent-office is an anomaly. In theory it is ruled by the four Commissioners, the Lord Chancellor, the Master of the Rolls and the Attorney and Solicitor General; in practice it is entirely administered by their clerk, who, however competent an officer, is not responsible to the public or to Parliament for his management of this most important department. When Mr. Bennet Woodcroft retired a few months ago from the post of clerk to the Commissioners, the place was filled by a member of the Council of this Society, Mr. Reader Lack, and I may be permitted to refer to the satisfaction which was felt by myself and the other members of the Council at Mr. Lack's appointment. To so able and energetic a worker as Mr. Lack has shown himself in another Government department, it would, I am sure, be more satisfactory if, instead of a Board of important officials who snatch a hasty hour now and again from their other duties to give to the concerns of the Patent-office, he could have over him a Commission of really competent and responsible men, unburdened with other engrossing duties, and properly paid for service, whose only duty it might be to direct the administration of that office.

23. The really important reform wanted is that one or more paid Commissioners of Patents should be appointed, as was contemplated when the Act was passed. Until this is done, and not before, the office cannot be properly administered. It stands to reason that where there is weakness at the head, the same feebleness must pervade the whole system. Once let the central administration be sufficiently provided for, and the details will arrange themselves. At present there is no real acting head to the Patent-office. The Commissioners of Patents are a purely ornamental body, with only legal aptitude. It is surely desirable that they should become a useful one. If there were

added to the Commission one or two men of sufficient capacity and standing—the office being of course made such, in salary and position, as to attract fit men—the duties now perfunctorily performed by the Law Officers, the intermittent inspection by the Master of the Rolls, the nominal superintendence of the Lord Chancellor, these, and numerous other functions now not performed at all, might well be delegated to the new Commissioners, while the *ex-officio* members of the Commission would still give it—all they were ever intended to give—the authority of their names. All this, if I am not much mistaken, might be done without any fresh enactment, without even an Order in Council, but by some formal representation to her Majesty by the Lord Chancellor of the desirability of the change. I presume that, if the Lord Chancellor and his colleagues really wanted this reform, the traditional opposition of the Treasury to the provision of additional funds for salaries would soon be overborne.

24. It was hoped at one time that the Patent-office would grow into a great scientific department; it was to this end that the museum and library were founded; but the present Government, which is doing so much for science elsewhere, is strangely neglecting its opportunities here. The Loan Collection will, it is to be hoped, absorb the contents of the museum, or, at least, such parts of its contents as are worth absorbing, and that will be the end of a project which made a good deal of noise when it was first started. If a genuine "Patent Museum" (as distinct from a Museum of Invention) is to be kept alive, that is a matter which does not greatly interest anybody, except the gentlemen who are fortunate enough to have the various posts about such a place. It will be, of course, quite useless. A bad sign about the present administration is the fact of certain of the regular publications having been stopped. It is true that the publication in question was not all that could be desired, but that should surely rather be considered a reason for improving than for abolishing it.

25. Taking all these matters into consideration, and seeing much need for administrative reform, though none for legal, the Council have determined to memorialise the Lord Chancellor, asking him to abstain from further attempts at legislation, and praying that steps may be taken to put into force the provisions of the Act of 1852, which authorises the appointment of additional—necessarily paid—Commissioners of Patents. In so doing they trust that they will express the feeling of the majority of those members of the Society who are interested in the matter, and will be advocating a course likely to have the most practical and beneficial results to all concerned.

26. When a real trial shall have been given to the Act of 1852, then, and not before, will be the time to consider whether fresh enactments are required. Perhaps they will.

INDUSTRIAL HYGIENE.

27. There is one other subject to which I should desire to call attention, as deeply interesting to all connected with Arts, Manufactures, and Commerce. There are, doubtless, many here who have read with interest the lectures delivered in this room by Dr. Richardson, on the diseases affecting those employed in various trades and manufactures. Mr. Benjamin Shaw, one of our members, ever alive to promote the well-being of his fellow-men, has invested, in the name of the Society, an amount of Consols sufficient to provide every five years a Gold Medal to be awarded by the Council "for any discovery, invention, or newly-devised method for obviating or materially diminishing any risk to life, limb, or health, incidental to any industrial occupation, and not previously capable of being so obviated or diminished by any known and practically available means." The first award will be made in May, 1877.

DOMESTIC ECONOMY.

28. This subject, now made a part of national education, appears to the Council of the highest importance, and a special committee has been appointed to watch it. Domestic Economy embraces much of the science that is necessary to be generally known for health, food and cookery, clothing, thrift, &c. Parliament has already sanctioned grants for the encouragement of the knowledge of Domestic Economy, but they are coupled with conditions that require much modification, and have an air of theory rather than practical work about them. Some inspectors encourage them, whilst others positively discourage them. If the Education Department is in earnest with Domestic Economy, its present system of administration will require to be changed greatly.

CONCLUSION.

29. There are other subjects to which I would gladly draw your attention, but time does not admit of my taking them up, I must simply content myself by naming them. The National Training School for Music has been started, as you know, and is in action, but it still requires all the aid which the public can be induced to give, and I specially commend it to the liberal consideration of our members.

30. The Council have thought fit, in exercise of their powers under the bye-laws, to confer honorary life membership upon their Majesties the King of the Belgians and the King of Sweden, in recognition of the deep and active interest which their Majesties have evinced in the promotion of the Arts, Manufactures, and Commerce of their respective kingdoms. It has, however, been considered that the act of the Council would receive additional weight were it confirmed by a resolution of the members in General Meeting assembled, and a Special General Meeting has been convened for the purpose this evening, at which a resolution confirmatory of the Council proceedings will be brought forward.

31. I need do no more than allude to our Evening Meetings, Cantor, and Juvenile Lectures, as the particulars of these arrangements are fully given in the *Journal.*

32. Such, gentlemen, are some of the subjects which will engage the attention of the Council during the ensuing session. Doubtless many others will form the theme of discussion at our evening meetings.

After the conclusion of the Chairman's address:—

Mr. Botly proposed a vote of thanks to the Chairman for his interesting and valuable address. It was a great pleasure to the members to see the chair again occupied by one who had filled it so well during the last year. He was also glad to be able to congratulate him on the large accession to the members of the Society which had been made during his tenure of office.

The motion having been seconded by **Mr. Hale**, was put to the meeting by **Mr. Botly**, and carried unanimously.

The CHAIRMAN then presented the following prizes:—

The Society's Gold Medal to Mr. T. A. HEARSON for his Revolution Indicator.

The Society's Silver Medal to Mr. C. E. FRYER for the establishment in this country of a new industry, whereby the pilchard, so abundantly taken off the coast of Cornwall, is preserved in oil after the manner of the French sardine.

The Society's Silver Medal to each of the following gentlemen:—

CLEMENTS MARKHAM, Esq., C.B., for his paper "On the Cultivation of Caoutchouc-yielding Trees."

W. T. THORNTON, Esq., for his paper "On Irrigation Works in India."

E. HUTCHINSON, Esq., for his paper "On the Development of Central Africa."

W. VALENTIN, Esq., for his paper "On Dextrine-Maltose, and its use in Brewing."

The Prince Consort's Prize of Twenty-five Guineas, accompanied by a special certificate, to PAUL JUSTE DESCOURS, aged 19, of the Birkbeck Literary and Scientific Institution, in the Civil Service, who has passed in the First-class in the following subjects during the specified period:—

1874. French, with the First Prize of £5.
,, Arithmetic.
,, English History.
1875. Commercial Geography and History.
1876. Political Economy, with the additional Prize of £2.
,, English.
,, Book-keeping, with the Second Prize of £3.

The Council Prize (for female candidates) of Ten Guineas, accompanied by a special certificate, to MARY LATTIMER, aged 17, of the Carlisle Mechanics' Institution, who has passed in the First-class in the following subjects during the specified period:—

1875. Arithmetic, with the Prize of £2 for females.
1876. English, with the Prize of £2 for females.
,, Book-keeping, with the Prize of £2 for females.

At the conclusion of the ordinary business the meeting was made special, when the following resolution was proposed by Professor TENNANT:—

"This meeting heartily approves the action of the Council in electing their Majesties the King of the Belgians and the King of Sweden as Honorary Members of this Society, and desires to express its high estimation of the services which those sovereigns have rendered to Arts, Manufactures, and Commerce, the chartered objects of this Society."

Mr. SAYWELL seconded the motion, which was put by the CHAIRMAN, and carried unanimously.

The proceedings then concluded.

MISCELLANEOUS.

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SOUTH KENSINGTON LOAN COLLECTION.

INSTRUMENTS AND APPARATUS EMPLOYED IN INVESTIGATIONS CONCERNING SOME OF THE PHENOMENA OF PLANT-LIFE.*

By W. B. Hemsley.

From a practical point of view, no less than in the interest of pure science, an exact knowledge of the various processes of vegetable growth and nutrition is of the first importance, for plants actually satisfy, either directly or indirectly, nearly all the wants of mankind. In short, plants are so many chemical laboratories, in which inorganic matter is converted into nutritious substances, a large proportion of which is consumed as food by the animal kingdom. Furthermore, besides the numerous plants cultivated for their amylaceous, saccharine, and nitrogenous products, there are many species possessing peculiar secretions of the utmost value to man, such, for example, as quinine and opium, to say nothing of the innumerable applications of various parts of the plant fabric itself. It is obvious, then, that all knowledge relating to the conditions under which each species is able to grow and secrete its peculiar substances most abundantly is valuable, and that long and patient research is fully rewarded by the discovery of any new facts bearing upon this important inquiry. Plants are, perhaps, even more varied in their structure and constitution than animals. Some species, it is true, will grow and flourish in a great variety of soils, and under widely diverse climatal conditions; but others will only attain perfect development in certain soils and subject to certain very restricted degrees of heat and humidity. Illustrations of these peculiarities are constantly before our eyes in the vegetation of this country. It is a noteworthy fact that the cultivator is unable to acclimatise a plant or alter its constitution to any appreciable extent, especially to enable it to bear continued exposure to a temperature above or below certain given points. Thus the common groundsel and purple-flowered dead-nettle will germinate at or even below the freezing point, and grow rapidly at a few degrees above it; and the plants themselves will revive and continue growing after having been exposed to many degrees of frost for a long period, whereas all the vital functions of such plants as the dahlia, the heliotrope, and the potato, are arrested at or above the freezing point, and two or three degrees of frost will kill them to the ground. Although these latter plants have been cultivated in this country for a great number of years, they are, so far as can be judged, as susceptible to cold now as when first introduced. Another very curious and familiar instance of a peculiar constitution is afforded by the common cineraria, which is injured by the slightest frost, though it will only flourish in a cool, humid climate. Again, in our climate many fruits rarely become thoroughly ripe, that is to say, there is a deficiency in the secretion of saccharine matter. It is almost superfluous to mention that the yield of any crop is largely dependent upon the relative amounts of heat and light to which it is subjected. These introductory remarks go to show that even if all the elements necessary to build up a plant are present in the soil and air, certain other conditions are essential to enable the plant to feed and grow. But after we have selected suitable plants for cultivation, according to the climate of the country or locality in which the operation is conducted, it becomes necessary, in course of time, to supply some of the food which a crop of clover, wheat, or beetroot requires, because continuously cultivated land is gradually exhausted of some elements without which a plant will either not grow at all, or not attain perfect development, and yield a profitable crop. The chief difficulty is to discover the proper form in which the various constituents of the food of plants should be offered, as the different elements are derived from diverse sources and taken up in certain combinations. To elucidate this question Mr. Lawes, assisted by Dr. Gilbert and others, has been conducting several extensive series of experiments for now upwards of thirty years. Many of the results obtained have been published from time to time in the journals of the Chemical and Agricultural Societies, in the "Philosophical Transactions" and other journals, but the immense labour, to say nothing of the expense, involved in working out these problems, renders it a slow process. And all experiments of this nature have to be repeated, and repeated again, before they can be said to possess any positive value. The chemist can easily determine the chemical composition of a plant, but the sources of the different elements of its composition can only be ascertained by diligent research. Much has already been done in this direction, but the subject still presents many unsolved problems. Before explaining the apparatus, models, tables, &c., exhibited by Mr. Lawes, in the Loan Collection at South Kensington, it may be useful to say a few words respecting the elementary constituents of the food of plants, as well as the history of the progress of discovery in some of the more important phenomena of the nutrition and growth of plants. The most important non-metallic elements present in plants, in various ternary and quaternary combinations, are, carbon, oxygen, hydrogen, and nitrogen, and phosphorus, sulphur, chlorine, and silicon. Of the metals, iron, potassium, calcium, magnesium, and perhaps sodium, are, so far as research has been carried, invariably present. Several other elements are found in small quantities in various plants, but their precise importance in the economy of plant life has not been determined. It seems, however, that they are not connected with any of the vital functions, and, therefore, it is assumed that they are not absolutely indispensable. The essential metals are usually present in excessively minute quantities in comparison with the quantities of carbon, hydrogen, oxygen, &c., but they are none the less important. Experiments for practical purposes, then, are almost limited to ascertain the sources of those elements without which a plant could not live. Here it seems desirable to distinguish between growth and nutrition as two totally distinct processes, though of course the former may be regarded as the result of the latter. These processes may proceed simultaneously in the same plant, or at different periods and under diverse conditions. In the first place, let us consider the nutrition or feeding of the plant, that is to say, the sources of the principal elements. Carbon forms about one half of the dry weight of a plant, and is taken up from the atmosphere in the form of carbon dioxide, although this gas is present only in so very small a proportion in the atmosphere. The leaves and other parts, containing the green colouring matter called chlorophyl, are alone able to decompose the carbon dioxide under the influence of sunlight. In this process some of the liberated oxygen returns to the air, whilst the carbon and some of the oxygen enter into the composition of various combinations with oxygen and hydrogen, the elements of water. These elements are derived from the decomposition of water in the chlorophyl. Carbon, oxygen, and hydrogen, combined in various proportions, form the starch, sugar, and gum compounds, as well as lignin or cellulose, of which the permanent fabric of the cell-walls of the plants is composed. The supply of these elements, which together form so large a proportion of vegetable substances is practically inexhaustible, and the presence of chlorophyl, acted upon by sunlight, is alone essential to enable a plant to decompose their original combinations and form the organic products. Nitrogen is the element next in importance, forming (associated with the foregoing, and small proportions of some others), the gluten, albumen, casein, legumen, &c., of plants. It is also present in the protoplasm or vital substance of plants. As some of the experiments described below relate to the source of this element, it is unnecessary to enter more fully into the subject in this place. With regard to the metals, they are taken up in the water absorbed by the roots in the form of soluble salts. It is contended by some writers that all the vital functions of plants are due to the presence of some metal. It seems to be beyond doubt that chlorophyl is never formed in the absence of iron, nor is the chlorophyl in a condition to assimilate the food offered to the plant without potassium. To enter more fully into the parts played by the various elements, and the combination in which they exist, would unduly lengthen this article. It will be seen that the soil affords most of the elements of the food of plants, whilst the air furnishes at least one very important element, namely, carbon.

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* With especial reference to the experiments carried out on the farm and in the laboratory of J. B. Lawes, Esq., at Rothamsted.

The progress of discovery in all that relates to the vital functions of plants was, until within about the last forty years, remarkably slow, and important discoveries were disregarded. In the beginning of the last century, Hales in this country demonstrated that a large proportion of the food of plants is taken up in a gaseous form, and towards the latter end of the century Ingenhousz promulgated the opinion that all the carbon of plants was obtained from carbonic acid of the atmosphere, and Senebier soon after showed that the decomposition of carbonic acid took place only in the green parts of plants and under the influence of light. In spite of these discoveries, and those of Priestley and Saussure, the theory that plants obtain their carbon from decaying vegetable substances still held sway; and, so far as practical agriculture is concerned, it was not till about 1840 that Liebig in Germany, and soon afterwards Lawes and Gilbert in this country, began their labours in this field. More recently various other workers have appeared, and the results of their experiments, conducted upon scientific principles, are such as to encourage the belief that few of the problems of plant-life will long remain unsolved. Boussingault, in France, conducted experiments for years, mainly to ascertain the sources of the nitrogen of plants, and he arrived at the conclusion that plants are unable to assimilate the free nitrogen of the atmosphere. Priestley and Ingenhousz, who had previously investigated the subject, were of the opposite opinion, whereas Senebier and Woodhouse had arrived at the same conclusion as Boussingault. These conflicting views, and the inconclusive results of some of Boussingault's experiments, induced Mr. Lawes to take up the subject. No. 2,714, in the Biological section, is the kind of apparatus actually employed by Messrs. Lawes, Gilbert, and Pugh to ascertain whether plants are capable of assimilating uncombined nitrogen. The principle of it is to convey water, washed air, and carbonic acid to a plant enclosed in a glass shade, and growing in a soil which has previously been deprived of all combined nitrogen. The air is forced by water through a washing apparatus consisting of two glass Wolffe's bottles containing sulphuric acid, then through a long tube filled with fragments of pumice saturated with sulphuric acid, and, lastly, through a Wolffe's bottle containing a saturated solution of ignited carbonate of soda. The air, after being thus washed, enters the glass shade covering the plant, from which it passes by an exit tube through an eight-bulbed apparatus containing sulphuric acid, by means of which communication with the unwashed external air is prevented. Carbonic acid is supplied, as occasion may require, by adding a measured quantity of chlorhydric acid to a bottle containing fragments of marble, the gas thus evolved being washed through one of the bottles of sulphuric acid, through the long tube, and through the carbonate of soda solution. In 1857, twelve sets of such apparatus were employed;

in 1858, a still larger number. The diagrams on the wall near the apparatus exhibited give a graphic illustration of the difference in the growth of plants thus treated, and others supplied with a known quantity of combined nitrogen beyond that contained in the seed. In sum, these experiments most conclusively proved that plants are unable to assimilate free nitrogen, although it forms so large a proportion of the air. The nitrogen of plants is taken up in the form of ammoniacal and nitric acid salts in the water absorbed by the roots. Messrs. Lawes and Gilbert are still carrying on various experiments, with the view of ascertaining the most profitable form of applying nitrogen in manure; some of these experiments are alluded to again further on.

A brief notice of a series of experiments, to determine the amount of water given off by plants during growth, and the comparative evaporating properties of evergreen and deciduous trees, may be useful, as they were conducted nearly a quarter of a century ago, and published in a journal accessible to few people. The first set of experiments was constituted especially with a view to obtaining an insight into the fixation and sources of the various constituents of the plants under experiment.

The results of one or two seasons' experiments are recorded in the *Journal of the Royal Horticultural Society*, vol. v. p. 38, 1850; but the experiments were continued up to 1858, inclusive. The balance, No. 2,741, in the Loan Collection, is the one that was employed for weighing the plants, and it will (or would) turn with less than one grain when loaded with 50 lbs. or even more. But the evaporation was so great that this extreme delicacy was not necessary. During the whole growth as much as from 15 to 20 lbs. of water was given off by the small plants employed in the experiments, and during the most active period of growth, as much as from 1,500 to 2,000 grains per day. The plants were grown in glass or zinc vessels, without any hole at the bottom for drainage, and with the top closed by a glass firmly cemented to the rim, and having a hole in the centre for the plant to grow through, and another smaller one near the side fitted with a cork. Weighed quantities of water were introduced throughout the latter, and to prevent as far as possible evaporation from the soil other than through the plant itself, small pieces of glass were laid over the centre hole close up to the stem of the plant as they grew. It is impossible to give in a short space the general indications of the results of these experiments, which were extended to the bean, pea, clover, and several cereals; but there appeared to be some relationship between the quantity of water evaporated and the quantity of non-nitrogenous substances fixed. With regard to the comparative evaporating properties of evergreen and deciduous trees, full details of which appeared in the sixth volume of the journal cited above, one fact, interesting to the gardener, was established beyond a doubt. It was the relatively large amount of water evaporated by evergreens during the first four months of the year, which was 44 per cent. of that evaporated during the following four months, against only 14 per cent. in the case of the deciduous plants. This, Messrs. Lawes and Gilbert think, would account for the great loss when evergreens are transplanted in winter. This also corresponds with the active formation of roots during the same period. Another noteworthy series of observations and experiments is illustrated by the large case of samples against the wall, on the top landing of the staircase at the south end of the apartments devoted to the Biological section. This series was commenced in 1856, and has been continued with few alterations ever since. These experiments, like many others at Rothamsted, were originally instituted to test the value of various artificial manures containing the principal constituents of vegetable substances, of which the soil in time becomes exhausted when under constant cultivation. Now they are continued to determine various questions in plant life. This is a series of experiments on permanent grass-land with the same kinds of manure or manures year after year. The area under experiment is about seven acres in extent, and is divided into some twenty plots, each plot annually dressed with its particular kind of manure or manures, or left unmanured, as in the case of two plots on distant parts of the ground. The principal elements the manures contain are nitrogen (in various forms), phosphorus as superphosphate of lime, and potassium, magnesium, and sodium in the form of sulphates. These manures are supplied in different quantities and combinations, and the effects, as might be expected, are very remarkable, though one would hardly be prepared for the great changes produced in the constitution and quantity of the herbage. Many of these changes are very interesting, especially the increase, decrease, or disappearance of certain species. In 1856, when the experiments were commenced, the herbage was nearly uniform over all the plots, as well as the distribution of the various species of grasses and other plants. By 1862* the changes on certain plots were very marked, and in 1872, as the examples in the case at Kensington show, the differences were so great as to strike the most casual observer. Besides these changes in the character and quantity of herbage effected by the different manures, there is the question of increase of the various elements in the crop, according to the quantity supplied. Excluding toadstools and mosses, about eighty different species of plants grow on the plots. Eighteen of these are true grasses; eight, including the common red and white clovers and the yellow vetchling, belong to the *Leguminosæ* or pea-family; and the remainder belong to eighteen different families, constituting what is termed the miscellaneous herbage, in contradistinction to the graminaceous (grass) and leguminous (clover, &c.) herbage. The various plants are very unequally represented on the plots; some being present on one or two plots only, and numbering few individuals, while others occur more or less plentifully on all the plots. As already observed, the herbage was tolerably uniform over all the plots when the experiments were commenced; that is to say, the same, or nearly the same species of grasses, clover, and other plants, were, with unimportant exceptions, equally distributed. From an agriculturist's point of view, the total crop and the relative proportions of graminaceous, leguminous, and miscellaneous herbage constituting the crop, are the chief things to be considered. The case of examples alluded to, illustrates the different kinds of herbage of a selection of twelve different plots. But these experiments offers numerous suggestions and problems for the consideration of the chemist and botanist, and, indeed, for every intelligent observer of natural phenomena. To note only one or two; the laws governing the distribution of plants, with especial reference to the increase and decrease in the area of a species, and the relative number of species, according to the nature of the soil, and the habit and vital energy of each of the species. The unmanured plots furnish a very interesting illustration of the composition of the herbage of ordinary meadow-land, and also of the natural vegetation of a given area of open country. Each of these plots is a quarter of an acre in extent, and the vegetation comprises between fifty and sixty species; some of them rare, and others scattered all over. Comparing this kind of vegetation, in which none of the species exhibit a marked superiority in the struggle for existence, with that of a neighbouring plot to which 3½ cwts. of superphosphate of lime and 200 lbs. each of the sulphate and muriate of ammonia (equal to 82 lbs. of nitrogen per acre) are applied annually, a vast difference is at once apparent, both in the number of species and the proportions of the different kinds of herbage. In 1872, the unmanured plot gave 68·66 graminaceous, 8·98 leguminous, and

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* See *Journal of the Royal Agricultural Society of England*, vol. xxiv.

22·36 per cent. of miscellaneous herbage, and the plot just named in comparison, yielded respectively 88 65, 0·03, and 11·32, or twenty per cent. more grass. The number of species on this plot was twenty-six, whereof fifteen were grasses, and most of the other plants are only represented in the samples by very small quantities. An exception to this is the common sorrel, *Rumex acetosa*, which furnished 6·85 per cent. of the whole crop. Here it may be observed that this is almost the only plant, not a grass, that flourished under all the different conditions of manuring, usually increasing with the larger quantities of manure. The average crop of hay, for the last eighteen years, taken from the plot in question, is about a ton and three-quarters, so that the disappearance of many of the species found on the unmanured plots is scarcely due to crowding out or excessive luxuriance of others. The cause should be sought in the nature of the food offered. Where the superphosphate alone is applied, the number of species is scarcely less, and the crop very little heavier than on the unmanured plots; and where the same amount of nitrogen is given in the form of nitrate of soda, associated with the mineral manures, the number of species is only about ten fewer than on the unmanured.

Moreover, with the nitrogen in the form of nitrate of soda, the per-centage of miscellaneous herbage exceeded 21 per cent., thus constituting a kind of pasture or hay, much more relished by cattle. Very many other interesting facts, illustrated by the examples at South Kensington, might be pointed out, but space forbids more than a brief reference to some of them. Further details will be found in the journals cited above, and much remains yet to be published. The particulars of the crop of one other plot may be given, as they constitute an instance of extreme change from the original state of things. The manure, per acre, is—300 lbs. sulphate of potass, 100 lbs. sulphate of soda, 100 lbs. sulphate of magnesia, $3\frac{1}{2}$ cwts. superphosphate of lime, and 400 lbs. each of the sulphate and muriate of ammonia. Treated in this manner the number of species has been reduced to sixteen (in the samples), whereof thirteen are grasses; and the average crop of hay exceeds three tons per acre. No trace of leguminous herbage was found, and only about three-quarters per cent. of miscellaneous, leaving 99·24 per cent. of graminaceous herbage. Here, then, there is a large increment in quantity with a loss of quality. The crop is made up almost entirely of six of the coarser grasses, stimulated to excessive luxuriance. The cocksfoot grass, *Dactylis glomerata*, alone constitutes a quarter of the crop, and grows in favourable seasons nearly six feet high. It is almost superfluous to say that the crops on all the plots vary slightly from year to year, according to the season. The effects of severe and protracted frosts, amount of rainfall, and average temperature during the growing period and other conditions, are different on different plants. Some remarkable facts on the influences of manures in the exceptionally dry season of 1870 are recorded by Messrs. Lawes and Gilbert, in the seventh volume of the *Journal of the Royal Agricultural Society of England.* That season there was a deficiency of nearly four inches from the average rainfall at Rothamsted during the three months, April, May, and June, in other words the fall was only one-third of the average for the preceding eighteen years. Naturally, too, the amount of sunlight and heat exceeded the average. Under these conditions the crop of the unmanured plot showed a deficiency of 17 cwts. in an average crop of nearly 23 cwts.; the crop of the plot dressed with "mineral manure" (sulphates of potass, soda, and magnesia and superphosphate of lime), and nitrogen in the form of sulphate and muriate of ammonia, suffered a deficiency of $22\frac{7}{8}$ cwts. from an average of $52\frac{3}{8}$ cwts.; whilst the plot dressed with mineral manure and nitrogen in the form of nitrate of soda yielded within $1\frac{3}{8}$ cwts. of an average crop of $57\frac{5}{8}$ cwts. The main causes of this comparatively very slight loss in the latter case is attributed to the penetrating properties of the nitrate of soda, which enables and induces the plants to root much deeper into the soil than they do where ammonia salts are applied. But another fact should not be lost sight of, namely, on an average nearly half of the crop of the plot on which the deficency was slight, is furnished by an annual or biennial grass, *Bromus mollis*, which, with one other grass, *Poa trivialis*, is favoured by this combination of manures. Another singular fact is the disappearance from all the plots to which ammonia salts are applied of the common ribwort plantain, *Plantago lanceolata*, whereas the nitrate of soda seems to favour the increase of the same plant. The mineral manures alone effect a considerable increase in the per-centage of leguminous herbage. See the samples in the case taken from plot seven in 1872, when it formed nearly 40 per cent. of the total crop. On the other hand, a neighbouring plot, from which the sulphate of potass has been withheld since 1861, gave only 8 per cent. of leguminous herbage.

Enough has now been said to demonstrate the importance and interest of the costly experiments Mr. Lawes has been carrying on for so many years. Perhaps to the uninitated the separation of a sample into its constituent species, even down to fragments of a blade of grass, may seem almost impossible; but a visit to the laboratory when this work is going on would at once dispel such a notion.

A few figures relating to the increase of certain constituents in the produce, in proportion to the quantities supplied, will show that, beyond a certain point, manuring is not profitable. Plants can assimilate only a limited quantity of their various constituents; hence it is wasteful, and even injurious, to apply excessive quantities of manure. And plants belonging to different families require different food. It has already been stated that the mineral manures alone greatly favour the production of leguminous herbage, and it may be added that there is comparatively little increase of the grasses in the same crop. The addition of ammonia salts to the mineral manures gives an increase of a ton and a half in the total average weight of hay per acre; and, what is more remarkable, the leguminous element is quite absent, 94 per cent. being grass. An experiment at Rothamsted, with large quantities of saw-dust on meadow land, gave no increase of carbon in the crop beyond that of the unmanured, clearly proving, in connection with other experiments, that it is not necessary to supply carbon. In other words, the increase of carbon is dependent upon the presence of the mineral elements and nitrogen. For instance, where a mixture of mineral manures and ammoniacal salts was applied, without any direct supply of carbon, there was an increase of $1\frac{1}{2}$ tons of dry substance per acre, or an increased assimilation of carbon from the atmosphere of about 12 cwts. The per-centage of [supplied nitrogen recovered in increase in the crop depends to a great extent upon the presence of the mineral elements. Very little over 25 per cent. is recovered when nitrogen alone is applied, either in the form of nitrate of soda, or the sulphate and muriate of ammonia; and only about 50 per cent. is recovered under the most favourable association with mineral manuring, that is, above the yield without manure of any kind; and the amount recovered in increase is even less as compared with the mineral manures alone. With regard to the increase of the mineral constituents, or ash, it has been determined to vary from 167·5 lbs. per acre on the unmanured to 435·6 lbs. on the most heavily manured plot; or an increase of 268·1 lbs. per acre. These figures represent the average of seven years. Here, as in the case of nitrogen only, a portion is recovered. The most striking instance of increase of a constituent over the yield on the unmanured plot is afforded by potash on the plot which receives an annual dressing of the mineral manure and ammonia salts, equal to 164 lbs.

of nitrogen per acre. Without manure the total produce per acre was found to be 32·3 lbs., and manured as indicated, the produce was increased 132·9. The foregoing figures were borrowed from various articles by Messrs. Lawes and Gilbert.

The consideration of the feeding of plants has extended beyond the limits anticipated, and therefore the growth of plants will be discussed in another article.[*]

ON IMPROVED TRANSIT, REQUIRED AS A MEANS OF URBAN SANITATION.

At the recent meeting of the British Association at Glasgow, a paper on "Overcrowding in Liverpool," by Mr. R. W. Pitcher, was read. The author said that borough had the densest population of all cities in the United Kingdom, and it averaged 99·1 per acre, being 10·5 more per acre than the next most crowded place. In 1821 the inhabitants of the parish of Liverpool were 118,972, and in 1861, 269,724; but during this increase of 12·6 per cent. in 40 years, the space for labourers' dwellings had every year diminished. It was supposed Mr. Cross's Act would be a great service, but the very crowded districts could not be improved anywhere without demolishing healthy front houses and shops, which would be attended with enormous cost. There appeared to be no help available, unless the railway system could be extended in the shape of a town's railway.

In the discussion which ensued, Mr. Edwin Chadwick stated that his public services in Poor-law and sanitary administration had heretofore made him acquainted with the conditions of the population of Liverpool, which was denoted by one of the highest death-rates in the kingdom, due mainly to over-crowding and to defective sanitary administration. The conditions of old tenements in the metropolis, which had once been mere fever-nests, the worst there when occupied as common lodging-houses, had, by proper supplies of water, and cleanliness, and drainage, and ventilation, and by a limitation of the numbers occupied in each room, been entirely changed under police regulations. They had now almost an immunity from epidemic visitations, and were now in a far superior condition to the great mass of the weekly tenements occupied by the wage classes. Those weekly tenements were occupied by populations frequently as changeable as the populations of the common lodging-houses; and the conditions of heavy death-rates from the foul air diseases in them suggested that the like authoritative protection might well be extended to them. Thus as to the old tenements. But new houses were needed for the relief of the present population, and also for the increasing population, brought there, and to Glasgow and other cities, by increasing manufactures and commerce. The great remedy indicated was to cheapen transit by every means, so as to spread the population to fresh suburban lands, where ground-rents were less expensive and sites more open. What would have been the condition of the metropolis if it had been piled up and crowded upon half its present area —if its population had not been spread, by railways, by omnibus and river transit, by the new tramways, and by such other means, such as there were. Old and bad houses might and ought to be pulled down—but still that process must frequently be attended with displacements to be provided for. The means of doing this would be by cheap transit. Science was providing silent and inoffensive steam and other power that would, to a great extent, supersede the use of horse-power, for internal as well as external transit by public vehicles. The use of steam for improved tram-cars had already been introduced at Brussels; and trials of it were in progress in Paris and elsewhere. But improvements were needed for the reduction of the tractive force required for them and for all vehicles on the road itself. This, it was confidently expected from demonstration, would be given by wheel tracks made of that remarkable material, the hardened asphalt. This would advantageously take the place of smooth wheel-tracks of slabs of stone, so long and advantageously used in Italian cities, or of the granite tramways, long used for easing heavy traffic from docks and warehouses. The cost of these asphalt wheel-tracks would, it was stated, be about half the cost of the granite tramways, one-third of the cost of the iron tramways, and would not require half the tractive force expended on the common roads. With legislative and administrative improvement from the advance of intelligence we should hence have a greatly cheapened transit, without noise, or jars, or the dung and dirt of horses for public vehicles, and half the horse-power at the least for private vehicles. But to get this important and necessary relief of our cities, and the requisite cheap extension of their external means of communication, there must be a change in the local administration of our roads. The improved means of transit might be required to radiate out of a city some six miles or more. But it was common that every mile of the road—often internal as well as external—was under the jurisdiction of a parochial or other inferior authority, destitute of science or of proper appliances, yet excessively expensive for road maintainance in multiplied inferior officers, these vestral authorities were obstructive of any extended effort, and exacting upon all public or private enterprise. If three vestral authorities agreed to any plan, a fourth would commonly obstruct or make exactions for every concession. It was absolutely necessary to the internal relief of a civic community, that its means of external communication should be under one Road Trust, or under unity of management by a competent local authority. This would be indeed a complement to the measure of the legislation of the last session for the improvement of the dwellings of the wage-classes, and getting appropriate sites for them at reasonable rates. New concrete constructions would greatly improve the sanitary quality of dwellings, and reduce their cost.

Sir James Watson gave an interesting account of the operations of the Glasgow Corporation, in making both street and dwelling-house improvements in the city. He stated that on one area, where the death-rate had been 42 per 1,000 in the old dwellings, according to the last returns it was only 28 per 1,000 in the new dwellings.

Mr. Chadwick observed that this death-rate of 28 per 1,000 was, of course, an important advance, but it was not up to the model dwellings in the metropolis and elsewhere, which were open to further improvement, but where the death-rate was about 17 or 18 per 1,000; nor was it up to the common lodging-houses even in Glasgow. But this must be said, that in houses of the common brick construction the death-rates were always exceptionally high during the first year of occupation, and it was to be hoped they would be lower hereafter. The principle as carried out by the Town Council was most exemplary, and it was to be hoped they would join in seeking legislative aid for the freedom of transit.

On Saturday last, a lecture, in connection with the National Health Society, was given in the large room of the Society of Arts by Professor Corfield, explanatory of a course which he is about to deliver, beginning to-morrow (Saturday) evening, on the Laws of Health. Although the charge for the course is one guinea, the Trades' Guild of Learning has made arrangements for the admission of working men and women at a nominal charge. The room was crowded on Saturday. The chair was occupied by Professor Huxley. The next lecture is on Saturday next.

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[*] Since the above was written, Dr. Gilbert has kindly communicated a copy of his address to the Chemical Section of the Science Conferences at South Kensington. In this address Dr. Gilbert treats more in detail, and in a purely scientific manner, several of the subjects touched upon here. In a future article occasion may arise to allude to it again.

CORRESPONDENCE.

FARMING IN BULGARIA.

SIR,—Farming has been a little tried in the English style in Roumelia, which our countrymen incorrectly call Bulgaria. The machinery imported has generally been allowed to rust in the fields, the natives declining to use it. No finer area can exist in Europe for the use of the steam plough. Having accompanied Viscountess Strangford here, I have felt anxious to ventilate an idea that has occurred to me, which, if carried out, would be, of course, entirely independent of her ladyship's and other funds. If any farmers will kindly undertake to receive a Bulgarian orphan or two, or a boy and girl, on farms during the winter and spring, or as much longer as they may feel inclined, these children might return to carry English views of life and farming into their native land. It might be objected, they would not wish to return; but, after they had a year on an English farm, they might return to be employed on a model farm out here, which might be obtained on favourable terms now, and I am sure be worked to a profit, if any members of the Chamber of Agriculture would consider the project with me on my return. My wife, at 35, Albemarle-street, would be glad to receive any list of names of those who would care to join in infusing English ideas amongst the miserable inhabitants of these naturally most favoured lands. Three thousand miles may be too long a distance for English sympathy to travel very effectively, but I have been impressed with the conviction that if English farmers saw this country, and compared its facilities with the want of agricultural knowledge of the inhabitants, although they have plenty of cares at home, they would be as likely as any class of the community to extend the foundation of knowledge and improvement. This place is further by post from England than America; and, should curiosity or kindness prompt a favourable reception of my suggestion, a telegram in a week's time would be a useful guide to me.—I am, &c., ROBERT JASPER MORE.

Philippopolis, Turkey, Nov. 1, 1876.

GENERAL NOTES.

The Needlemakers' Company's Prizes.—The Company of Needlemakers having determined to offer prizes by way of encouraging and developing the art of needlemaking in the neighbourhood of Redditch, in which locality this manufacture has been established for many years past, the Court of the Company appointed a special committee to arrange a scheme for that purpose, and to confer with some of the leading manufacturers as to the most desirable mode of inducing competition in the respective processes necessary to the development of the art. A Committee of Manufacturers was selected from the manufacturing district, and the various details of the prize scheme were considered by it. The scheme of prizes sought to develop the art of needlemaking under three heads, for which prizes were offered; first, to encourage the introduction of labour-saving machines; secondly, to reward skill in handicraft; and lastly, to stimulate the inventive and reflective talent of the needlemaking locality in the neighbourhood of Redditch by means of prizes for essays in connection with the needle manufacture. It must be understood that there are not less than thirty distinct processes in the manufacture of a needle, many of them requiring great manual dexterity, and others very great care, intelligence, and discretion, on the part of the mechanics. With reference to labour-saving machines, none were submitted for competition; the conditions stated that they must have been originated since 1st January, 1875, and although a great deal of machinery has of late years been introduced, with success, into the manufacture, only one machine is known that would come within that stringent condition, and this was not entered. In the second section, "Improvement in any of the processes of sewing needle manufacture," four inventions were sent in. The judges awarded the first prize to Benjamin Hill, needle hardener, of Studley, for a pair of foot shears; and a second prize, consisting of one pound, from local sources, with a certificate of merit, to Richard Bennett, junior foreman, of Redditch, for a "Double Polishing Buff." Section No. 3, prizes for handicraft (tool making) produced, as might have been expected, the greatest number of competitors and the keenest competition. The prizes in this section were offered for the best specimens of tool and work for sewing needles and sewing-machine needles. The art of toolmaking has always been considered, in this and kindred trades, one requiring the greatest skill, and it will be readily understood that the delicate needles used in the manufacture of gloves and fine cambric sewing, whether by hand or by sewing machine, must be made from dies of the greatest nicety and finish; undoubtedly the toolmakers were much stimulated by the prize scheme and exhibition, and, as a consequence, the merits of many of them became better known. In this section the judges awarded the principal prize to Charles Townsend, toolmaker, of Redditch. For sewing-machine needle tools the judges awarded the first prize to Jonah Warner, of Redditch. The prize for the best essay was not awarded; a second prize for an essay was given to W. Shrimpton. The exhibition of the various objects took place in the rooms of the School of Art, Redditch, on the 31st July, 1876, and the following days. It created much interest in the town and district, and a large number of manufacturers and artisans visited the exhibition and inspected the objects submitted for competition.

MEETINGS FOR THE ENSUING WEEK.

MON. ...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. George A. Thrupp, "The History of the Art of Coach Building." (Lecture I.)

Society of Engineers, 6, Westminster-chambers, 7½ p.m. Adjourned Discussion on Mr. C E. Hall's Paper on "The Conversion of Peat into Fuel and Charcoal."

British Architects, 9, Conduit-street, W., 8 p.m.

Medical, 11, Chandos-street, W., 8 p.m.

TUES....Women's Education Union (at the HOUSE OF THE SOCIETY OF ARTS), 6 p.m. Mons. Edmund Ardrade, "The Galin-Paris-Chevé Method of Teaching Music." (Lecture II.)

Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Mr. W. W. Beaumont, "The Fracture of Railway Tires."

Statistical, Somerset House-terrace, W.C., 7¾ p.m. Opening Address by the President, and Report by Dr. Mouat, on "The Ninth International Congress held at Buda-Pesth, from 1st to 7th September, 1876."

Zoological, 11, Hanover-square, W., 8½ p.m. 1. Mr. G. B. Sowerby, jun., "Descriptions of Six New Species of Shells, from the Collections of the Marchioness Paulucci and Dr. Prevost." 2. Mr. Edward R. Alston, "Two New Species of *Hesperomys*." 3. Prof. Garrod, "The Chinese Deer, named *Lophotragus michianus* by Mr. Swinhoe." 4. Mr. Arthur G. Butler, "Descriptions of New Species and a New Genus of Lepidoptera, from New Guinea."

WED. ...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. The Rev. E. L. Berthon, "Collapsible Boats; their Peculiarities and Advantages."

Geological, Burlington House, W., 8 p.m. 1. Mr. Henry Hicks, "The Pre-Cambrian (or Dimetian) Rocks of S. David's." 2. Professor Salvador Calderon, "The Fossil Vertebrata of Spain." Communicated by the President. 3. Mr. W. J. Sollas, "*Pharetrospongia Strahani*, a Fossil Holorhaphidote Sponge from the Cambridge Coprolite Bed." 4. Mr. Robert Etheridge, jun., "A New Species of *Eurypterus* from the Carboniferous of Scotland."

Royal Society of Literature, 4, St. Martin's-place, W.C., 8 p.m.

FRI.......Volunteer Medical Officers (at the HOUSE OF THE SOCIETY OF ARTS), 3 30 p.m.

Quekett Club, University College, W.C., 8 p.m.

SAT.......Trades' Guild of Learning and National Health Society (at the HOUSE OF THE SOCIETY OF ARTS), 8.30 p.m. Prof. W. H. Corfield, "The Laws of Health." Part I. (Lecture II.)

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,253. Vol. XXV.

FRIDAY, NOVEMBER 24, 1876.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

PATENT LAW REFORM.

The following petition has been presented by the Council to the Lord Chancellor:—

To the Right Honourable the Lord High Chancellor of Great Britain.

The Humble Memorial of the Society for the Encouragement of Arts, Manufactures, and Commerce, founded in 1754, *and incorporated by Royal Charter in* 1848,

Sheweth,—

That your memorialists have for upwards of a century been engaged in promoting the Arts and Manufactures of the kingdom, and have taken, and still take, a deep interest in the laws relating to Letters Patent for Inventions.

That your memorialists were largely instrumental in bringing about the change which took place in the Patent-law in 1852, and in promoting the "Patent-law Amendment Act, 1852."

That under the provisions of that Act the Lord Chancellor, the Master of the Rolls, and certain Law-officers of the Crown therein named, together with such other persons as her Majesty the Queen should appoint, are made Commissioners of Patents, with full powers as therein specified, to conduct the business of granting Letters Patent for Inventions, and to make regulations for the administration of the Patent-office.

That up to the present time the provisions of the foregoing Act, authorising the appointment of one or more persons as Commissioners of Patents, in addition to the *ex-officio* Commissioners, have not been acted upon; no additional Commissioners, as contemplated by the Act, have been appointed, and thus the whole business of the Patent-office falls upon the *ex-officio* Commissioners, who are already overburdened with other important and heavy duties.

Your memorialists, while admitting that great improvement has been effected by the energy and zeal of those who have been employed in the office, desire respectfully to urge upon your Lordship the importance of acting upon the provisions of the Act of 1852, and carrying it out in its integrity, by appointing such additional Commissioners as are contemplated by the Act.

Your memorialists venture to think that if such additional Commissioners were appointed, duly paid, and made responsible for the effective working of the Patent-law as it at present exists, a large amount of beneficial reform would be obtained, and many of the objections now made, if not all, would be got rid of without any further legislation, at all events for the present.

Your memorialists, therefore, humbly pray your Lordship to cause the provisions of the Act of 1852 to be put into force, by the appointment of one or more additional Commissioners of Patents, to whom might be entrusted the full carrying out of the duties of the office, and who should be responsible for the same, and that no further legislation be attempted until after such Commissioners shall have been appointed, and the system contemplated by the Act administered in its integrity.

Sealed with the Seal of the Society, this 16th day of November, 1876, in the presence of

L.S.

Alfred S. Churchill, Chairman of Council.
P. Le Neve Foster, Secretary.

CANTOR LECTURES.

The first lecture of the course by G. A. Thrupp, Esq., on "The History of the Art of Coach-building," was delivered on Monday last, the 20th inst. In order to give to the classes specially interested in the subject the opportunity of attending the lectures, the Council decided to issue a number of tickets at the price of 6d. each, admitting to the whole course, and available only for members of the coach-building trade. Of these tickets 250 were issued, all of which were sold.

INSTITUTIONS.

The following Institution has been received into Union since the last announcement:—

Educational Institute, Stockwell-green, S.W.

NATIONAL TRAINING SCHOOL FOR MUSIC.

Royal Scholarships.

A competition among the scholars of this School, for the Musical Scholarships founded by the Queen and other members of the Royal Family, commenced on Monday, the 13th instant, and terminated on Thursday, the 16th, when the following students were elected to be Royal Scholars:—

Eugéne d'Albert, to be the Queen's scholar.

Minnie Eliza Webbe, to be the Prince of Wales' scholar.

Eva P. Pidcock, to be the Duke of Edinburgh's scholar.

Hélène Heale, to be the Duchess of Edinburgh's scholar.

Proxime accesserunt { Annie A. Marriott, Mary Thomas, } Æquales.

The following scholars acquitted themselves so as to obtain honourable mention:—

Henry Balfour.
Eugénie Bénard.
Theresa Benez.
Gertrude Jones-Bradwen.
Frederick Cliffe.
Annie E. Glen.
William Hodge.
Gertrude Harding.
Sophia Hudson.
Robert Jefford
Charles Marshall.
Emma Mundella.
Adelaide Thomas.

The examination was conducted by the Principal,

A. Sullivan, Esq., Mus. Doc. Cantab., assisted by all the members of the Professional Staff.

The Scholarships which become vacant by these elections, are—

One of the Society of Arts.
Two of the Fishmongers' Company.
One of the County of Northumberland.

Mr. T. Macco, of Bath, has just presented his valuable collection of music to the School, with a view of its forming the nucleus of a Students' Lending Library, and as a mark of his interest in the success of the institution.

Mr. Howard Morley's Scholarship was competed for at the School, on Wednesday, the 8th inst., and has been awarded to Mr. John C. Bennett, of Brighton.

SECOND ORDINARY MEETING.

Wednesday, Nov. 22nd, 1876, Lord ALFRED S. CHURCHILL, Chairman of the Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Ashbury, Thomas, A.I.C.E., M.I.M.E., 424, Stockport-road, Manchester.
Dyer, Colonel H. C. S., 44, Chorlton-street, Manchester.
Frazer, Daniel, J.P., Cumbernauld-house, Cumbernauld, by Glasgow.
Hemsley, Alexander, Castle-hill, Ealing, W.
Hilman, Reginald Arthur, 1, Fairmead-villas, Albert-road, Peckham, S.E.
Stallard, Josiah, D.L., The Blanquettes, near Worcester.
Vaizey, John Robert, Attwoods, Halstead, Essex.

AND AS HONORARY CORRESPONDING MEMBER,

Stab, Captain Simon, Smyrna.

The Paper read was—

COLLAPSIBLE BOATS; THEIR PECULIARITIES AND ADVANTAGES.

By the Rev. E. L. Berthon, M.A.

It will be quite unnecessary, in these days, to impress upon the members of the Society of Arts the urgent demand for increased and improved means of saving life at sea, and therefore I need not begin, as many inventors do, by making out a case to show that there is a real want which they propose to meet.

It is not denied that considerable progress has been made in the life-boats carried by ships. No one can inspect the magnificent troop-ships which at this moment are engaged in carrying our soldiers to and from our Indian Empire, or the splendid steamers of the Peninsular and Oriental Company, and the many still larger ships of other companies that convey passengers to all parts of the world, without being struck by their greatly improved boat accommodation; nevertheless, it is equally manifest that, when all that is possible has been done with existing appliances, there is still a lamentable deficiency; for when carrying their full amount of troops or passengers, not one such ship has ever put to sea with boats of any kind capable of saving one-half of the people on board, in the awful event of fire, wreck, or collision. For instance, let us take the most favourable case in existence. It is not uncommon for one of H.M. Indian troop-ships to convey at one time 1,700 men, women, and children; every available spot in which a boat can be stowed is utilised, so that each of these ships carries fourteen boats, four of them being the largest troop-boats in the service; yet were a fatal accident to befall such a ship—which God forbid—and, by some grand display of discipline and self-denial, all those boats were safely launched, and filled with people, only 600 at the utmost could be saved, and 1,100 must inevitably perish.

In emigrant ships the deficiency reaches its most appalling limit. The regulations of the Board of Trade with respect to boats have no regard whatever to the number of persons a ship may carry, but only to the size and tonnage, and thus it came to pass that, in two typical cases of frightful loss of life by collision and fire—the *Northfleet* and the *Cospatrick*—the official report of the Board of Trade inquiry, after stating the number and capacities of the boats, and thus showing that they would not have held one-third of the human beings, makes this startling announcement, almost in the same words in each case, that "the ship was well supplied with boats, which were in excess of what is required by law!" I submit the fact that such a state of things should be tolerated is a reproach to the intelligence and humanity of the age.

But it is not only the deficiency of boat accommodation that so frequently causes such fearful sacrifice of life. There is another fatal evil which is very common, even in those cases in which the number of persons happens to be small, I mean the practice rendered necessary of carrying the boats inboard, or on the booms, or often bottom upwards, so that, though the boats might be sufficient if they could be got into the water, they cannot be lowered in time; such was the case with the *Strathmore*, and probably the *Strathclyde* too.

It has been said that no increase of boat accommodation could avail to save all the lives in case of some supreme disaster. In reply, I admit that there are cases of such an awfully sudden nature as to give no time for the employment of the most ready and perfect appliances; but the accounts we have had of the most terrible catastrophes at sea in the last thirty years are enough to show that, in a very large majority of cases, there was ample time to launch the boats, had they been ready for service.

Again, it is more strongly urged that the most frequent spectacle of a mad and selfish spirit of self-preservation—too frequent in cases where many human beings are included in a common danger, and panic-struck individuals communicate their frenzy to the rest—is a fatal obstacle to all efforts to save life. This objection requires a fuller reply. Admitting that this selfish spirit of "*sauve qui peut*" is generally exhibited, and that hitherto it has acted as the insuperable hindrance to the proper use of the boats of a ship in time of extreme peril, there is no reason why this state of things should continue. I hold the opinion strongly, and I am able to prove it by very many instances, that the panic, hitherto so fatal, need not and would not ensue, if proper and abundant means of safety were not only in existence but known to be hand. Imagine two cases of ships that must sink within, say, an hour, both crowded with passengers and crew. In the one case the captain knows but too well that, at the best, three out of every four must perish; how can he expect to calm the frantic, and cheer the despondent? They know, as well as he does, that his boats will not hold a quarter of them; nor can he prevent that fatal rush by which, more frequently than not, the boats are improperly lowered, and those that had crowded into them on the davits, are lost.

In the other case, in which it is well known to all that there is abundant means of refuge to every soul on board, how different the state of things. The master of such a ship has hopeful grounds for calling all to their duty, and to maintain discipline and order. With cheering voice, though he tells them that the fate of the ship is sealed, yet in all probability, he says, she will float another hour, and if they will only obey orders, and not crowd into the boats, they will all be saved. In the terrible fire on board the *Cospatrick* some two years ago, we have a case that sadly illustrates this point. That ship, when she took fire, had about 480 people on board, and her boats, as shown by the report of the Board of Trade, would not have carried with safety more than about 150. In an early stage of the conflagration it is stated that Mr. McDonald, the chief officer, asked Captain Elmslie, who commanded the ship, the following question, "Shall I put out the boats, sir?" "No" said the Captain, "put out the fire." For this his memory has been charged with want of judgment, and it is said had he ordered out the boats at that moment more lives might have been saved. I do not think so. All told, the crew and officers numbered only 44, the rest were the most helpless class of landsmen, who were rushing about the deck, far beyond control. Let us suppose it possible to have launched those boats (most of them stowed inboard) at all, it would have taken the whole ship's company to do it, and what is more, the moment the boats touched the water it would have been necessary to pull away at once, to lay one minute alongside would have been fatal, for the men and women jumping into them would certainly have swamped them.

But, happily, history records cases of heroic self-denial, and the preservation of perfect discipline in the most appalling scenes of wreck, *e.g.* the troopship, *Birkenhead*, wrecked some 25 years ago in Simon's Bay. There the brave soldiers, after handing the women and children into the few boats they had, stood in their ranks on deck as steady as if on parade, and even fired their own funeral volley when the ship's deck sank below the waters. Can any one doubt that if they had been supplied with efficient and abundant boats they would all have been saved?

Or to recur to another case, the *Northfleet*; if she had had her boats, not only sufficient in quantity, but properly stowed ready for use in a moment, instead of having them turned bottom upwards on the skids, would not a far larger number of her helpless passengers have been saved?

The two things absolutely necessary to make any system perfect are, first, that the boats should be abundant and efficient; and second, that they should be stowed so as to be available at any moment, without the labour and loss of time expended in hoisting them out. Both these desiderata are secured by the system of collapsing boats, which I now have the honour of presenting to the Society of Arts, for not only can boats of this kind be carried in number and capacity very far exceeding those hitherto in use, but, owing to their great reduction in size when shut, they can be carried outboard without the slightest risk of injury; in fact, they collapse into about one-sixth of their width.

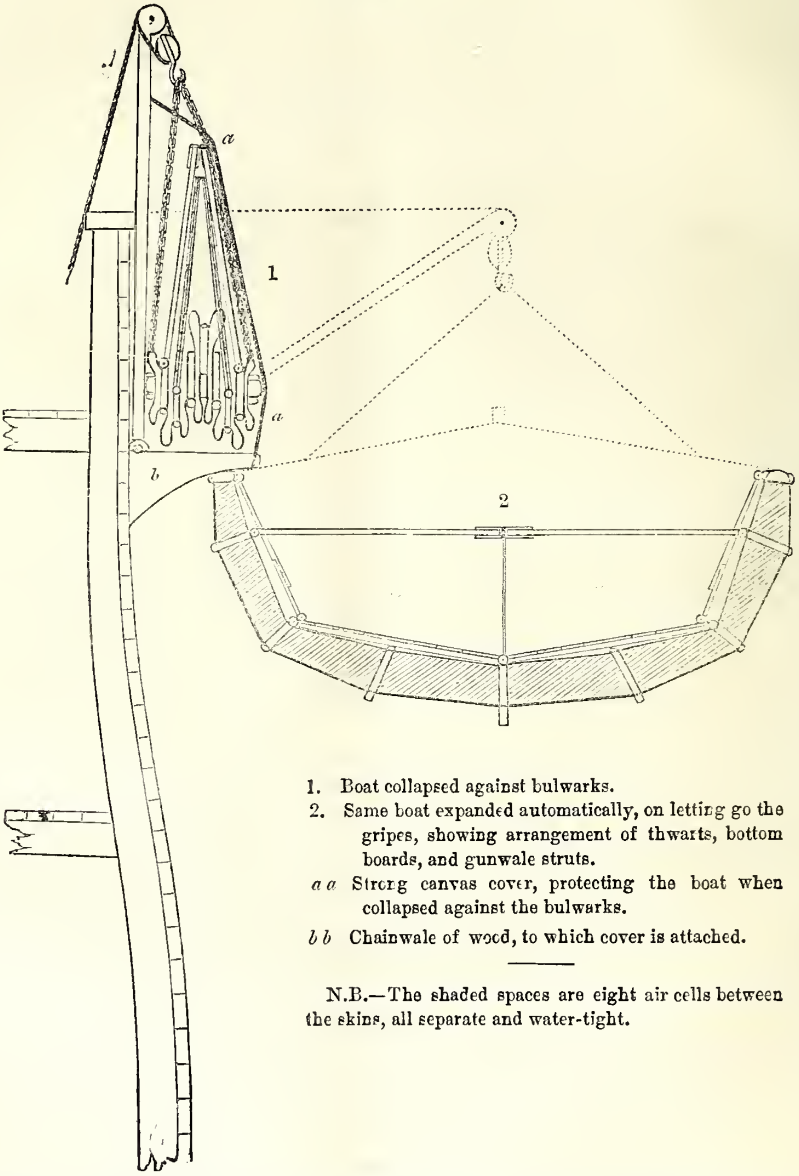
Perhaps I may be pardoned if I here relate the personal circumstance which first brought the idea of such boats to my mind. It may be in the recollection of some present that, on a calm and lovely summer night in June, 1849, one of the most melancholy shipwrecks on record occurred. The *Orion* was a favourite iron steamship, employed in carrying passengers between Liverpool and Glasgow. On her last and sadly fatal trip she had a large number of passengers, nearly all of the first class, bound for tours in the Highlands, and if ever freedom from danger could be justly premised at sea, it was so then. They had reached a part of the coast close to Portpatrick without a cloud in the sky, or a ripple on the water, when, just as the first streak of dawn was appearing in the north-east, by the most extraordinary carelessness, the ship was run on a sunken rock, close to the lighthouse, and not two cables' length from the shore. After hanging a few minutes on the rock, she slid off, and sank in deep water, carrying with her 200 persons, of whom about 150 were drowned. Of her boats, three or four in number, owing to the rush that was made to them, only one was successfully launched, and that was taken by the sailors and firemen, who left the passengers to perish.

A clerical friend of mine, who was saved in a wonderful manner, though he was no swimmer, writing a narrative of the wreck, and knowing that I was a good draftsman and acquainted with this particular ship, begged me to make a drawing of the final plunge, to illustrate his little book, and it was while preparing it for the engraver that I suddenly conceived the principle of collapsing boats.

I will not weary the members of this Society with a recital of the mountains of difficulties that, for more than a quarter of a century, have stood in my way; but this I must say, they chiefly were not of a mechanical or structural kind, but personal. I had to fight the battle singlehanded, and nothing but faith and confidence in the invention which a Higher Power had put into my mind, and a sense of certainty that some day it would prevail, carried me through. And now I am thankful to say, that these boats are to be found in all parts of the world. They have been adopted by the Admiralty and the India Board, and though hitherto shipowners stand off as being free from all responsibility with regard to the lives of their crews and passengers, so long as they act up to a most defective law, I may confidently assert that the day is not distant when this system of supplementary boats will be general. I have just received a most gratifying letter from a gentleman of great influence in the mercantile marine, who is personally interested to a large extent in steamships in the East, and he wishes to be the first to apply these boats to ships carrying large numbers of passengers.

It is not easy to describe the details of these boats, as the whole structure, from first to last, differs entirely from all others. But, probably, the following will give some idea. Imagine a long melon cut into thin slices, their shape will be more or less lenticular. Now, suppose these to be jointed together at each end, so as to lay flat side by side, like the leaves of a shut book, or to take any other positions radiating from a central line. Now, if when a certain number of such segments, properly placed at certain distances, are connected together by some flexible material on their outer edges, and made water-tight, the structure becomes a boat; but, having as yet only one skin, it would only float so long as that skin is not pierced. But now let us suppose another skin to be applied to the inner edges of these lenticular segments, and made water-tight, not merely is there then a boat within a boat, but the spaces between the segments being all separate and distinct, an injury to one does not affect the rest.

Fig. 1.—Midship Section.



1. Boat collapsed against bulwarks.
2. Same boat expanded automatically, on letting go the gripes, showing arrangement of thwarts, bottom boards, and gunwale struts.

a a Strong canvas cover, protecting the boat when collapsed against the bulwarks.

b b Chainwale of wood, to which cover is attached.

N.B.—The shaded spaces are eight air cells between the skins, all separate and water-tight.

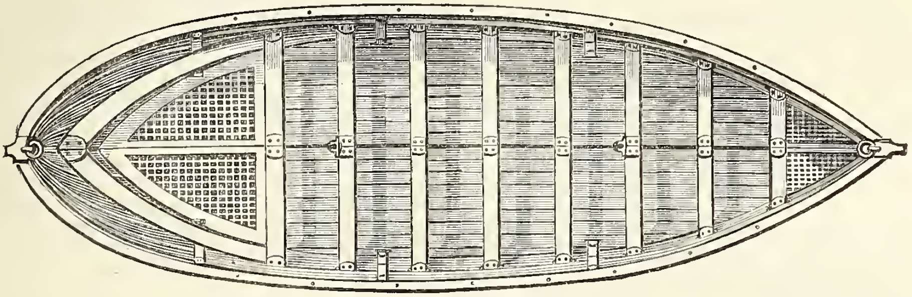
In practice, these flat segmental timbers are made by bending, with the aid of steam, slips of hard, elastic wood (preferably, Canada elm) one over the other, in a mould of the proper form, till the proper width is attained, and then clinching them together with copper rivets.

The frame-work is chiefly of wood, of the strongest and most elastic kind. To the keelson, or backbone of the boat, the stem and stern posts are attached, and on each side are four longitudinal curved timbers, which are jointed to the tops of the former by a peculiar kind of chain-hinge. When shut, these timbers fall down on each side of the keelson in vertical and parallel planes; and when open they assume such positions as to form the skeleton of a boat, extending two skins (one outside, the other inside) of a very strong and highly flexible material. The whole body of the boat is thus divided into eight segmental compartments, into which air is inhaled automatically, by the act of expansion. These cells being all separate and watertight, any injury that might befal one of them does not affect the others, nor materially impair the safety of the boat.

Horse and Artillery Boats.

By order of the Admiralty I have built collapsers 40 feet by 13 ft. 6 in., which have, on repeated trials, performed their duty in a most perfect manner. Such a boat carries eight horses and the heaviest field gun with the gunners and her crew. To embark or disembark these on a beach, one of the gunwales is lowered down nearly to a level with deck, when the horses walk in or out, and the gun follows. These boats, the largest of any in the service, weigh only 2 tons 15 cwt., and shut into 2 feet 6 inches.

Fig. 2.—Gunwale Plan of the Boat.



Pleasure Boats.

Hundreds of these collapsers of small size are now in use in all climates for fishing, shooting, and other purposes.

As yachts' lifeboats they are very convenient, and as dingies and punts they are greatly in demand, although for lack of capital they are not advertised.

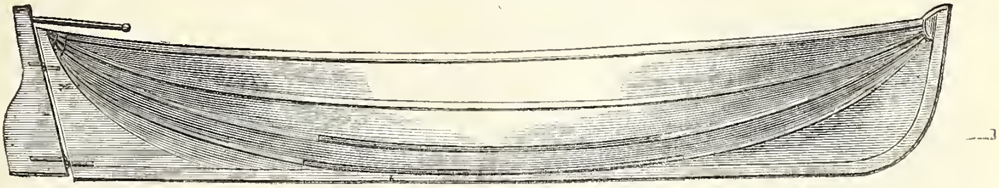
Twin boats on this principle are now navigating the lakes of Central Africa, and are found extremely useful for a variety of purposes.

Several collapsing canoes have been built of full size which shut into three inches; they are quite equal in speed to the *Rob Roy*.

A kind of catamaran has just been built on this principle; it is the stiffest and by far the fastest thing afloat in the world.

These are a few out of a great number of secondary applications of the collapsing principle, and are of minor importance. I rejoice in this opportunity of bringing the far more important bearing of it before the Members of the Society of Arts, feeling confident that their intelligence and influence will go far to apply whatever is good in it to the all-important end of saving life at sea.

Fig. 3.—Profile of the Boat.



DISCUSSION.

The Chairman said the paper was one of great interest, and Mr. Berthon having devoted a great deal of time and money to this subject since 1849, seemed at last to have arrived at something like perfection. He hoped that before long the Board of Trade would insist on this invention being adopted in emigrant vessels, where it was of even more importance than in troopships.

Mr. Clarkson said he had been practically engaged in boat-building for 25 years, and had invented a life-boat which he would challenge the world to surpass. He did not approve of the canvas used by Mr. Berthon, and contended that his own patent material was much superior.

Capt. Townshend, R.N., thought this invention one of the most ingenious he had ever seen, for in large vessels, particularly transports and emigrant ships, there were never enough boats to hold the crew and passengers. As the Government had approved of this invention, he hoped it would be taken up by others. If the model exhibited was exact, there was, however, one mistake in the slinging, the hook being placed at the end of the tackle, where there would be danger of its catching in the thwarts or injuring the men. The hook should be in the sling, and a ring at the end of the tackle.

Mr. Berthon said it was a mistake in the model.

Capt. Townshend also feared that there would be a danger of these boats being injured or lost in bad weather, if slung as described underneath the ordinary boats, which were often known to be washed away, although further out of reach of the waves. He thought it a mistake, again, to advocate the abolition of the boom boats, which really did no harm where they were, and if the men were smart about it they might be the means of saving many lives in case of accident. He should like to know what the flexible material was, and if there was no fear of its being easily injured.

Mr. Christopher Cooke mentioned several patents which had been taken out for improved life-boats.

Mr. C. G. Gompel said they were not there to discuss the best form of life boat; Mr. Berthon's main object had been to enable a vessel to carry sufficient boat accommodation to ensure the safety of all the passengers, in case any calamity occurred. This had been attempted by many previous inventors, but it seemed to have been reserved to Mr. Berthon to carry it out. He had on many occasions admired the enthusiasm with which he had devoted himself to this question, notwithstanding the many rebuffs from fellow inventors and the public; but there was no doubt he had now solved the problem of stowing boats in so small a space that every ship could carry enough to hold all her crew and passengers. With regard to the boats being injured, he might suggest that an ordinary boat, when slung on davits, exposed a large surface to the action of the waves, but these were fastened close to the gunwale, and offered no resistance. They would therefore probably suffer much less damage than an ordinary boat slung higher out of the water.

Mr. Liggins said it was a constant source of grief to read in the *Times* the accounts of loss of life at sea, and therefore any gentleman who brought forward any invention which would tend to reduce this loss of life was deserving of national gratitude. He certainly looked with admiration at the skill brought to bear in the construction of these boats, but it had been said there was nothing new under the sun, and in the proceedings of the Institute of Naval Architects there was a drawing supplied by Mr. Scott Russell, showing boats somewhat of this construction, invented and used in the time of Herodotus. A similar idea could be seen carried out in the coracle, still used in Wales, and of which an example might be seen at South Kensington. For the last forty years collapsible boats had been brought forward; but with regard to life-boats, the only form practically adopted was that of Mr. White, of Cowes, in which there was an inside lining to the gunwale, forming an air-tight compartment, and of such a shape that if the boat shipped a sea a great deal of the water rolled out again on the other side. But these life-boats were very unpopular, because they were heavy to row, and they were of no more use than ordinary boats, and besides no boat, when properly handled, was allowed to fill. He spoke with some experience of yachting, having sailed some thousands of miles in the *Cambria*, which beat the American yacht across the Atlantic, and English yachtsmen, who were pretty good judges, never used life-boats if they could help it. They were heavy and difficult to launch. These boats were light, and it might be thought they would be easily launched, but he did not think so. He remembered the loss of the *Orion*, where the sacrifice of life was entirely owing to the disgraceful panic of the crew, and it was this which required to be guarded against. It was very easy to exhibit models working very nicely in a room, but all such inventions must be looked at in the light of a gale of wind at sea. They might be carried outside in troopships of 4,000 tons measurement, but it was very different in vessels of 1,000 or 2,000 tons; and if Mr. Berthon had ever been to sea he would know that a boat could not be carried outside like that, even from Gravesend to the Nore, in a gale of wind. The iron supports from which these boats were slung would be in the way, and would be almost sure to injure the ordinary boats swung on davits above them when they were being lowered. He supposed these collapsible boats would be lowered with the people in them.

Mr. Berthon said, No.

Mr. Liggins was sure they could never get into them alongside, in a gale of wind. In rough weather he was sure these boats would be carried away like a box of matches, for his own experience in crossing the Atlantic had shown him that boats were often carried away, even when slung much higher. With regard to the Board of Trade, he was quite sure that it was composed of able men, and there was as much humanity there as anywhere, and if they saw an invention which would hold water they would soon enforce its adoption: but up to the present time these collapsible boats had been merely looked upon as toys, and he did not think their use would be made obligatory. They appeared to him too frail for hard, practical wear and tear, and it would be very hard to subject ship-owners, who already had heavy burdens to bear, and keen competition from foreigners, to the great expense of carrying these boats in addition to those now required, which long experience had sanctioned, and which were best understood. Still, there seemed great merit in the invention, and he should be delighted to hear of its being found useful in saving life.

Mr. Galloway spoke in favour of the invention, and suggested that if the material were too frail, vulcanised india-rubber might be employed. There were always difficulties in the way of inventors, but human life was the most sacred thing, and no pecuniary considerations ought to stand in the way of anything which would preserve it.

Mr. Smartt said there seemed to be two main objections to the use of these boats; one, that they would be carried away by the sea if slung outside, and next, that the material was too frail. With regard to the first point, as they occupied so little space, there was no reason why they should not be stowed away in some convenient place inside; and the second objection would be met by building them in water-tight compartments.

Mr. McMinn asked if it would not be very difficult to get the passengers into the boats, after they were launched in such a sea as would necessitate their use at all? He should like to know if they had been tried in a heavy sea.

Mr. Berthon said he should be able to give satisfactory answers to all the questions which had been raised. Though an inventor and a clergyman, he had some practical knowledge of the subject, having spent much time at sea at different periods on board men-of-war. He would not do away with boom boats, but he objected to making them the only stand-by, and to their being filled with sheep and pigs, and all sorts of lumber. He had used india-rubber years ago, and it proved one of his greatest enemies. He procured some of the very best quality, which stood a heat of 400°, and the most intense cold, and when stretched it kept all right, but, unfortunately, when folded up and sent to a hot climate, it contracted so that the boats could not be opened without stamping on the thwarts and breaking them, and this caused the Admiralty to reject his invention years ago, for they would not allow him to try anything else. He now used several thicknesses of canvass, No. 0, or 00, saturated with a composition of ground yellow, litharge, and boiled oil, and in every ten pounds was dissolved 1 lb. of yellow soap. This kept it soft and pliable, and increased its strength. He had some which had been exposed to the weather for four years, and was as good as ever. The word coracle no doubt came from *coriaculum*, a little leather structure, and this name was given to the ancient British boats by the Romans; but the coracle only had one skin, and did not collapse. With regard to the objections that the boats were liable to injury, and should be made in watertight compartments, he had already mentioned that they were all so made, and this construction gave them great power of flotation, so that, even if filled with water, they would carry as many persons as they were intended to. With regard to the strength of the structure, the timbers were not cut out of a solid piece, but were bent and spliced together, so as to combine the greatest strength and elasticity. On one occasion, when taking a boat 17 ft. wide down to Messrs. Siemen's ship *Faraday*, when lying alongside a wharf, she was run into by a smack coming down the river, and her side bulged in at least a foot; but as the smack went back, so the bulge came out, and the boat was none the worse. The same boat went out, and laid the shore end of the Atlantic cable on the American shore, which weighed one cwt. to the yard, but, unfortunately, she was left on the beach all night with ten tons of cable in her, and got knocked to pieces there by a strong gale of wind. As to the danger of the boats being washed away, theory was one thing, and sanguine hopes were another, but facts were the true test. When the *Perseverance* first took these boats to sea they were slung in the waist; she was very deep, and before she got to Ushant she fell in with a tremendous gale of wind, which carried away both the quarter cutters, but the collapsible boats were not injured to the extent of a halfpenny. A boat might be carried away in two ways—by a sea striking her under, lifting her up, and allowing her to dash down again, or by a heavy sea falling upon her; but these boats, which were close up to the bulwarks, and securely lashed with strong gripes, could not be affected in either of these ways. In the *Assistance* the boats are carried just abaft the catheads, in the most exposed parts of the ship, and are often pitched clean under the water, but she carried them more than twelve months, through many a gale of wind, and they never received the slightest injury. He had sometimes been asked how he would do if one got on to the rocks? His reply was, that a boat ought not to get on the rocks, and if she did it was time to get out of her. Having shown by the model how the canvas was attached, he explained that in case any damage occurred it was easy to put in another piece, or a patch of canvas could be put on with a thick solution of shellac; or if the rent were large, the edges might be caught together, and then a piece be put over it. On one occasion, when bringing a boat 32 ft. long from Sheerness to Spithead, when it was being hoisted up from the deck one of the blocks gave way, and the boat fell down 9 feet on to a 68-pounder, which went clean through the bottom segment. However, he went ashore in her all right, which he could not have done with a wooden boat. With regard to putting men on board before launching, he had no objection to it, but it increased the difficulty and danger of lowering. It was not always in a gale of wind or in very bad weather, when you could not get under a ship's stern, that accidents occurred; a fire or a collision might occur in calm weather, and sometimes a ship got on a rock in a fog. But in many cases he believed it would be far better to follow the rule in the navy, where the boats were lowered with only the crew in. On the whole, if there were more dangers of some kind with these boats, they enjoyed some immunities which others did not. The frame work was quite strong enough to bear the weight of a boat load when suspended, which would be seen from the fact that the small model on the table, only 6 ft. 4 in., when placed on two chairs, had supported the weight of a man.

Mr. Liggins, in proposing a vote of thanks to Mr. Berthon, said the explanations he had given would certainly induce him to think twice on some of the points he had raised.

Mr. Gompel seconded the motion, which was carried unanimously.

The Rev. Mr. Berthon, in reply, said he should esteem it a great favour if the audience would endeavour to consider the subject in all its bearings, and endeavour to find out any further objections. He should be glad to have the subject ventilated and sifted to the very bottom, in order that something might be done for saving life at sea. He thought it would be a disgrace to the intelligence and humanity of the 19th century if they allowed these accidents to go on to such an extent without making further efforts to prevent or mitigate them.

MISCELLANEOUS.

LOAN EXHIBITION AT SOUTH KENSINGTON.

Meteorological Instruments.—Barometers.

By **Dr. R. J. Mann.**

The atmosphere, or "vapour-sphere," which surrounds the more compact, solid nucleus of the earth, is one of most interesting portions of the terrestrial globe, on account of the important part which it plays in furnishing the immediate means for the support of life. It consists of exceedingly minute particles of matter—much too small even to be seen by the powers of the microscope—but floating, nevertheless, each one many of its own diameters asunder from its neighbours. The whole of these atmospheric atoms are drawn down together towards the earth by their proper weight, as all really material substance must be. But they are at the same time kept from coming into contact, as they thus press down to the earth together, because, when they get within a certain close distance of each other, they exert a mutually antagonistic repulsion, which not even the force of gravity is sufficient to overcome. The particles of the atmosphere, it will be understood, thus float elastically suspended between the power of the earth drawing them together everywhere from below, and their own mutually repellent and resisting energy, and in that elastically suspended state are capable of the freest and readiest motion, rolling about in incessant gyrations and whirlpools amongst themselves. The weight of the entire mass of the atmosphere is quite easily measured. It amounts to about 15 lbs. pressing down upon every square inch of surface at the level of the sea. One hundred cubic inches—that is, a cubical block a trifle more than four inches and a half across—weigh, in the same position, nearly 31 grains. Of these 31 grains a trifle more than 24 grains consist of pure nitrogen gas, which is so largely used in the fabrication of the living textures of both vegetables and animals. Nearly six grains and a half are made up of pure oxygen gas, which is the great agent of vital movement, the builder up of dense vegetable structure, and the arch-consumer of animal organisation. The air is, in fact, the floating balance of these two important elements of vital operations and manufacture, kept ready at hand for all purposes of need, and both elements are, at every passing instant, in the process of being given out and taken in from the great atmospheric reservoir, as current demands are made, and as new deposits are supplied; the two gaseous elements are, however, merely mingled together in the loosest possible way, and are kept in proper and almost unchanging proportions by the vastness of the accumulated fund contained in the atmospheric reservoir, and by tho largeness of the daily transactions of deposit and expenditure.

Of the 31 grains of material substance contained in 100 cubic inches of air, nearly half a grain is ordinarily composed of the vapour of water, scattered up amongst the particles of the nitrogen and oxygen in the same invisibly minute and elastically suspended condition. But this vaporous constituent of the atmosphere varies to a considerable extent in its proportion. It is more abundant, and materially exceeds the half-grain, when the atmosphere is very warm; and it is diminished more or less below the half grain when the atmosphere is cold. The supply of this vapour, whether in large or in less amounts, is obviously from the vast reservoirs of water which occur upon the ground. The vapour steams up at all times from the surface of the seas, lakes, rivers, and moist soil, and is thus again furnished to the atmosphere as rapidly as it is removed.

The vicissitude of the weather, at any place upon the surface of the earth, is almost entirely due to the circumstance of the great mobility of the atmosphere which is thus composed, to its capacity to receive and carry the heat of the sun, and to part with it as readily as it takes it up, and to the fact that it can hold more vapour in quiet suspension when it is warm than when it is cold. The alternating winds, bringing at one time warm, genial air from the more sunny regions towards the south, and at another time cold, chilling blasts from the less sunny north, the inflow of vapour from the warm western ocean, and its deposit as rain when it is cooled over the hill tops and mountains, the fabrication of cloud screens in the higher chill regions of the air, and the arid touch of the air currents that have been long travelling across the broad, dry plains of the Eastern Continent, are all due to these leading conditions. The science of meteorology has arisen out of the necessity for a close systematic study of these manifold conditions, and of the various influences and powers by which they are brought about, modified, and controlled, if any exact and reliable knowledge of weather-vicissitudes is to be attained. On account, however, of the great number of elements which ordinarily combine to produce one single result, and of the unstable and ever-shifting state of the conditions themselves, the work is one of almost unparalleled difficulty and complexity. It is, nevertheless, of great practical moment in human affairs, and it is in process of being carried out by a large number of patient and resolute inquirers, with a considerable measure of success. The meteorological instruments exhibited in Room L of the Loan Collection at South Kensington, very completely and elaborately illustrate the instrumental provision which has been made for the furtherance of the investigation.

The first point, before all else, to which the meteorological inquirer directs his attention is the ever varying density and weight of the air over the place where his observations have to be carried out. The movement of the wind is almost entirely due to the fact that the air is heavier over some parts of the earth than it is at surrounding stations. The consequence of this varying weight is that the heavy air presses the lighter air out of the way, and takes its place. The wind is the heavy air coming in to drive away the light, or it is the light air moving out of the way of the denser and stronger antagonist which is forcing its way in. The entire surface of the earth is thus divided into regions of low and regions of high atmospheric pressure, or low and high pressure areas, as they are technically called; and, as a general rule, there is movement of the wind from the place of low pressure to the place of high pressure. But as the centres of pressure, whether low or high, are themselves drifting rapidly along over the earth, and as the air which is thrown into currents and streams is very elastic and moveable, the flow of the current is almost always more or less of the nature of a revolving and shifting whirl. The movements of the the wind are also most violent and strong around the spot where the antagonistic forces meet, and where the dense air comes into immediate conflict with the light, that is, in the area of low pressure; and at the same time are the most gentle and orderly in the area where the pressure is the most. As heat expands all material substances, air amongst the rest, the light air almost always comes from the warm regions more towards the sunny equator of the earth, and the cold air from the frigid spaces towards the poles. These are all matters of primary moment, which the meteorologist has to deal with in laying the first foundations of his work.

The royal instrument of meteorology which stands in the centre of its armoury of apparatus of investigation is, on this account, the barometer. This is the instrument which is employed, in one or other of its various forms, for measuring the weight of the atmosphere which rests over any given place at the time. Its essential character of construction is simply a bent, horse-shoe shaped tube, placed with the ends upwards, and with one end closed and the other open. Mercury is so introduced into this tube that the heavy liquid metal in one arm is balanced against air in the other. The varying weight of the air is thus counterpoised by a higher or lower column of mercury. The liquid metal is so dense, that a column of thirty inches is equal in weight to an analogous column of air extending above the clouds quite to the summit of the atmosphere, and probably to about 45 miles. The portion of the tube which contains the mercury, it will be observed, is closed at the top, and is emptied entirely of air, or made into a vacuum, in order that the heavy liquid may rise freely into it when pressed up by the weight of the air at the opposite side. The air side of the tube, on the other hand, is left open, in order that the entire column of air, 45 miles high, may be able to press down into it upon the surface of the mercury. As the air column presses upon the open side of the tube with greater or less force, the mercury rises or falls in a corresponding degree in the closed side of the tube, where there is no corresponding air pressure above, and its rise and fall is there marked at the top surface of the mercury in the transparent glass tube, which plays up and down against the measures of a scale.

The barometer which is prepared for the close and delicate work of the observatory, is, however, provided with various contrivances, to enable it to indicate the finest possible changes of air-pressure in the most exact and and reliable way. In this perfected form the instrument is called "the standard barometer." In the Loan Collection of the Apparatus at South Kensington, a very complete series of these "standards" is shown, and the series serves very especially to illustrate the perfection of workmanship that is attained in apparatus of this class. The leader of the array of this instrumental muster is an interesting large standard barometer, by Mr. Casella, constructed upon the same principle and form as one which he prepared for the Meterological Observatory at Kew. The tube which contains the mercury is, in this instrument, an inch and a-half in diameter, and the cistern is a square receptacle five inches broad and seven inches long. The cistern of a barometer, it will be understood, is, in effect, merely the representative of the short open end of the bent tube which has been already spoken of. If a tube, closed at one end is filled with mercury, and then inverted with the unclosed end downwards, into a cup full of mercury, the pressure of the air upon the surface of the mercury in the cup, all round the tube, keeps the column up in the tube to its appropriate height. The mercury in the cistern acts as if the lower end of the tube were turned up all round into the form of an open reservoir, instead of being merely bent up into the curve of a horse-shoe. The great central column can be observed in this instrument dipping down into the midst of the square cistern, and the top of the mercury in the cistern can be seen through two small glazed windows opened in its side. It will be noticed that in each of these windows there appears a small wiry point, directed down towards the surface of the mercury. When the instrument is used these points are just brought down until they touch the surface of the mercury in the cistern, by turning a milled head placed at the side of the scale. The scale is then so adjusted that it reads off in inches, and in parts of an inch, the length that is comprised between the two surfaces of the mercury; that, namely, which is contained in the cistern, and that which is up above in the closed inch and a half glass tube. In other words, it shows how high the top surface of the mercurial column is sustained above the lower surface, upon which the atmosphere presses down. There are two scales, one on either side. Of these one scale is divided into inches, and twentieth parts of an inch, the other is dividod into hundred parts of a metre (that is 39·37 inches) or centimetres. The reading on both scales is taken through the instrumentality of a sliding slip of brass, which is termed a vernier, and which enables the smallest divisions of the scale to be again very delicately subdivided, by merely noting which two marks they are which correspond in the contiguous unequal divisions of the vernier and the scale. The inches are, by this ingenious contrivance, virtually subdivided each into 1,000 parts, and practised observers, with good standard instruments, readily read changes of atmosphere pressure, affecting the mercurial column of the barometer only, to this very minute extent. On account of the great weight of the mercury contained in this large instrument, the entire structure stands upon a thick iron pillar, which descends to the floor. But the barometer is capable of being turned round upon this central supporting pillar, so as to bring the ivory points in the cistern and the graduations of the scale into the best position for observing. A thermometer is so placed in front of the instrument that its bulb can be plunged down into the mercury of the cistern, to indicate its temperature, whenever observations are taken, and to enable an allowance to be made for the expansion of the long column of mercury within the tube by heat.

The standard barometers, which stand next in point of pretension and size to this leviathan of the race, are what are termed standards " on Fortin's construction." Of these, there are excellent specimens by most of the distinguished makers. One very large and fine instrument, by Negretti and Zambra (No. 2,796*b*), hangs in the large vertical case on the right of the office-door which opens out from the west side of the room, nearly opposite to the case of old astrolabes. No. 2,888*a*, in the same case, is a similar instrument upon a smaller scale, also by Negretti and Zambra, well suited for ordinary observatories. In the side cases, nearly opposite to Sir Isaac Newton's reflecting telescope, are four beautiful specimens of the Fortin form of standard, by Adie, which only differ from each other in matter of size; No. 2,790 is large, with a tube seven-tenths of an inch in diameter, 2,791 is intermediate, 2,794 the same size, and of what is called the Kew pattern, because it hangs from a suspension pivot above, and is made vertical by adjusting screws beneath, instead of the adjusting screws being at the top, as in the other pattern; and 2,792 is of small size, and the very convenient and portable instrument which has been adopted for military service by the War-office. No. 2,809 is a Fortin of Pastorelli's construction. 2,806, one by Elliott, the same size as the medium standard of Adie, but of dark bronzed brass. In all these instruments there is a similar adjustment for the surface of the mercury in the cistern, to the zero of the scale, as in the large standard of Casella, but it is managed in a different way. The mercury is raised or lowered in the cistern, until the surface just touches the ivory point that corresponds with the bottom of the scale, by lifting or dropping the bottom of the cistern, which is formed for the purpose of flexible leather. This operation is practically effected by turning the screw which is seen below. The cistern is a cylindrical vessel of glass, kept in close contact with its bearings by three vertical binding screws. This arrangement of the cistern, which enables the mercury within it to be adjusted to the "fiducial point," marking the zero of the scale by the movement of its own floor, is the peculiarity which distinguishes the Fortin principle of construction. All these instruments are so mounted that they can be made to hang in an absolutely vertical line, by turning adjusting screws, placed either at the bottom or top; they are all read by verniers which discriminate the thousandth part of an inch; they can all be twisted upon the vertical axis, to secure a convenient position for reading; and they all have attached thermometers, to indicate the temperature of the mercury. The thermometers are needed because the brass scales and the column of mercury expand unequally with increase of temperature. With a rise in temperature of from 40 to 60 degrees, a column of mercury expands 54 thousandths of an inch more than a brass scale of the same length. An allowance has therefore to be made for this influence, before the height of the column is noted, and the allowance is different for each different point of temperature, as well as for the extent of the rise or fall. The particular allowance which is required in the case is furnished by tables prepared for the purpose. A small correction has also to be made for the power of the sides of the glass tube to lift up the surface of the mercury, by what is termed capillary attraction, which is greater in small tubes than it is in large ones. These are, collectively, what are termed the "corrections of the barometer," and they have all to be severally attended to, as well as the adjustment of the lower surface of the mercury to the fiducial point, when scientific observations are made.

In another form of the standard barometer, which is known as the "marine pattern," because it is the most convenient and reliable instrument for use on shipboard, and which is also well represented in the Loan Collection, there is no provision for the adjustment of the mercury in the cistern to the fiducial point of the scale. The cistern is contained within an altogether rigid case of metal, into which the air finds its way, to produce its pressure, through minute apertures, that serve to prevent the outflow and escape of the mercury, although they do not exclude the inflow of the rarer and more elastic medium. The correction for the different transverse dimensions of the tube and cistern is therefore made, not by the raising or depressing of the surface of the mercury which receives the air pressure, but in another way. The scale is not divided into true inches, but into parts which contain in themselves the necessary corrections for capacity and capillarity, as well as the parts of the inch. What, however, makes this form of apparatus especially a "marine" instrument, is that the lower portion of the tube between the main column and the cistern, is contracted into a narrow bore, which renders the rise and fall of the mercury so gentle and sluggish that it is not materially affected by the rolling and pitching of a ship at sea. This "marine" instrument is also frequently made with a firm packing of India-rubber round the tube, to prevent it from being broken by the concussion of the firing of heavy ordnance, and it is then called the "gun barometer." The instrument has also the further advantage that it can be very readily carried about from place to place. It only requires to be gently turned upside down, when, after a few minutes, the mercury makes its way through the narrow bore into the tube, and the narrow opening then becomes an efficient safe guard against the spilling of the mercury from abrupt motion. The two forms of this instrument which are supplied to the Meteorological-office, for issue to the navy, by Adie, are shown in the third case from the south of the room L. Both instruments are hung in gymbals, upon a projecting bracket or arm, to allow them free swing, and to secure a constant vertical position on shipboard. No. 2,776 has the compensated scale engraved upon the outside of a tubular metal sheath, surrounding the upper end of the rising and falling column. In No. 2,788 the scale is placed on two inclined brass plates, of which one reminds the observer that "a rise means cold, dry, or less wind; and a fall warm, wet, and more wind." Other excellent specimens of this marine form of barometer, identical in all essential conditions of construction, are placed in one of the smaller detached upright cases, nearly opposite to the reflecting telescope of Sir Isaac Newton, and a little towards the south. Three of these constitute a very interesting series, corresponding with the three Fortins already alluded to by Adie, distinguishable as large, intermediate, and small. No. 2,808 is Pastorelli's marine barometer. In the large case by the office door, 2,796*c* is Negretti and Zambra's marine barometer, with the double flat scale; and near to it is a similar pattern by Adie, both being commendable kinds of the instrument.

In all the barometers by Mr. Adie which have been alluded to, a contrivance, which he terms a "pipette," for the preservation of the vacuum, has been introduced into the tube. It is a modified and improved form of a plan originally conceived by Gay Lussac, and consists of a kind of funnel of glass, with a minute orifice to its pipe, so introduced in the middle course of the tube as to intercept there any stray trace of air that finds its way into the tube, between the mercury and the inner surface of the glass, instead of its being allowed to ascend to the top of the column, where it would impair the vacuum. A similar arrangement has been adopted by other makers, but the plan is especially insisted upon as an indispensable feature of construction by Mr. Adie.

In the same large case by the office door, is a barometer by Pastorelli (No. 2,787), which is not designed for sea use, but in which the closed cistern below, without fiducial point adjustment, and the compensated scale of the marine pattern, are adopted. The instrument is intended for cadet service in colleges and schools, and not for the sea, and is especially fit for this particular purpose, on account of the absence of the adjusting cistern screw, which may be so easily tampered with and deranged by inexperienced fingers, and of its not requiring the tedious process of capacity correction by figures when it is employed. Near to this instrument is the still more simple form of barometer of Hick's, possessing the same recommendations, which has been adopted as a weather-glass, for fishery stations on the coast, by the Meteorological department of the Board of Trade, and is issued to them by the Meteorological-office. This is mounted upon a wooden slab.

In this case there is also a very ingenious piece of apparatus by Negretti and Zambra, which is deserving of notice. The instrument (No. 2,796*a*) is a standard, resembling Fortin's in the general arrangement of its parts, but the adjustment of the lower surface of the mercury to the zero point of the scale is managed in a very captivating and luxurious way. The scale is carried down by the turning of a screw, until a metal point comes in contact with the surface of the mercury, when immediately a current of electricity passes through the column, from a battery to an electro-magnetic coil, and an index-hand hanging on the front of the barometer is twitched to indicate the fact that the scale is duly adjusted. By this contrivance the need to watch the fiducial point in the cistern, whilst raising or depressing the mercury in it, a delicate and somewhat tedious process at all times, is avoided. The instrument also has the further recommendation of the very clever contrivance of making the screw which lifts and drops the scale perform the vernier's work. The milled head of this screw is graduated into 120 divisions, so that the exact height of the column, from the lower surface sustaining the air pressure, can be at once measured to the value of these divisions. If the turn of the screw raised or depressed the scale to the extent of one-tenth of an inch, one of the divisions would indicate a change of the twelve hundredth of an inch. No. 2,796*f*, hung near to the electrically adjusting instrument, is a somewhat notable French standard barometer, by Tounelot; in which the peculiarity is a cylindrical cistern of very large diameter, intended to make the difference of area in the cistern and column more marked, in order that the chance of error in the correction for capacity may be lessened. This instrument is supported on a tripod stand when in action.

The barometers designed for use on great elevations above the sea, and therefore distinguished as "mountain barometers," are contained in a small upright case, standing nearly opposite to the three reflecting telescopes of Sir William Herschel No. 2,796, by Adie, may be taken as a good specimen of the typical form of this group. It, is what is called the "Gay Lussac" mountain barometer. Its characteristic peculiarity is that the tube is in reality an inverted syphon, or turned up arch, with one long and one short leg. The long leg is inclosed at the top and contains the column of mercury with the vacuum above. The short leg is open, and sustains the pressure of the air. In this instance no adjustment of either the scale or the mercury is required. Both the upper and lower surfaces of the liquid metal are read off upon the same scale by separate verniers, and the difference of these two distinct readings is taken for the length of the mercurial column intervening between the levels of the two surfaces. This instrument is perhaps the most perfect of all the different forms of barometers in principle. The only objection that is attendant upon its use is the necessity of taking two readings instead of one, in order that this difference of level may be found. The instrument is exceedingly light, as it has no cistern, and when it is about to be carried from one place to another, it only needs to be turned upside down. The mercury then all runs into the long tube of the syphon, and rests securely upon its glass end until the instrument is again set up for use. The Gay Lussac barometer is, for these reasons, supereminently the instrument of travellers who are engaged in scientific research in mountain regions, and indeed may be strongly recommended to every one to whom the necessity for a double reading does not seem a serious disadvantage. Apart from the question of trouble, the reading above and below is certainly the most exact and satisfactory of all the expedients for getting the true length of the mercurial column that is sustained by the air. Adie's mountain barometer is perhaps the most finished specimen of the Gay Lussac instruments in the collection, and is good at all points as a standard barometer for travellers. A more satisfactory instrument for purposes of scientific investigation in travelling can scarcely be required. No. 2,799, contained in one of the larger vertical cases, is an interesting illustration of the form in which this instrument was used by the distinguished traveller, De Saussure, during his excursions amongst the high Alps. The barometer is contained in a light wooden case, convenient for its safe transport, and is fitted with an ivory tap for opening and closing the short arm of the syphon, according as the instrument is in or out of use; it has also an ivory cup and plug above the tap, for the introduction of the mercury into the tube.

Mr. Symons exhibits two other old specimens of mountain barometers, in wooden cases (2,807*c*). No. 2,808*a*, in the same small vertical case as the Adie Gay Lussac, and catalogued as a mountain barometer by Pastorelli, is also a very excellent form for travellers. It, however, is not a barometer with a syphon tube. It has a cistern, and is essentially of the same general construction as the marine barometers, but with a cistern and scale that allow a very much larger range of depression of the mercurial column than the instruments which are intended for the sea level, or for places not more than a few hundred feet high. It, nevertheless, weighs only one pound and a half, and must be more convenient in use on account of its single reading, and more safe for rough transport than the syphons. Mr. Pastorelli recommends this instrument for the service of surveyors and engineers, in the place of the aneroid. It will be understood that all barometers of this class that have closed cisterns and no fiducial-point adjustment, must either have the corrected divisions on the scale, like those which are adopted in the Board of Trade marine barometer, or the corresponding correction for the difference of the size of the cistern and of the tube must be made by calculation and allowance. Thus, if the area of the cistern be larger than that of the column in the closed tube by 42 times, a forty-second part of the entire height of the column, from the cistern-level of the mercury, must be added to the reading when that reading is above what is marked as the neutral point of the instrument, and must be deducted from it when that reading is below the neutral point. This is what is termed the "capacity correction." The relative capacities of the cistern and column, and the position of the neutral point of the scale, are marked in all good barometers that are not made with the fiducial-point adjustment for capacity.

In the large case near the office-door, Captain George, of the Royal Geographical Society's Map Department, exhibits a practical suggestion for turning the flank of the difficulty of transport in regard to travellers' barometers. He purposes always to empty the tube of the barometer when not in use, and to charge it with the mercury whenever it is to be brought into activity. In No. 3,029 the cistern itself is turned into a funnel, when the tube has to be filled, and the vacuum in the long tube is secured by the rapid rotation of a spiral cord during the operation of charging, which efficiently brings out all air-bubbles. With this form of instrument, spare tubes, as a provision against accidental breakage, are easily carried.

The Russian barometer (Wild's pattern), of which one specimen, contributed by the Geneva Meteorological Association, is shown in the vertical case nearly opposite to the bust of Galileo, and another specimen, furnished by the Meteorological-office, placed in the third case from the south end of the room, has the aspect of what may be called a "double-barrelled" instrument. It is a syphon barometer read at both surfaces of the mercury, as in the Gay Lussac, but it has also a screw adjustment below, which enables the mercury to be adapted to a particular range in the tube. It is thus a combination of the Gay Lussac and Fortin principles of construction. A key enables the tube to be closed a little way up in the short arm, when the barometer is out of use, and prepared for transport. This is the form of instrument adopted at the observing stations of the Russian Government.

Mr. Casella has yet another form of contrivance for the construction of a very compact portable barometer, capable, nevertheless, of exact scientific work, which is shown in the large case by the office door, and is eminently deserving of notice, on account both of the ingenuity and efficacy of the plan. This instrument (No. 2,809*b*) is aptly called the mercurial pocket standard barometer, and when it is divided into two parts, by the unscrewing of the cistern, it is literally what it professes in that particular to be. When set up for use, it is only 15 inches long, the shortness of the column being due to the fact that it is pressed by the atmosphere against an elastic cushion of imprisoned air, instead of into a vacuum. The pressure of the atmosphere, however, takes place at the top of the long column of mercury, instead of at its base, and the closed air chamber against which the pressure is brought to bear is below in the usual position of the cistern. The great excellence of the instrument, however, consists in the fact that the air is imprisoned in this reservoir at the instant when the observation is about to be taken, and that the amount of the aërial compression is regulated to the utmost precision. When the mercurial cistern is attached, and the instrument about to be used, a screw below is turned until the mercury is driven up from the cistern, first covering and closing the lower end of the otherwise open erect glass tube in which the observation is taken, and then rising higher into the closed air reservoir, until a minute driplet of the mercury is seen to touch the top of a fiducial slip. The air is then so much compressed within the air reservoir that, by its reaction, it lifts the mercury up to a certain extent in the open tube. The mercury is then counterpoised between the pressure of the atmosphere on one hand, and the elastic resistance of the compressed air on the other; but as the pressure of the air is a variable quantity, it rises and falls with its change, and in that way furnishes the barometric indication which is required. The mercury is let down into its cistern after each observation, to allow the external air free access through the central tube into the reservoir, and is then raised again, to produce the compression in the air-chamber, when a fresh observation is required. When, however, the mercury is withdrawn into the cistern, its outlet can be closed, and the cistern itself be unscrewed, and the barometer is then in a state to be carried anywhere, in its two parts, with the utmost facility. The same corrections are applied for varying temperature as those which are used with the Fortin's barometer; but it needs no correction or adjustment for capacity. This instrument is well calculated for the use of travellers, or for those who move much about in foreign lands. It is read by a vernier to hundredths of an inch.

Amongst the simpler and cheaper forms of the barometer which are designed for special service, may be named the pit barometer of the Messrs. Elliott, which is contained in the small vertical case nearly opposite to the three reflecting telescopes of Herschel. This instrument is mounted upon a mahogany slab, and is read upon a scale divided to tenths of an inch without a vernier. It is a very neat and commendable barometer for the purpose for which it is designed. Near to this pit barometer is a German barometer, also on a wooden slab, by Geisler and Son, of Berlin, with the graduations and figures very legibly attached in red colour to the glass tube.

Several notable attempts have been made, from time to time, to render the barometer more sensible, by increasing the scale of the divisions; that is to say, by causing each inch of rise to spread itself out through more than an inch of length. Two old barometers, 3,026 and 2,807, contained in one of the large upright cases near the windows, are of this character. The tube in these instruments is bent diagonally towards the side within a few inches of the top, so that the mercury runs along the inclined way six or seven inches, in rising one inch of perpendicular height. In No. 2,976*f*, contained in the large case near the office door, Messrs. Negretti and Zambra have demonstrated how this object of an elongation of scale may be effected in another way. The short end of a syphon barometer has a narrower tube attached by an impervious joining to its end, and this smaller tube is filled with a light fluid, so that the mercury is pressed up into the closed end of the syphon, by the conjoined weight of this fluid and of the superincumbent air. The result of the arrangement is, that the mercury at the top of the tube ranges through six or seven inches with each change of atmospheric pressure that in the ordinary arrangement would lift the column one inch, and that changes of one hundreth of an inch can be easily read without the intervention of the vernier. In the Howson long range barometer of the same makers (No. 2,796*e*) contained in the same case, which in external form resembles a large edition of the fishery barometer of the Meterological-office, a similar result of greatly lengthened scale is secured in a yet more ingenious way. In this instrument the cistern contains a long, slender, erect tube, rising up from the middle of its floor, and thrust into the the midst of tall mercurial column, to some three-quarters the height of the barometer. In this state of affairs the cistern itself is supported by the outer pressure of the atmosphere, as well as the mercurial column, and rises and falls with it on its own account. The changed reading of the top of the column is therefore due to the double rise or fall, first of the mercury itself, and then of the glass tube projected up from the equipoised cistern, and is augmented to the extent of the twofold influence which is brought to bear. Precisely the same result is secured in this instrument as with the one last mentioned. A range of the mercury under changing atmospheric pressure is provided, which can be read without a vernier to the hundredth of an inch. This instrument is very sensitive and exact, and is recommended as a domestic or fishery weather glass, on account of the facility with which small changes of pressure can be marked without the intervention of the vernier. A much more notable attempt in the same direction of lengthening out the space through which the counterposed column is raised under any given change of the atmospheric pressure is, however, shown in what is termed the glycerine barometer (2,804) placed on the staircase, at the south end of the gallery, and in which the problem seems to have been quite effectively solved. In this instance a column of glycerine, a liquid which is about one-tenth part of the density of mercury, is sustained in a glass tube by the pressure of the atmosphere, instead of a column of mercury, and the column is thus many feet long instead of many inches. The glass tube which shows the top of the column, and its oscillations, is joined below to a flexible gas-pipe, which goes down the well of the staircase to a large glass reservoir on the basement floor, and there has its open end plunged into a bath of glycerine, covered by a layer of paraffin oil, to prevent moisture being taken into it from the air. The specific gravity of the glycerine is 1·26. The glass tube at the top, where the indications of rise and fall are given, has an area of one square inch, and the area of the cistern is 100 square inches. The tube is filled, in the first instance, by a very ingenious plan. There is a stopcock below in the cistern. This having been closed, glycerine is poured in through a stoppered cap at the top. The tube having been in this way filled to the brim, the stopper is firmly fixed into the open orifice above, and the stopcock below is turned. The glycerine then runs down into the cistern, but only until it reaches the height at which it is balanced in the tube by the pressure of the atmosphere upon the large open surface below. There is then a vacuum in the top of the closed tube above the glycerine, and the barometer is formed. The top of the glycerine moves up and down in the tube, as the pressure of the air is greater or less upon the liquid in the reservoir below. The vacuum at the top of the tube is fairly good, because glycerine only boils at 420° of Fahrenheit, instead of at 212°, at which water is thrown into ebullition. Water under the same circumstances would fill the top of the tube with vapour, which would seriously embarrass the rise and fall of the liquid beneath. The average height at which the column of glycerine is sustained above the level of the cistern is 27 feet. When the mercurial barometer stands at 29·75 inches, the glycerine barometer stands at 321 inches. A change of a tenth of an inch of mercury corresponds to a change of an inch of the glycerine. The instrument is furnished with two scales, one having true inches engraved upon it, and the other the divisions which correspond to an inch of mercury and its fractional parts. As the cistern has an area one hundred times that of the top of the column, the correction for capacity is, therefore, one inch for every hundred inches of the column in the tube. This barometer is contributed to the collection by its inventor, Mr. Jordan, of the *Mining Record* office.

It is obviously important that the barometer should be made capable of registering its own fluctuations in large public observatories, where continuous records, or records at very brief intervals, are required. No. 2,892, the old barograph which was for a long time in use at the observatory at Kew, and now stands in a prominent position in front of the windows towards the south end of Room L, shows how this desirable object was accomplished in the first instance by the aid of photography. In this instrument, which is presumed to be used in a dark room, the light of a lamp is thrown through a lens and a fine slit in a metal shield, across the top of the mercurial column of the barometer; it then passes again through a lens, and through a somewhat wider slit at the far end of a square tube, where it is received upon a sensitive daguerreotype plate drawn slowly across its path. A photographic stain is then left at the part of the slip which corresponds to the free space above the mercury. Below this, the mercury of the column intercepts the light, and the photographic plate remains unchanged. As the mercury of the barometer rises and falls, the stained track left upon the plate rises and falls in precisely the same degree. The outline of the stained track, therefore, very exactly represents the fluctuations of the barometer. It will be observed that the barometer itself is carried upon a kind of gridiron of steel and zinc rods. This is so arranged as to furnish the compensation for changing temperature. A similar plan is still in use for registering photographically the fluctuations of the barometer at the observatory at Greenwich, but the record is made upon a revolving drum covered with sensitive paper, and placed vertically, instead of upon the sliding daguerreotype plate.

Kreil's barograph (No. 2,800*a*) standing in the same range of instruments with the Kew barograph, but a little further towards the north, represents one of the contrivances by which the fluctuation of the barometric column is registered mechanically. A float, resting on the mercury in the open end of the barometer tube, rises and falls with the mercury there, as it moves up and down with the changing weight of the atmosphere. The float is attached by a rod to the lever, which has a long projecting arm carrying a pencil. Every five minutes a pin upon a revolving clock face causes the lever and pencil to start, and make a dot upon a paper arranged to receive the impression. Each dot is higher or lower upon the paper, just as the mercury in the tube of the barometer is higher or lower. In Milne's barograph (No. 2,789*a*) the pencil fixed on the long arm of the lever, which is lifted up and down in a similar way by the rising and falling of the float in the open end of the tube, is held near to a sheet of paper ruled by horozontal lines, so that it can be struck against the paper and caused to make a mark upon it by a hammer moved at regular intervals by a clock. The most perfect and notable instrument of this class is, however, Negretti and Zambra's "self registering mercurial barometer," which is fixed upon one of the iron pillars in the same part of the room, looking towards the windows. In this very ingenious and beautifully-finished instrument, an ivory float rests upon the mercury in the open end of the tube of a syphon barometer, and, as it is lifted or depressed, drops or raises a small brass block by means of a cord carried from the float, up and over a wheel, and then down to the block. The block is steadied as it moves up and down on a sliding rod, and it carries a pencil whose points rests against a paper-covered drum, which is marked off into hours of time by vertical lines, and into parts of an inch, representing heights of the mercurial column, by horizontal lines. A continuous trace is in this way left upon the paper as the drum is carried round at a regulated rate by clockwork, and this trace is higher or lower as the mercury in the barometer tube falls or rises. The long trace trailing up and down upon the paper in this way, leaves an exact record of the way in which the mercury oscillates up and down, during the twenty-four hours that are occupied by one revolution of the drum.

In one of the large vertical cases there is a somewhat noteworthy Russian barometer, by Gloukhoff, of St. Petersburg, in which a novel arrangement is made for effecting the adjustment of the lower surface of the mercury to the zero point of the scale. Both the mercury and the scale are moved to perfect the adjustment. In the thermo-barometer of Ronketti, contained in the large upright case by the office door, the pressure of the atmosphere is measured against a confined mass of air through a short column of mercury, instead of against a column of mercury moving up freely into vacuous space, the correction required for the varying expansion of the air at different temperatures being supplied by means of a sliding scale, that is shifted up and down against the altitude scale of the barometer. No. 2,821 in the same case is the more ordinary form of "sympiesometer," an instrument constructed upon the same principle, contributed by Mr. Pastorelli. In this form of apparatus the liquid which gives indications of the varying pressure of the atmosphere is driven up against a confined volume of air imprisoned in the top of the tube, and the compensation for the different bulk which the confined air has at different temperatures is made through the intervention of a sliding scale, exactly as in Ronketti's thermo-barometer. This compact instrument is very sensitive, and gives good results when properly made, but it is obviously a piece of apparatus that requires careful handling.

Amongst the notabilities of this class Professor Kruezer's compensated barometer deserves to be named. Its peculiarity is a bulbous enlargement at the top of the tube, into which a regulated quantity of air is introduced, and a scale, which is so divided in reference to the elastic resistance of this air, as to give the temperature correction at once from the mere inspection of the column of mercury.

The most important of the varieties of this fundamental instrument of meteorological science, which are contained in the collection, have been named in the notice. A few instruments only, such as Wanke's self-registering barometer, an instrument apparently of very elaborate contrivance and finished construction have been omitted on account of the difficulty, in the absence of any adequate description, of comprehending the purpose and plan of their mechanism, and two or three notabilities, like Mr. Brooke's automatic self-registering barometer and magnetometer, which are contained in the catalogue, have not been alluded to, only because they have become lost in some undiscoverable nook of the vast collection. Unavoidable omissions of this class are, however, of less importance than they would otherwise be, because they are not irreparable. Future opportunities may easily be found for drawing attention to objects of this class, if further consideration suggests that it is desirable to do so.

WORKS OF ART IN FRANCE.

The Minister of Public Instruction and of Fine Arts in France has commenced a work which will be hailed with welcome by many. It is called a "General Inventory of the Riches of Art in France," which, however, is a misnomer; it is an inventory of "French Works of Art in the Civil and Religious Monuments" of the country, as given in the official announcement.

It is to include all the paintings, frescoes, tapestry, sculpture, bas reliefs, enamels, miniatures, cameos, engravings, medals, drawings, &c., in all the churches, museums, libraries, hôtels de ville, and palaces containing anything deserving of note; and, by way of introduction, the style, the age, and the successive designations or employment of each building noted. The work is to consist of two series, which are to be published simultaneously, one treating of Paris, and the other of the provinces.

Besides the value of such an inventory in itself, the commission appointed to carry out the work has carefully considered the best modes of supplying the information required by artists and the public, and having drawn up a series of rules in accordance with which all inventories will be drawn up, it is to hoped that this will have the effect of teaching travellers, catalogue makers, writers of guides, &c., to put some order in their works, and thus save readers much trouble and disappointment. The commission includes the Marquis de Chennevières, Director of Beaux Arts, President; M. Reiset, Director of the Public Museums, Vice-President, and many of the chief officers of the various museums and libraries of Paris and Versailles. The members of the commission will themselves draw up most of the monographs, which together will make up the work, and will revise the rest.

Three numbers of the work have already appeared, dealing with the Church of Saint Germain l'Auxerrois, the Palace of Archives, and the Versailles library, and a dozen more are in the press.

The following extract will exhibit the mode of execution of the work:—

Church of St. Germain l'Auxerrois.

Transept.

Coté Gauche.—Porte du presbytère. Le tympan est occupé par un vitrail—" Saint Vincent, Martyr."

Dans la voussure du tympan—"Isaïe et Jeremie." Peintures sur mur.—Signè, T. Vauchelet, 1866. Isaïe est à gauche, robe blanche, manteau rouge. Jérémie est à droite, robe verte, manteau jaune.

Coté droit.—Sur l'aire du transept. Un bénitier à trois faces surmonté d'un groupe de—"Trois Enfants au pied de la croix." Marbre; h. 1 m.—Signé, Jouffroy et Madame de Lamartine, 1844.

Paroi de gauche. Au-dessus de l'arcade du bas côte:—Un Cadran entouré de deux anges dévelloppant une banderole sur laquelle on lit—" Vigilate, quia nesciti diem neque horam." Peinture sur mur, par Guichard 1855.

" L'Adoration des Mages." — Peinture sur murs h. 5 m., l. 2 m.; par M. Guichard, 1845. A droite, au premier plan, la Vierge assise, robe rose, manteau bleu, tient l'Enfant Jésus debout sur ses genoux. Derrière elle, Saint Joseph. Devant elle les trois Mages, dont un est agenouillé. Dans le ciel, des anges tenant des palmes et jetant des fleurs.

Porte du sud. Le tympan est occupé par un vitrail—" Saint Germain, Martyr."

Dans la voussure du tympan:—" Daniel, Ézéchiel." Peintures sur mur.—Signé, Vauchelet, 1865. Daniel est à gauche, robe jaune, manteau bleu. Ézéchiel est à droite, robe jaune, manteau vert.

Paroi de droite:—" La Descente de Croix." Peinture sur mur; h. 4 m. 25 c., l. 3 m.; par M. Guichard. Au fond, au second plan, Jésus-Christ descendu de la croix, soutenu par les disciples. Au premier plan, à gauche, la sainte Vierge dans les bras des sainte femmes. A droite, la Madeleine, agenouillée, soutenue par une femme. Derrière elle, Saint Jean.

La composition est encadrée par une bordure contenant six médaillons:—Esdras, Moïse, David, Saint Grégoire, Saint Pierre, Saint Paul.

Nave.

Le banc d'œuvre en bois sculpté est en forme de dais. Sur deux colonnes accouplées deux anges soutiennent un baldaquin figurant des draperies fleurdelisées. Les panneaux du dossier sont à jour. Cette œuvre de menuiserie fut faite en 1684, sur les dessins de Lebrun, par François Mercier, maître menuisier.

Bas Coté Gauche.—Dans le tympan de la fausse porte, un vitrail:—" Saint Grégoire, Charlemagne, Pépin, en pied; saint Gélase, saint Célestin, et saint Pierre, en buste." Par Maréchal (de Metz).

1. Chapelle de Saint-Michel servant de fonts baptismaux.—Paroi de gauche:—" L'Ange de la Rédemption." Statue marbre.—Signé, Capellaro, 1865. Il a les bras croisés sur la poitrine et les ailes étendues sur les bras de la croix. Paroi du fond. Vitrail:—" Le Baptême de Jésus-Christ entre deux anges."—Signé, Maréchal et Gugnon. Metz, 1847.

It is calculated that the inventories will form volumes of about 500 pages yearly till completed, but it should be specially mentioned that there is a double pagination, so that the numbers may be had separately. The work is published by MM. Plou.

ADULT INSTRUCTION THROUGH PUBLIC MUSEUMS.

(*Subsidised by Parliament.*)

The results, giving important information for public education, are obtained as correctly as possible, from inquiry and Parliamentary returns, in the hope that they may hereafter be officially collected and published periodically, like the Registrar-General's returns. Number of visitors for the month of October, 1876. When they are counted by sight the letter "S" is used, when by turnstile the letter "M":—

Institutions.	Amounts voted in 1876.	Number of Visitors in October.	How counted.	Remarks.
	£			
1. British Museum	108,947	32,793 (1)	S	Return refused. Open Mondays, Wednesdays, Fridays, and Saturdays. Closed, except to students, on Tuesdays and Thursdays. (1)
2. National Gallery, Charing-cross	6,898	145,709	S	Open Mondays, Tuesdays, Wednesdays, and Saturdays. Closed on Thursdays, and Fridays. Open from 10 to 4.30. (2)
3. Kew Gardens and Museum	22,622	18,368	S	Open on Sundays and week days. (3)
4. South Kensington Museum	39,058	88,145	M	Open Morning and evening till 10, on Mondays, Tuesdays, and Saturdays. Students' days—Wednesday, Thursday, and Friday, 6d. entrance. (4)
5. Bethnal-green Museum	7,200	133,645	M	Ditto. (5)
6. National Portrait Gallery, South Kensington	2,000	..	M	Return refused. Open daily except Sundays. (6)
7. School of Mines and Mining Record Office, Geological Museum, Jermyn-street	8,947	3,000	M	Open daily, except Sundays and Fridays, and in the evenings till 10 of Monday, Tuesday, and Saturday. (7)
8. Patent Office Museum, South Kensington	..	20,746	M	Open daily, except Sundays. (8)
9. Edinburgh National Gallery	2,100	5,146	M	(9)
10. Edinburgh Museum of Antiquities	..	5,118	M	(10)
11. Edinburgh Museum of Science and Art	10,320	27,742	M	Open daily (10 a.m. to 4 p.m.) except Sundays, and Friday and Saturday evenings (6 to 9). Students' days—Monday, Tuesday, and Thursday; admission 6d.; other days, admission free. (11)
12. Edinburgh Botanic Gardens	1,750	4,255	M	(12)
13. Dublin Museum of Natural History	1,742	9,198	M	Open daily, and in the evening. (13)
14. Glasnevin Botanical Gardens and Museum	2,224	15,192	M	Open daily, including Sundays. (14)
15. National Gallery of Ireland	2,339	.. (15)	M	
16. Museum of Royal Irish Academy, Dublin	300	..	M	(16)
17. Zoological Gardens, Dublin	500	6,555	M	Open daily, including Sundays. Number of visitors in July, 15,281. (17)
18. Tower of London	1,590	27,153	S	Open daily, except Sundays. (18)
19. Royal Naval College, including Greenwich Painted Hall	38,051	23,919	S	Open daily, including Sundays. (19)
20. Royal Naval Museum, Greenwich	1,055	3,848	S	Open daily, except Fridays & Saturdays. (20)
21. India Museum, South Kensington	..	4,756	M	Paid for by Indian Government. Open on Mondays, Tuesdays, Fridays, and Saturdays, 1d. admission; on Wednesday and Thursday, 6d. admission. (21)
22. Hampton Court Palace	7,475	..	..	Open on Sundays, and on week days except Fridays. (22)

(1) The numbers are those for the corresponding months of last year, as given in the Parliamentary return.
(9) (10) (12) (16) No information as to opening.
(15) Gallery closed.

An automatic break for perambulators and similar vehicles has recently been patented by Mr. C. Ingray. The object of the invention is to put on the break and lock the wheels whenever the vehicle is left to itself, and is not being pushed by the hand. The break consists of a sliding bolt carried by a short arm fitted to the axle, and by means of a spring, pressed into any one of a number of slots in a disc fixed on the nave of the wheel. The bolt is withdrawn by a line attached to a plate on the handle, so arranged that the pressure of the hand in pushing forward the vehicle, depresses the plate, and acting through the line, withdraws the bolt. When the hand is removed the spring is set free, and pushes the bolt into one of the slots on the disc.

DOMESTIC ECONOMY.

At a meeting held at the Public Library, at Watford, on 7th November, Sir Henry Cole made the following observations on this subject, which the Society has appointed a committee to promote:—

"The Education Department in its wisdom has inserted domestic economy in the Code. Young ladies will never be married if they don't study it, and those who are married will never make their husbands comfortable and happy if they don't encourage it. Lord Sandon, the Vice-President of the Committee of Council on Education, announced two years ago that domestic economy was to form a part of primary education, and he took credit to the Government for introducing it, which I think the Government greatly deserved. Domestic economy is in the Code defined to give a knowledge of several things—first, food and cookery. You cannot do without food, and you would be no better than Esquimaux if you do not know how to cook it. It is also to give a knowledge of the laws of health—to do without doctors, although you have such admirable doctors on your committee. The next subject is 'The dwelling, its heating and ventilation.' What a deal of science there is in that—it is a subject which puzzles everybody to this day. You don't know how to get the house cool when it is hot, or hot when it is cold. The next subject is 'cleanliness,' washing, washing materials, and all that. You know somebody was asked what is the evidence of the civilisation of the people, and one answer was, 'Why, printing,' and somebody else guessed at something else. At last somebody said, 'The real evidence of the civilisation of the people is the amount of soap used.' Another subject under the head of domestic economy is cottage economy and thrift—not to spend more money than you have, not to get into debt, to economise all your resources, save up your money for a rainy day, and not to go to the workhouse—all of which are worth consideration and practice. It seems to me that this embraces the sciences in which all the people of this country should be instructed. The Government has proclaimed that the people are to know this domestic economy. As practical subjects affecting the daily welfare of the people they rank in my opinion as more important than even the three R's. Good food is more necessary than reading. I think you must eat food before you begin to read. A clean and healthy home is more necessary than writing, and I consider that practical thrift is more necessary than decimal fractions. Our ancestors without public education practised them. We must all have known some poor old body who kept her cottage a model of cleanliness, but did not get into debt, and kept her husband sober, notwithstanding he might sometimes have had a glass of beer. I do not undervalue reading, writing, and spelling, but I think the other things more important. Never did a Government proclaim a policy in education more valuable than the necessity of knowing what domestic economy is; but I regret to say it has been left as a theory only, and no practical steps have been taken to make the words a reality. There are no text-books suitable for elementary schools, and the Department has not cared to stimulate the production of any. The subject is not named in the table of qualifications of pupil teachers in training colleges. Not even an individual has been charged with the direct responsibility of seeing if the subject is in motion at all. The Central Executive of the Education Department has more than enough to do to direct and control the annual expenditure of two millions of pounds for elementary education. It has no force to spare for special subjects. The inspectorial power has been constituted under old traditions, and the inspectors are chiefly University men. The Universities themselves have not hitherto much cultivated the sciences involved in the knowledge of health, food, or domestic economy. Such knowledge carries no degrees; it gives no fellowships. Many inspectors are not even qualified by marriage to know anything of domestic economy. The inspectors are but mortals, and each acts according to his temperament. They have no responsibility whatever to urge schools to study these subjects, yet as being virtually the distributors of the grants they have a kind of omnipotence in directing what should be done. No specimens of any examination papers which the inspectors might use have been issued by the Department, no advice telling schools what to do. For two years the code has nominally encouraged these subjects by offers of grants, but the results, as shown by 'my Lords'' last report, appears to be *nil.* They report that five female students in all the training colleges were examined by the Science and Art Department in biology, but not a single one in health. Three hundred and ninety-six were examined in French, not one is reported as having passed in food! Eight examined in German, but not one in domestic thrift! It cannot be doubted that my Lords must desire to see domestic economy a success, but it will never become so until, as a first step, at least five special examiners or inspectors are appointed to foster and inspect instruction in laws of health, food, and cookery, clothing and its materials, the dwelling, and household thrift. You know that Parliament, in blind faith, has voted grants of 4s. a head for every student—every girl. They limit it to girls; a boy is not supposed to have any need of thrift. But I cannot make out that ever a single penny has been paid for such knowledge. When the public mind is sufficiently alive to the value of domestic economy and the value of the Parliamentary grants, Parliament itself will move, and then the subject, which has been talked about in Blue-books since 1849, will be effectively administered. In the meantime, let me tell you, as is the custom of the country if it does not find the Government doing its work, some private institutions have taken the matter up, though their abilities are poor when compared with Parliamentary money. The National Training School for Cookery has been established. I am also happy to say that Watford-heath is one of those few places in the whole United Kingdom which has started a practical school for cookery. It is some distance from here, and I could wish that Watford, in the town itself, taught the principles of cookery. There is scarcely a single lady, young or old—there are such things as old ladies—that might not be much benefited by attending to this matter of cookery, and if you think it worth while, you have only to apply to the Rev. Newton Price, who has already done the work at Watford-heath, and will show you how to do it in Watford. Before to-day I have not had a personal acquaintance with him, yet I inferred from his handwriting and the style of his letters that he is that sort of man who, if he begins a thing, manages to get it accomplished. I recommend the ladies all to place themselves at the feet of Mr. Newton Price, in a deputation headed by Mrs. Newton Price, and let them become good cooks. Then we have the Baroness Burdett Coutt's Institute, promoting an institution for teaching needlework; and the Society of Arts—a sort of society which pokes its nose into everything—has appointed a standing committee to watch the subject of Domestic Economy in general. Well, this subject of cookery, it seems, is not altogether in favour with the inspector who looks after the Greek and Latin in this neighbourhood. He does not like cookery. Perhaps he is an anchorite, perhaps a vegetarian—he does not know what a good dinner is. I pity him. I find from a printed document that the only difficulty which the Watford - heath School has had to face is the Government inspector. A more favourable official regard may be hoped for at some time in the future. But I must say that there are some inspectors who do know something about what cookery is. I find in the annual report before Parliament that the inspectors who look after Shrewsbury do. The committee there say, 'The scheme of cookery meets the warm approbation of the Rev. B. Temple and of J.

C. Colvill, Esq., Her Majesty's Inspectors of Schools for this district.' It is right to say you may have got an exceptional inspector for Watford-heath, and I hope he will be changed and cookery prosper under his successor some day."

CORRESPONDENCE.

COFFEE-LEAF TEA.

On reading the letter of your correspondent, "J. F. D.," dated November the 7th, on "Coffee-leaf Tea," I procured a small quantity of the leaves of a coffee-tree growing in the Crystal Palace. These I dried on a steel plate before a brisk fire, and having broken them up, used them to make tea. The result was disappointing, the decoction having neither strength nor flavour, and being wholly devoid of aromatic properties.

I enclose you specimens of the green and dried leaves I used.—I am, &c., Mary Hooper.

Norwood, November 16, 1876.

I have read with much interest the letter of "J. F. D." on the above subject, in the last number of the *Journal* of the Society, all the more so that being at the present time a director of one company for growing tea, and of two for growing coffee, all in India, and having often, when in India, been on tea and coffee estates, I know well the great effect it would have in the case of coffee if we could find a market for the leaves, and not have to trust entirely to the berry. Anyone who knows both cultivations knows how much more reliable is tea cultivation, because the leaf of the tree is not liable to injury and destruction by storms on one hand, and by extreme heat on the other, as is the case of the coffee tree, above all at the time of blossoming.

Your correspondent hopes that the matter may be found worthy the attention of our Society; so do I, and I would make this suggestion: he says truly that the coffee tree is found in various conservatories in this country, and it is also at Kew and other botanical gardens; if "J. F. D." understands the way in which the leaves are prepared in the Eastern Archipelago, could not the Society get some leaves, have them prepared, and try the infusion at one of our meetings?—I am, &c., William Maitland.

Oriental Club, 15th November, 1876.

NOTICES.

Ordinary Meetings.

Wednesday evenings at eight o'clock. The following arrangements for the meetings before Christmas have been made:—

November 29.—"The Construction of House Drains," by Major-General F. C. Cotton, C.S.I. On this evening Robert Rawlinson, Esq., C.B., will preside.

December 6.—"Street Tramways," by Captain Douglas Galton, R.E., C.B., F.R.S.

December 13.—"A New Process of Printing a Number of Colours at One Impression," by E. Meyerstein, Esq.

December 20.—"The Philadelphia Exhibition," by Professor Archer.

Cantor Lectures.

Monday evenings at eight o'clock. First Course, on "The History of the Art of Coach Building," by George A. Thrupp, Esq.

Lecture II.—November 27.

Carriages of the Middle Ages, and introduction of coaches into England, France, Italy, and Germany. State coaches of the time of Louis XV.

Lecture III.—December 4.

Carriages from 1770 to the present time.

Lecture IV.—December 11.

Ancient and modern travelling, and public carriages of Europe.

Lecture V.—December 18.

Rules of coach building and theories applicable to the carriages of the future.

The Second Course will be on "The Chemistry of Gas Manufacture," by A. Vernon Harcourt, Esq., F.R.S., and the Third Course on "The Connection of Greek and Roman Art with the Teaching of the Classics," by Sidney Colvin, Esq., M.A., Slade Professor of Fine Art at the University of Cambridge.

The First and Second Courses have been arranged with special reference to the Society's Technological Examinations.

Juvenile Lectures.

This Course will consist of Two Lectures, by R. A. Proctor, Esq., F.R.A.S.

Lecture I.—January 3rd.

"The Sun and his Family."

Lecture II.—January 10th.

"Comets, Meteors, and the Stars."

Special tickets will be issued for these lectures.

MEETINGS FOR THE ENSUING WEEK.

Mon. ...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. George A. Thrupp, "The History of the Art of Coach Building." (Lecture II.)
Institute of Surveyors, 12, Great George-street, S.W., 8 p.m. Mr. W. Sturge, "The Rating Act of 1874."
Royal Geographical, 1, Savile-row, W., 8½ p.m. 1. General Stone, Cairo, "Colonel Gordon's Observations on the Nile in the neighbourhood of Albert Nyanza." 2. M. Gessi, "Boat Journey to the South of Albert Nyanza." 3. "Report on the Khedive's Expedition to the Lake Regions." Communicated by the Rev. E. J. Davis, Alexandria.
Medical, 11, Chandos-street, W., 8 p m.
Institute of Actuaries, Somerset-house-terrace. Mr. J. M. Templeton, "Mutual Assurance."
Tues....Women's Education Union (at the House of the Society of Arts), 6 p.m. M. Edmund Andrade, "The Galin-Paris-Chevé Method of Teaching Music." (Lecture III.)
Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Mr. Joseph Lucas, "The Chalk Water System."
Anthropological Institute, 4, St. Martin's-place, W.C. 1. Mr. W. Harper, "The Tribes of British Guiana." 2. Mr. W. J. Knowles, "Classification of Arrow-heads." 3. Mr. W. J. Knowles, "Prehistoric Objects at Portstewart." 4. Mr. A. Humboldt, "The Physical Condition of the Laplanders."
Wed. ...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. Major-General F. C. Cotton, "The Construction of House Drains."
Thur....Antiquaries, Somerset House, W.C., 8½ p.m.
Sat.......Trades' Guild of Learning and National Health Society (at the House of the Society of Arts). 8.30 p.m. Prof. W. H. Corfield, "The Laws of Health." Part I. (Lecture III.)

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,254. Vol. XXV.

FRIDAY, DECEMBER 1, 1876.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

PATENT LAW REFORM.

The following petition has been prepared by order of the Council, for signature by Members of the Society, Members of Institutions in Union with the Society, and others interested in the subject of the Patent Laws. A copy has been sent to the Institutions. Members and others willing to sign it are requested to communicate with the Secretary:—

To the Right Honourable the Lord High Chancellor of Great Britain.

The Humble Petition of the undersigned,

Sheweth,—

That under the provisions of the "Patent-law Amendment Act, 1852," the Lord Chancellor, the Master of the Rolls, and certain Law-officers of the Crown therein named, together with such other persons as her Majesty the Queen should appoint, are made Commissioners of Patents, with full powers as therein specified, to conduct the business of granting Letters Patent for Inventions, and to make regulations for the administration of the Patent-office.

That up to the present time the provisions of the foregoing Act, authorising the appointment of one or more persons as Commissioners of Patents, in addition to the *ex-officio* Commissioners, have not been acted upon; no additional Commissioners, as contemplated by the Act, have been appointed, and thus the whole business of the Patent-office falls upon the *ex-officio* Commissioners, who are already overburdened with other important and heavy duties.

Your memorialists, while admitting that great improvement has been effected by the energy and zeal of those who have been employed in the office, desire respectfully to urge upon your Lordship the importance of acting upon the provisions of the Act of 1852, and carrying it out in its integrity, by appointing such additional Commissioners as are contemplated by the Act.

Your memorialists venture to think that if such additional Commissioners were appointed, duly paid, and made responsible for the effective working of the Patent-law as it at present exists, a large amount of beneficial reform would be obtained, and many of the objections now made, if not all, would be got rid of without any further legislation, at all events for the present.

Your memorialists, therefore, humbly pray your Lordship to cause the provisions of the Act of 1852 to be put into force, by the appointment of one or more additional Commissioners of Patents, to whom might be entrusted the full carrying out of the duties of the office, and who should be responsible for the same, and that no further legislation be attempted until after such Commissioners shall have been appointed, and the system contemplated by the Act administered in its integrity.

NATIONAL TRAINING SCHOOL FOR MUSIC.

A public meeting was held at Bristol on the 15th inst., to promote the establishment of local scholarships at the National Training School for Music. The Mayor of Bristol was in the chair, and there were present, among others, Mr. S. Morley, M.P., and Canon Girdlestone. After some introductory remarks from the Chairman, Mr. Lionel Benson, who represented the Society of Arts, gave an account of the objects and character of the school. Mr. Morley then moved a resolution to the effect—"That this meeting fully concurs in the scheme of the Society of Arts for the formation of a National Training School for Music, and desires that Bristol should assist in the formation of scholarships in connexion therewith." The second resolution was moved by Canon Girdlestone as follows:—"That a committee be formed for the purpose of carrying out the foregoing resolution, and that such committee do consist of the members of the Bristol Musical Festival Society Committee, with power to add to their number." Both resolutions having been duly seconded, were carried unanimously.

The following subscriptions were promised in this room:—

	£	s.	d.	
The Mayor (G. W. Edwards, Esq.)	10	10	0	Annually for five years.
John Hare, Esq.	10	0	0	
C. Thomas, Esq.	2	2	0	

CANTOR LECTURES.

The second lecture of the course by G. A. Thrupp, Esq., on "The History of the Art of Coachbuilding," was delivered on Monday last, the 27th inst.

THIRD ORDINARY MEETING.

Wednesday, Nov. 29th, 1876, Robert Rawlinson, Esq., C.B., in the chair.

The following candidates were proposed for election as members of the Society:—

Brown, Edward, 25, Church-street, Spitalfields, E.
Brunlees, John, 5, Victoria-street, Westminster, S.W.
Coates, George, A.I.C.E., 30, Great George-street, Westminster, S.W.
Frost, Francis Aylmer, J.P., Spring-hill, Reddish, Stockport.
Hooker, John, F.C.S., 104, Upper Thames-street, E.C.
McCarter, James Wilson, Foyle-street, Londonderry.
Meads, Arthur, A.I.C.E., Chelmsford, Essex.
Oetzmann, John Robert Augustus, 67, Hampstead-road, N.W.
Stayton, G. H., C.E., Vestry-hall, Chelsea, S.W.
Swindells, Rupert, A.I.C.E., F.M.S., Old Trafford, Manchester.
Willis-Bund, J., 3, Old-square, Lincoln's-inn, W.C.

The following candidates were ballotted for and duly elected members of the Society:—

Abbott, Arthur Robert, B.A., Grove-house, Tottenham.
Abell, George E., The Cross, Worcester.

Andrew, Frank, Apsley-place, Ashton-under-Lyne.
Bacon, Rev. James, B.D., Warden of St. Thomas's College, Colombo, Ceylon.
Balmer, Peter, Ormskirk.
Barr, William Henry, L.R.C.P., L.R.C.S., L.A.H., Manchester-road, Bury, Lancashire.
Beningfield, T. F., Grafton-cottage, Hornsey-road, Holloway, N.
Benson, James Levett, Ph.D., 115, West-parade, Off Spring-bank, Hull.
Bickerton, Joseph, Alderman, J.P., Oldham
Biddle, Frank, 68, Finchley-road, N.W.
Bird, Richard, F.R.G.S., St. John's, Fulham, S.W.
Blaine, Henry, 2, Cleveland-road, Ealing, W.
Blair, George Young, J.P., Stockton-on-Tees.
Booker, Edward John, Edmonton, Middlesex.
Boulton, William, Aberdeen.
Brereton, Andrew Jones, Mold, Flintshire.
Brooke, Col. John Cheap, Llanidlocs, Montgomeryshire.
Bruce, George Barclay, 2, Westminster-chambers, S.W.
Burbidge, George Thompson, M.C.P., 70, Roman-road, Barnsbury, N.
Burrell, Alexander, 2, Jermyn-street, S.W.
Carrington, William Edward, Cale-green, Stockport.
Chomsai, Prisdany, 40, Sackville-street, W.
Clarke, Henry, Bulmershe-lodge, Erleigh, Reading.
Cotton, William Gordon Lynch, Eton-villa, Shanklin, Isle of Wight.
Denny, Thomas Anthony, 7, Connaught-place, W., and Budingwood, Horsham.
Dering, George Edward, Lockleys, Welwyn, Herts.
Ellis, John Edward, The Park, Nottingham.
Ellis, Richard, 16, Mark-lane, E.C., and 1, The Grove, Hackney, E.
Espinos y Julia, Senor Don Modesto, 2, Seething-lane, E.C.
Feast, A. R., 6, Ingleby-road, Holloway, N.
Feist, Carl Ernest, 26, Crutched Friars, E.C.
Forster, Thomas, Sparrow-hall, Streatham, S.W.
Foulis, William, Engineer's-office, Town-hall, Glasgow.
Galton, Francis, F.R.S., 42, Rutland-gate, S.W.
Gill, Robert, Delia, Sicily.
Glover, Robert Reaveley, 22, Great St. Helen's, E.C., and Allendale, Green-lanes, Finsbury-park.
Gough, Foster, LL.D., Groiseley, Wolverhampton.
Graham, John Cameron, B.Sc. Ballewan, Strathblane, Stirlingshire.
Gray, Matthew, 14, St. John's-park, Blackheath, S.E.
Green, George, Glanton-house, Sydenham-rise, S.E.
Griffiths, Thomas, Silverdale, Oxton, Birkenhead.
Halford, James Valentine, Gothic-house, Queen's-road, Clapham-park, S.W.
Hankey, Ernest A., Elmhyrst, Bickley-park, Kent.
Harris, Lewis, 154, Piccadilly, W., and The Ferns, Maida-hill West, W.
Harte, John, Home-office, Whitehall, S.W.
Haywood, George Harris, 95, Upper Thames-street, E.C., and Rotherham.
Heathcote, Frederick Arthur, 1, Northfield, Ryde, Isle of Wight.
Heys, William E., The Barton Arcade, Manchester.
Hoare, Hamilton Noel, 37, Fleet-street, E.C.
Holmes, Everard Britten, 73, Queen's-crescent, Haverstock-hill, N.W.
Humby, W. R., 48, Little Britain, E.C.
Hunt, E. H., Cheyne-house, Chelsham-road, Clapham, S.W.
Hyde, Colonel, R.E., India-office, S.W.
Jackson, Dr. James R., 15, Pembridge-crescent, Bayswater, W.
Jacques, Walter, 2, Fenchurch-buildings, Fenchurch-street, E.C.
Johnson, Henry Alfred, 67, Lower Thames-street, E.C., and 286, Dalston-lane, Hackney, E.
Jolivet, Eugène Charles, 11, Victoria-terrace, Surbiton.
Jones, George Horatio, 57, Great Russell-street, W.C.
Kuhl, George R., 1, Hanover-street, Hanover-square, W.
Langman, Andrew William Fenton, School of Art, Coalbrookdale, Shropshire.
Leon, Frank Philip, 79, Gloucester-place, Portman-square, W.
Loyd, William Jones, 16, Grosvenor-place, S.W., and Langleybury, Watford.
Mackie, Charles Hastings, 23, Yonge-park, Holloway, N.
McKerrow, Alexander, 5, Victoria-street, Westminster, S.W.
Madocks, John, Warfleet, Dartmouth.
Mann, Godfrey Oates, Atherton-house, Orrell, near Wigan.
Martin, E. B., C.E., Stourbridge.
Moore, John, West Coker, Yeovil.
Morrieson, Colonel Robert, Oriental Club, Hanover-square, W., and 30, Windsor-road, Ealing, W.
Murray, David, Paisley.
Paget, Joseph, J.P., Stuffynwood-hall, Mansfield.
Parker, Arthur James, Shrubbery-lodge, Dulwich, S.E.
Pemberton, Charles Seaton, Grove-house, Hampton, Middlesex.
Porter, John Henderson, Lavenham, Suffolk.
Prince, John S., 25, Savage-gardens, E.C., and 34, Craven-hill-gardens, W.
Reynolds, Frederick W., 73, Southwark-street, S.E., and Sydenham.
Rowland, Frederick Arthur Alexander, 178, Strand, W.C., and Hampton, Middlesex.
Sadler, Thomas, 39, Chester-terrace, Regent's-park, N.W.
Serena, Arthur, 20, Ladbroke-gardens, W.
Smith, Basil Woodd, Branch-hill-lodge, Hampstead-heath, N.W.
Smith, George Fereday, M.A., F.G.S., J.P., Grove-hurst, Tunbridge Wells.
Smith, Henry, 30, Tressillyan-road, St. John's, S.E.
Sterry, William, Union Club, Trafalgar-square, S.W.
Stirling, John Carolus, 79½, Gracechurch-street, E.C.
Sturman, Rev. Mark Cephas Tutet, B.A., T.A.K.C., Heston-house, 54, Talfourd-road, Camberwell, S.E.
Swinburne, Charles Alfred, 4 Upper Hamilton-terrace, St. John's-wood, N.W.
Tanner, Benjamin, 160, North Strand, Dublin.
Thurman, Edward, 6 and 7, Frederick-place, Weymouth, Dorset.
Trathan, James Jenkin, Liskeard, Cornwall.
Turner, Ernest, 44, Bedford-row, W.C.
Vizer, Robert Robinson, 2, Flora-terrace, Albion-road, Stoke Newington, N.
Wallroth, Frederick Anthony, Sunbury-lodge, Sunbury.
Webb, Henry, Redstone-lodge, Redhill.
Wickham, Rev. Edward Charles, Wellington College, Sandhurst, Wokingham.
Williams, Frederick J., B.A., 1, Carlton-place, Cheltenham.
Wise, Alfred, 16, West Kensington-gardens, W.
Wood, James W., Northampton.

And as Honorary Corresponding Members.

Galiano, Señor Don Antonio Alcalá, Governor of the Province of Guadalajara, Spain.
Kramers, Dr. J. G., Delft, Holland.

The Paper read was—

HOUSE DRAINAGE.

By Major-General F. C. Cotton, C.S.I.

The paper I am about to read is not volunteered by me. It is written in furtherance of the effort now being made by the Society of Arts to elicit information on the subject of house-drainage, and to aid in its promulgation, by which it is hoped that the knowledge of this all-important subject may be made more general, and that this extended knowledge may so enhance the value of houses constructed on right principles, that builders will see the importance of being guided in their work by the teachers of sanitary science. Another result of a more general knowledge of the subject will, our Society hopes, be the enactment of better-defined laws for the guidance of those who are entrusted with the public health.

In accepting the duty I have undertaken to-night, I am placing myself in the unfavourable position of addressing at once those who have made the subject of my paper their deepest study, and those who have still to be awakened to its importance, and are in need of the most rudimentary education.

It must, of course, appear to those who have been preaching on the same text for years, that recapitulation of their teaching must be unnecessary. But that this is not the case is proved by the entire disregard of all the first principles of sanitary science shown in the last year, both by the builders and the occupiers of many new houses, and that even in London, from which so much of the teaching emanates.

With this explanation I must crave the indulgence of all the men of sanitary science who are present to-night; begging them to accept my assurance that I do not presume to offer an education to them. What I hope for from their presence is the criticism that will lead to the correction of my paper. And in addition to that, I ask a full and free discussion of the points touched upon, which cannot but make the evening instructive to both sections of the meeting.

Though I shall limit my remarks to-night to the pipes and drains of a house, without entering into the requirements of the main sewer, I shall not, as the notice of my paper would imply, confine myself to the "construction of house drains." I purpose to submit to the Society such a *résumé* of what has been determined in sanitary science as will be a safe and useful guide to those who, having little or no knowledge of the subject themselves, are, nevertheless, aware that pure air is worth having, and that they would, if they could, obtain it.

This much is generally admitted, but there are comparatively few who realise what is the daily loss of health, and consequently of happiness, even by the well-to-do classes, from breathing contaminated air. Everyone, indeed, is ready to admit that the best remedy for the effect of a town life is an occasional visit to the moors or mountains, where the air is so exhilarating that it gives the idea of containing some stimulating principle not to be found in the air of cities; whereas there is nothing intoxicating in the atmosphere of the most favoured regions. It is simply pure, as air ought to be; and so those who breathe it have the health, and vigour, and buoyant spirits that were their birthright.

It is in our houses—more especially in our town houses—that the air is in an abnormal condition, as Dr. May explained the other day to his neighbours at Kensington, who complained of lassitude and debility from the "relaxing climate" of the locality they lived in, that their languor arose from the loss of vital energy, the result of breathing air tainted by gases from their own foul drains.

It is this depressing effect of impure air that accounts for the "nine sinkings" said to be felt by London ladies between their waking hours and bed-time. In this there is no affectation of distress on their part. Follow these ladies in their Highland tour, and you will find them satisfying a healthy appetite by three hearty meals a-day, and craving for nothing more.

And if we watch the effect of these depressing gases on the poorer classes, who can have no change of air at any season, we must follow them to the fatal gin-shop, where, poor souls, they find an exhilaration which seems to them worth having, however evanescent, and however fatal in its after-consequences.

I am induced to insist upon this never-ceasing loss of vigour from impure air, as it comes directly home to everyone at all times; since it appears to me that the reports of occasional visitations from typhoid fever or diphtheria only stagger people for the moment, and being too terrible to dwell upon, they do no more to correct the defects in our sanitary system than public executions did to lessen the amount of crime. In the depression that results from living in an impure air, all our functions are crippled, and we have none of that elasticity to throw off disease which we have when in perfect vigour. Like the weakly plant, the blight can take possession of us unresisted. This is admitted in a way, but it is not fully recognised; or the great effort, both of rich and poor, would be to purchase the purest air that could be bought, according to their means, looking to sanitary laws as the only safeguard in the artificial life they are leading.

There is no doubt that some of our first efforts at refinement did anything but place us in a better sanitary condition, notably the introduction of closed sewers, and the closet in direct communication with them, which led to evils that are still only in progress of correction. Indeed, it is almost exclusively this refinement that affords us the subject we are to discuss to-night. On the other hand, giving them up would throw us back to barbarism.

When the danger arising from this was first looked into early in the century, it became apparent that some alteration was necessary in the sewers, for they carried off the waste so slowly and uncertainly that they virtually distilled the decomposing mass, and returned all that was poisonous in a gaseous form, most difficult to deal with.

We are indebted to Mr. Roe for the first effort to correct this, by altering the form of the sewer, so that a much smaller quantity flowing would have velocity sufficient to keep the passage clear. This was a most important step, and led to what was done immediately afterwards by Mr. Edwin Chadwick, who, realising fully the danger of allowing the sewage to decompose within reach of inhabited places, devoted his wonderful energy to convince the world that the only safety was in expediting its passage from its source in the house to its outlet in the air, wherever that might be done without fear of further mischief. In his investigations, that great reformer convinced himself that, under a perfect system of drainage, the sewerage of all London might be put out of harm's way before it began to liberate its gases. Whether this was attainable or not, it led to an entire change in our whole drainage system, the importance of which cannot be over-estimated.

I am sure I shall be forgiven if I occupy the meeting for a few moments, while I mention the services rendered by Mr. Edwin Chadwick, who, most unfortunately, is, by a rule of our Society, absent from the Council this year, when one of his own special subjects will be frequently under consideration; and I must at the same time express regret that we are, from the same cause, deprived of the advice in our Council of Mr. Robert Rawlinson, whose guidance would have been invaluable.

Mr. Chadwick was not by profession an engineer, and he had the difficulty to contend with of the country not being educated up to his mark. No Government can go far a-head of the people's education, so our great sanitary reformer was a difficulty to the Ministers of the day. Even the engineers could not take up his views, one eminent man of that profession having been heard to say, in irony, "Chadwick would drain all London through a gun-barrel." And although he brought to bear upon his subject thorough knowledge of it, ability of the highest stamp, and enthusiasm that nothing could curb, he had, unfortunately, to leave many important suggestions to be carried out at a later day. It must, however, be no slight satisfaction to him to find an engineer so pre-eminent in sanitary science as Mr. Robert Rawlinson, dedicating to him, as "the chief promoter of modern sanitary works and appliances," a collection of the most able papers and letters ever published on the subject.

Leaving out of account for the present the effect of sewage soaking into the ground, and contaminating the water we may need to draw upon for our use, all that is poisonous from the sewers comes to us in the shape of gas. This is produced by the organic waste from our houses being decomposed, the decomposition being aided by the addition of water, and expedited by heat, stillness of the air and stagnation of the fluid mass being highly favourable to this chemical process. Of the exact nature of all the gases evolved in this terrible retort we are not yet aware; and when the complication of the seething mass is considered, the variety of its ingredients, and the different proportion in which they are thrown together, its ever varying temperature affecting the liberation and expansion of the several gases, each according to its own laws, it cannot be expected that, even with the high talent engaged in the research, we shall, for some time to come, unravel its mysteries.

If it were necessary that we should master all this difficulty before we took steps to correct the evil, we might well be disheartened in our investigations; but, thanks to those who have watched the effect of these mixed gases, we have evidence enough that all we do to reduce the per-centage of them in the air, is a clear gain to human life and health.

If there are any still left who pride themselves on having found a seeming paradox or puzzle in the calculations of sanitary science, and would have us wait till it is explained, they are turning their talent to a very poor account, and have not much chance of a patient hearing in the present day.

I have said that all we have to fear is in the gaseous state; we cannot prevent decomposition liberating the elements in that form. We must, therefore, do all we can to remove the material from our home as rapidly as possible, by the most suitable means at our disposal, the vehicle for the present used being water; which, although it affords an extremely cheap carriage, and is very convenient for our purpose, is, nevertheless, not without its danger. Water in certain quantities aids in the decomposition of our refuse, and supplies some of the ingredients of the noxious gases that we dread. Great efforts have, therefore, been made to avoid the use of water, and several so-called dry systems have been introduced and tried, in some localities with success; but I need not now enumerate them, as they are foreign to our purpose to-night. We may, however, wish their promoters God-speed, while we make the best of the means now at our disposal, which must, under any circumstance, be in use for many years to come, even though any safer system should eventually be perfected.

I must be allowed to say that there is something very attractive to me in Captain Liernur's idea of everything solid or gaseous being drawn inwards and onwards to a distant vacuum, the solids to be dried and utilised, the rest to be evaporated by fire. But we have nothing to do with this at present; water is our vehicle, and we must so use it that it shall lessen, not increase our danger. To ensure this, the essential is an abundant, and, as far as possible, a constant supply. We will now consider the appliances by which we turn to account this water-carriage, the most important of which are what are usually called the house-drains, those which collect the discharge from all the pipes and convey it into the sewer. In large houses there are often several of these, but, for convenience of description, I will use the singular number.

In detached houses the house-drain may always be led clear of the building, and possibly no house in future will be placed at the disadvantage of having it under the basement. Many old houses have this fault, some no doubt in consequence of the house having been extended over it. In all such cases it would be well to correct this objectionable arrangement at almost any cost, since the danger of the position is extreme.

In houses built in streets this faulty system constantly prevails. It has been the general practice to have the sewer under the street, and as the offices and all that is unsightly lie at the back, the drain of necessity has to be laid under the house. Where the lines of houses are very near together this is unavoidable, but it raises a question whether in building in future this ought to be allowed.

I am no advocate for tyrannical Government; but I think that when the owner of land has to make his choice, whether he shall continue to cultivate it, or raise a crop of houses on it instead, the Government may fairly insist upon his not building at all, if he will not be guided by sanitary laws; and I would undoubtedly define the minimum distance at which lines of houses should be placed, as well as the disposition of the drainage, on which the sanitary condition of the new street will in the future so materially depend.

We have only to consider the nature of the house-drain, and the evils resulting from its being imperfect, to realise the importance of its not being under the house. This vital artery of the system, having to carry the whole refuse of the house, and deposit it in the sewer, will contain two currents, one of fluid and solid matter descending, and one of sewer gas ascending; for it is a neck of the great retort, and will be supplied with gas from it, do what we will to divert it by ventilators along its course, as is now so generally and so advisably arranged for.

The appliance in most frequent use for this drain is a stoneware pipe, which is made in short lengths, necessitating even in small houses very many joints. If these joints and the junction with the sewer and the house-pipes were water-tight and gas-tight, it would matter nothing whether the drain were under the house or not. But if the material fails from any cause, or a joint is broken, the consequences are an escape of either gas, or sewage, or both, that will in time saturate the soil surrounding it. If this takes place when the pipe is clear of the building, it will be detected, and may be comparatively easily corrected. But if the pipe is below the basement, the first cause of suspicion that all is not right may be in the illness or death of an inmate of the house. And as the pipe cannot be examined without taking up the basement floor, its actual condition will never be inquired into by the occupants of the house, unless they possess an amount of energy very unusual.

Back drainage, as it is called, when the drains from the house leads to a sewer at the back, has other important advantages, besides the accessibility of the drain, and the comparatively little mischief it will cause if it is imperfect. It will, in most cases, be shorter by the whole depth of the house, and consequently have a far more rapid fall, while the whole sewer-system can be opened at any time without interfering with the street traffic. This better mode of laying out building land has been adopted here and there, but there are great towns rising all round London, and, indeed, all over England, where the old mode is continued.

I must notice here the mode insisted on by Mr. Rawlinson of laying out house-drains, where curves have hitherto been used. He would have the whole system in straight lines, with manholes at all the angles; by which arrangement the drains can be cleared without being broken up. When the length of any line is great, a man-hole will be made at the spots necessary to bring the whole within reach of those engaged in cleansing it.

We will suppose our drains, then, to be under the house, in considering its requirements, and with reference to the size, return to the principle that guided Mr. Chadwick, namely:—That no drain or pipe intended for the passage of water and its burden should be larger than the maximum it will be called on to convey, without being subjected to undue pressure, in order that a favourable velocity and scour might be ensured, and the surface of the pipe kept as clean as possible thereby. The required size for each pipe will be determined by the supply and the fall that can be given to it, experience having led to the conclusion that it is well to make allowance for house-drains not being more than half-filled with their maximum charge, the fact being that even a pipe of six inches internal diameter will carry all the drainage of a tolerably large house. I mention this only to give a general notion of the size, for the actual size in every case should be decided on the spot by a qualified engineer, who would have all the peculiarities of the site before him. In all designs for house-drains it must be considered that, although we have, as compared with the sewer, only feet instead of miles over which to expedite the current, we must not lose sight of the fact that any material which will decompose may find a lodgment in our pipes, if the stream is not rapid enough to lift it and transport it. The first consideration is, how it can be kept clear, even though the supply of water entering it may not be constant. The essentials will be, a fall that will give a good velocity to the current, even when the depth of the flow is small; the most polished surface that can be obtained, and the best fitting joints, not only to prevent escape but to present no obstacle, however small, to the passing current, lest the detained particles should collect others, and so form a reservoir of the sewage, in which, when there happens to be little or no flow in the pipe, decomposition will take place, and a private distillery of poison will be established on the premises.

Glazed stoneware is a good material, as it is not acted upon chemically by the gas or sewage; and its surface being highly polished, and not capable of being corroded, it will offer less resistane to the fluid than would be the case with either lead or iron.

The objection to stoneware is the difficulty of perfecting the joints, and having them so true as to offer no inpediment. A vast variety of joints, and all sorts of lute and packing, have been suggested, the practical difficulty being to form a perfectly tight joint which is not so rigid that on the slightest movement of the pipe it would cause the ware to break. To obviate this, pipes are very frequently laid, trusting the safety of the joints to a packing of clay, which of all the materials in the world is the most treacherous. My experience, in a long life of engineering, is that clay is unfit for anything but the fire; it is admirable in the hands of the potter, but, unburnt, it is utterly untrustworthy. When wet, it is plastic and adhesive; water-tight, pleasant to work, and satisfactory in appearance, but on drying it shrinks and cracks, loses its hold, and its every characteristic is reversed. A house founded on clay may stand any number of years, and settle in a dry summer after all. A clay puddle-bank has been the cause of the most terrible disasters, and as a lute for joints it may be clay one day and powder the next.

As it would be utterly impossible to do justice, in the selection of the best material or appliance, amongst the numberless clever inventions of the day, I had resolved to offer no opinion upon any; but I am inclined to break that resolution, by recommending a pipe which from the form of its joint, and the perfection of its manufacture, I do consider one of the most valuable additions to sanitary appliances ever brought to light. I allude to Mr. Stanford's joints, as they are made by Messrs. Doulton, which from their spherical form admit of some movement without opening; and by the skill with which they are made are really as perfect as the ground-glass stopper of a phial. It is almost impossible to guard against careless workmanship, but from the rapidity with which these pipes can be laid, and the facility in laying them, particularly where the slope would help to ensure the joints being closed, superintendence of the work is simplified to the utmost, a point of great importance when the sanitary officer, with his many duties, is held responsible.

Whatever pipes are used, they ought to be lodged on concrete, so thick as to secure them against the operations of rats, which never seem to give up the hope that they may undermine a pipe, and when it settles, have access to the luxuries it contains. In the case of pipes being used, the joints of which can not be trusted, I know no way of making them secure, but by imbedding them entirely in concrete. Pipes very inferior to those now used were employed in the old city of Broussa, in Asia Minor, which, thus imbedded, bore a great head of water, supplying fountains in every house. Some of these remain in use to the present day.

When laid, this very important pipe is buried in soil of some sort, the floor is closed over it, and nothing more is known of its condition for any length of time. It is fully admitted that, before this is done, the work should have been inspected by some one deputed to report upon it to the Local Board. But it is urged that, where much building is going on, the Boards have not staff enough to watch the work, so as to be able to say confidently, not only that the design is satisfactory, but that the materials are suitable and good of their kind, and the workmanship faithful. Yet the drain, on which so much depends, may entirely fail if in any one of these points a fault may have been detected.

This brings it to a question as to whether we are to look to local government for security, and pay for it by higher rates, or whether we must take the chance of all being safe below us.

Before we leave the drain we must inquire what has been used to cover it. Is it tolerably free from organic matter that may rot and form gases, independent of the sewer, but, nevertheless, unwholesome? Does any one look into this—either public functionary or the would-be occupant? Certainly not the latter; sanitary knowledge has not yet led to that. And yet the value of the house, as a healthy home, in no slight degree depends upon it.

Our object being to elicit information, I would ask here whether there are still low-lying lands being filled up for houses to be built over; and whether the old system of raising the land economically is still adopted, of merely setting up a black board, with the words on it, "Rubbish may be shot here?" Where land is dear, rubbish cheap, and great interests are involved, have we a local government that will see what this rubbish is that is to be built upon, and prohibit the use of all that is dangerous?

The answer to this will, I am sure, differ as much from all parts of England, as the reading of the Local Management Act differs, by the several officers who were good enough to come to our Conference the other day. Even if the Local Boards have not staff enough to watch the building while in progress, they could, I imagine, prevent so radical a sanitary fault as may result from indifference on this point. In the meantime, I can confidently assert that many miles of houses have, even of late, been built, in which sufficient care has not been taken about the material used for filling in. Even the fine beds of gravel have in many places been injured as sites by this; the gravel has been sold, the sand below it used for the mortar of the house, and anything that came to hand has formed the surroundings of the drain.

It may not be known, by those of my hearers who have not examined such matters, to what extent this may affect a house. The fact is, that our walls are sufficiently open in the centre to form flues for air or gas, and when our fires are lighted in the winter they act as pumps, and very powerful pumps, to draw the air and all that is in it from below the basement to the attic; with a delivery between the ceiling and the floor of every story, where there is neither plaster nor paper to seal it up. If we have a rotting mass below the basement floor, we have a supply of gas in the best possible position for these pumps to draw from. With reference to this, it would be well if every wall had, what some few are built with, a water-tight and air-tight course a little way above the basement, the intention of which is to prevent the damp from rising, this would have a very important effect in this respect. Not that this would save the basement floor from inroad of this gas, but it would in, some measure, check its distribution through the house. If such filthy material as we are speaking of is used, a concrete covering of the whole is essential.

Now that we have so many really able and earnest men watching the builders, as much as their multifarious duties admit of, we may, I hope, feel confident that nothing so infamous will ever occur again as Dr. Whitmore found in Harley-street, where some thirty house-drains had never been led into the sewer, and had been for years pouring their contents into the soil.

But until some system is adopted that will induce builders to make this critical part of a house secure, we can never consider ourselves sure that we have the air of our rooms free from taint, from some flaw or other.

It will be for future consideration whether an extended supervision by the Local Board, or penalties on the builders for negligence, when discovered, certificates by accredited engineers, or any other better means can be devised. All we can do at present is to urge that the subject may not be dropped till it is thoroughly investigated, and the abuse corrected.

The connection of the pipes supplying the house-drain will be defended to a certain degree by one of the many ingenious traps that have been invented for the purpose, on the merits of which I will not venture an opinion. It is well established, now, that the water in any trap will absorb gas, and, if time is allowed, it will pass through it. It is not, in, short, the security it was once supposed to be; but when it is considered that what we are doing is to use every means to divert, exclude, and dilute the gas that is ready to enter the house wherever there is an opening, it is evident that a trap is one of the means not to be neglected where it can have any effect at all, and a well-constructed trap with fresh water passing through it frequently is of very important service, always provided that it does not lead to an accumulation of gas behind it. If it did so, it would do more harm than good, for then, sooner or later, the gas would force its way through in a concentrated and consequently a most poisonous state. Indeed, the whole point seems to turn upon the state of concentration the gas is in; and the sewer engineer is acting on that supposition when he makes an opening every hundred yards, in the hope of the gas escaping in so mild a form that, when mixed with the air, it will be harmless. It would be well if we could ventilate the house-drain as simply, but that would bring us too immediately in contact with the gas, which even in the open street is bad enough at times.

Where the house-drain can be continued to a higher point above the last connection with it, as is sometimes the case on a hill-side, an outlet may be made there for its ventilation on the level of the ground, if there is nothing to be injured by it. But in town houses the highest point or head of the drain will be where the highest pipe from the house enters it. And here the gas must be allowed to escape by a tube carried high up the roof, away from either attic, window, or chimney, lest a draught should draw it into either. If gas would take advantage of such an outlet, and rush up it rapidly at all times, ventilation of the drain by that means would be simple enough, but gas has no such accommodating tendency. It has the peculiar faculty of diffusing itself through the air and within other gases, but it seems to keep its cloud form when not under pressure, and to move with a rotatory motion, a remarkable illustration of which is seen in the cloud-form adopted by steam as soon as it is clear of the funnel of the locomotive.

Without going into the complex nature of gases, of which I am quite incompetent, I only allude to these peculiarities to give some idea of the slow progress gas might be expected to make in diffusing itself along a thin pipe, from which we see the advantage to be derived by the use of a tube of large diameter in ventilation. When the air is at rest, and there is no difference of pressure between that in the sewer and that at the head of the pipe, we shall only have the advantage of this diffusion, greater or less, according to temperature. But anything that alters the pressure in the sewer or drain, will cause another movement in the gas. A sudden gust of wind, entering by the sewer ventilator, may clear the whole pipe in a moment; and if the drain become warmer than the air, there will be a current established upwards. A passing wind across the head of the pipe is found to draw the air or gas out more rapidly; in short, the gas will always be moving in the tube, sometimes very rapidly, and the tendency will generally be in favour of an upward current. We have, therefore, in a simple pipe, a great auxiliary in our effort to get the gas away. A ventilator in that position should never be omitted, and in no case could a pipe of less diameter than four inches, be trusted. Many suggestions have been made to insure a good upward draught in the pipe, which I shall not discuss here, merely saying that it is the object to be sought for.

We will continue our consideration of the house-drainage system above the floor of the basement. It is thoroughly established that no pipe in the house should be actually connected with the house-drain, excepting the soil-pipe, which carries all that cannot be delivered in the open-air without offence. The rain-water, the waste from the several sinks and from the baths, can all be discharged into the open air, and be led into a grating with traps below them; they should on no account have a direct communication with the drain. It would seem impossible to many of you that any mention of this very obvious fact should require further notice; but I can assure you that if you will look into hundreds of houses close at hand, you will find that the builders of them are altogether ignorant of this. I say ignorant, because there can be no earthly reason why they should not act upon the knowledge, if they possessed it, seeing that the change from the old system to the new would not, in this particular, cost a shilling more in the building of a house of any size.

The pipes from all other sources than the scullery, flowing into the open grating, will be rather a gain to the house-drain, helping to scour it, but the scullery supply will be loaded with grease, which, when it chills, is difficult to deal with, and it would be well if it could be all deposited before it reaches the drain. Many clever devices have been invented to effect this, but none of them can be left to take care of themselves. If the grease is caught, as it ought to be, it must be removed by hand, or the drain will become foul and offensive, and be the cause of mischief. It is recommended that a stream of hot water should be turned into the drain occasionally, to melt any grease that may adhere to it; but if this is done, the sudden increase of heat will cause the gas to expand, with every probability of its forcing the trap above; while the grease will only be carried into the drain, and there be deposited out of reach. The clearing of the scullery-pipe, and the prevention as far as possible of grease in the house-drain, should never be overlooked.

All the waste from the baths and such like may be turned into the rain-water pipes, which may be of iron, and so that they keep the water from making the wall damp, and end about a foot from the ground; they require no special attention. In the country this arrangement will, of course, be modified where it is an object to save the rain water; and it would also be necessary in London, if the water did not contain so much that is objectionable.

The chief anxiety of the house system will be the soil-pipes, and the fewer there are of them the better. The soil-pipe should never be closed at the top, it should be extended upwards, whether over the roof or through the roof at its full size, and terminate, like the other ventilator, where its discharge of gas can do no harm. It will, under this arrangement, be a permanent ventilation, and an occasional waste-pipe; and although gas would be held in it in a very diluted state, still its condition depends upon so many influences, that it must always be considered dangerous. If no water has passed through the trap in the house drain for some time, it may be receiving a heavy charge from that source; there may be fumes from its own unclean state, or from gases generated in the traps that are in each closet drain that joins it, which will rarely be filled with quite clean water. This pipe ought not to be made of lead, if a better material can be found, because the gas acts upon and destroys it rapidly. If it is of lead, as it very generally is, it ought to be made without solder, as that is still more rapidly acted upon by the gas. A good lead pipe, however, will last a long time, and if outside the house, its condition can be watched. Stone-ware can be used when built into the wall, and if Stanford's joints are employed ought to be secure. There will be no soil-pipe inside the house when architects have completed the study of sanitary science.

Where the branch from a water-closet joins the soil-pipe there will be a trap; the pan itself forming another trap, there will then be that greatest of dangers in any system of drains, a space enclosed between two traps, in which gas may become concentrated to any amount. There is little doubt that gas has been collected in these spaces that has been most fatal. I was told of a case the other day, where a housemaid, opening a valve that had been closed for some time, became insensible from the load of gas that was discharged from it. The quantity of gas generated in this space from moment to moment is very small, and it is only essential that it should have an outlet to the air. In case of its opening near a window, a short length of pipe may be required, but this will not usually be needed, excepting when the closet is away from an outer wall.

It will be seen, as I said when speaking of our house-drainage system, that the whole and sole cause of the danger of concentrated gas entering our houses is from the use of the water-closet. Their position in a house ought, therefore, to have the architect's greatest consideration. These closets should either be projections or towers, cut off from the house, or failing the possibility of that, close to an outer wall, without which neither the light nor the ventilation essential to their purification can be obtained. It will be well to remember that, if the closet is hotter than the outer air, the tendency will be for the gas in the soil-pipe to force the trap when the valve is opened. In winter there must be a difference of temperature; but I mention the fact to show the advisability of not allowing the closet to be more heated than is absolutely required.

Having done all in our power to exclude sewer gas from our houses, we have still to purify the air of the rooms we are living in, by draining off that which has been vitiated by our own exhalations, and by the combustion which produces artificial light and heat. The air that has been injured by these causes is unfit for respiration, till it has been restored to a sufficient degree of purity by the admixture of fresh air, which, of course, implies a constant current of air out of the chamber to make room for the fresh supply.

The quantity of air polluted by each individual breathing, and the quantity demanded for illumination and heating, have, of course, all been tabulated, and tests determining the most minute quantities have been brought to bear upon the investigation, one result of which is to show that the chemical difference betwixt pure air and air unfit for respiration is very small in amount, showing how necessary a constant change must be. Dr. Angus Smith gives the difference of only ·3 per cent. of oxygen in pure air and in air that is unwholesome, while the quantity we require in an hour is said to be 3,000 cubic feet for a single individual. I need not go further into quantities to make my hearers wonder how we can find air enough to breathe in crowded and brilliantly-lighted rooms in winter, when there is no apparent inlet.

In summer, when the windows can be opened, we trust to an incessant diffusion from without, and to the almost constant motion in the air from changes of temperature, near or distant. But in winter, when our rooms have to be kept warmer than the outer air, we at once meet with a difficulty in obtaining the current into the room, without producing a chilling stream, undeniably dangerous to health. This danger being more palpable and instantaneous in its effects than the ills arising from breathing tainted air, induces us to take all possible means for preventing it. The door is surrounded with india-rubber, and there are sand-bags on the window-sills, but still the fire burns brightly, and the air is rushing up the chimney; it must come in from somewhere, and in large quantities too. It would be well if we took more trouble to inquire from whence it is supplied. It must enter, for the most part, by crevices in the floor, and inlets so small that they are not observable; indeed it has been demonstrated that air can find its way through the ordinary stock brick with very little pressure. The sources are as various as the directions in which the currents flow; this only being certain, that what does not come almost directly from the outer air is more or less impure.

Mr. Rawlinson says of air brought through flues, "it has the life taken out of it;" then what of air that has been brought by our fires from below the basement through the intricacies of an imperfect wall, and has expanded between the floor and the ceiling of the room below, loaded as that space usually is with chips and bits of plaster, cobwebs, and dust of all sorts? These are as bad flues as air can pass through, and there can be but "little life left in it" when it reaches us.

Even though the house-drain may have been well covered, and decomposing rubbish has not poisoned it at its source, as will frequently have been the case, those who do not so persistently close every possible entrance for fresh air, may still rest assured that in the winter, when every door and window is shut, a good deal of air in their rooms must come from sources that make it very impure before they breath it. The question of course is, how fresh air, cold as it is in winter, can best be brought into the room without flowing in chill streams upon its occupants. Numberless inventors have worked for this end; among the best results has been the Galton stove, which seems to me admirably adapted to its purpose. The outer air is led around this stove in such a way that it is warmed and not burnt, and though it enters the room near the ceiling horizontally, it does not, on account of its warmth, begin to fall immediately, as it would if it were cold. Its passage has been traced, and it is found to circulate in the upper part of the room, descending gradually as the fire abstracts the lower stratum, giving the inmates the benefit, before the fire withdraws it from the room. This stove must also be economical in fuel, as much of the heat that would be lost up the chimney, in an ordinary fire-place, is utilised in warming the air that enters the room. But a Galton stove is not at the command of everyone, and we want relief for millions who are living in semi-suffocation.

This, I think, we have in the mode of ventilation brought last year to notice by Mr. Tobin, which was to let the cold air enter by a vertical current, so that it should not fall into the room till it had diffused through the upper stratum. If this principle is correct, it is, I maintain, of extreme importance, because it can be applied at once, by means the most simple and inexpensive, while its use may be extended to buildings of any size.

To show how this suggestion can be utilised at once, I need only refer to General Scott's mode of supplying fresh air to his children's school room. He bored a line of holes in the door of the room, and turned the current upwards by a guard in front of them, by which simple means he obtained the vertical current required. No draught was felt, the air became warmed in the upper part of the room, and eventually was drawn from the floor-level up the chimney. I would ask how many stuffy village schoolrooms there are, that might be changed from being insufferable to sufferable by this simple means?

In a room close to the one we are in, an appliance even more simple has been in use for some time, with very good effect; the lower frame of the upper window-sash being cut, so as to allow the air to come in between the frames, where it takes a vertical course long enough to prevent its falling in a cold stream upon the heads of the inmates of the room, as cold air does when it comes at an angle and falls by gravity. This upward current arises from a similar cause that keeps up a fountain's play, and the extent of its action depends in both cases on the velocity of the stream, at its exit from the orifice for its escape.

There are many other simple ways of treating windows to induce this current, and many more will be suggested when the principle is understood. But I must refer to an admirable trial that has been made of the principle in a ward of St. George's Hospital, by Mr. Brudenell Carter, which has been in use for more than a year. The air is let into the ward by perpendicular tubes, supplied by horizontal tubes open to the air. The upright tubes open above the heads of the patients, who feel nothing of the cold air, though it enters very near them. At the time I had an opportunity of examining the ward, there was a fire in the room, and the thermometer stood at 68° at all heights, from the floor to the ceiling. The air was strikingly pure compared with that of the next ward of the same same size and character, but not so treated. Indeed no one could pass from one ward to the other without feeling that it was a complete success. As this ventilation has now had a good trial, I wrote to ask Mr. Carter, whether he was still satisfied with it. His reply was this:—"I am still entirely satisfied with the ventilation, both at St. George's and at home. Nothing could answer more admirably; and I have had its application in my own house considerably extended."

To have this ventilation in perfection, it is evidently necessary that there shall be such a current from the room as will ensure a considerable velocity in the stream entering. With a fire in the room this can be ensured, by stopping in the usual way other entrances that would cause draughts; but it is a question how this can be done, when there is no fire to induce a current. If the chimney flue is open, as it ought always to be, there will be an upward current, as the room becomes warmer than the outer air, and to this extent the system will work automatically when the room is inhabited; but whether the volume entering will always be sufficient under these circumstances I am not prepared to say. Mr. Brudenell-Carter, however, finds no fault with the ventilation at any season; at all events, as it now stands, it is undoubtedly valuable when most wanted, *i.e.*, in winter. On its first being brought to notice, it was asserted that all the cold air coming in did not reduce the temperature of the room, an assertion which led, at the moment, to a doubt being thrown on the whole suggestion. But it appeared that, as the loss of heat was entirely in the upper part of the room, where the air would have been over-heated, there was no loss to those who occupied the ward Indeed, the thermometer standing so high as 68°, with only one fire in the room, went far to prove there would be no reduction in the mean temperature.

What I would ask of this meeting on this head is, that some means should be suggested for causing a sufficient current out of the room at the floor-level, to induce a rapid supply through the tubes when there is no fire in the grate to ensure it. When that is established, this system will be made as perfect in summer as it now is in winter.

One great fault found with all currents brought from the outer air in London and other large towns is, that it brings in soot and dirt; and an undeniable objection this is, so objectionable that I am induced to notice what I consider by far the best suggestion yet made to cure this evil. I allude to the arrangement shown in this diagram, in which the air entering is made to impinge on the surface of a tray of water, which, as it becomes loaded, can be emptied and replenished, a most important step, I think, in the growth of this system, which I cannot but hope will be of very general use when once thoroughly understood.

As we have ample reason at all times to exclude sewer gas from our homes, I have not yet alluded to it in its most formidable character, as a nursery and vehicle for those fatal diseases which are classed as preventible, and well-known now as dirt diseases. The arrangement of the drains and pipes ought, if thoroughly carried out, to secure each house from its own impurities; but such is the character of some of these diseases that your own vigilance will not protect you against your neighbour's negligence. And a most important question rises, as to how those who have set their own house in order can be secured against the ignorance or apathy of those surrounding them. The law of the land ought to save a man from being drugged by poison brewed for him by anyone. Are there such laws in existence now as will protect him? It would appear from the various opinions given by the Officers of Health who attended our Conference, that the Acts of Parliament on which the public health depends, are capable of different readings by those for whose guidance they were passed. But before we go into the administrative, let us see what good results we can claim from our sanitary laws in the condition of the many lines of houses now being built in the extension of London. It is almost universally admitted by the local officers that, although the house-drains are nominally laid under supervision, the staff of the vestries is not strong enough to admit of the work being actually watched. In other words, no man can feel secure that his chief drain is not leaking, and forming a cesspool under his house. This fault may exist in one or all of these new houses. I will now enumerate others actually in sight.

The are two rain-water-pipes, both of which join the drain, with the nominal protection of a trap at the head of it, which has no ventilation. All the other waste-pipes of the house join either the soil-pipe or the drain. It will be observed that there is not an absence of ventilation in this system above the head of the house-drain; on the contrary, there is a passage for sewer-gas into all parts of the house by every pipe. And as the rain-water-pipe and the soil-pipe are of iron with open joints, what does not escape at their head, just on a level with the attic windows, steams from the joints around the windows of the rooms below; while the space beneath the pan of the water-closet, the trap connecting it with the soil-pipe, is left unventilated, a most fruitful source of danger. This list of faults does not, I fear, leave us much to show as good resulting yet from sanitary teaching.

There is one danger from sewer-gas almost more to be dreaded than any other. Its getting into the cisterns, where, from the tendency of water to absorb gas, it will become impregnated and poisonous, owing to the waste-pipes from cisterns being in communication with the drain. This was a very common fault formerly, but is being rapidly corrected now, and sanitary supervision, may, I think, claim its having arrested this most certain cause of danger.

Our sanitary laws are also doing much to correct the water supply; but where the water is obtained from wells in towns or near buildings, there is always the risk of contamination from leaks in the drains and sewers. Where this is the case, the effects are often fatal. The distance to which the poison may be conveyed was shown in the effect produced on wells supposed to supply the purest water to country houses, when, during the spread of the cattle-plague, the carbolic acid and other pungent disinfectants used in farm buildings near could be detected in the drinking-water. One case came under my own cognisance, where so much store was set by the water of a certain celebrated pump that glass-pipes were used to ensure its virgin purity, the strong carbolic taste proved that it must always have drawn upon the cattle-sheds for a part of its supply.

Although very much more interest is taken in sanitary subjects than formerly, and numbers of extremely able men are making a study of the science, and giving their knowledge to the world, still the new light has not reached our builders, or, I fear I may add, many of our architects; nor are the existing laws so carried out by pains and penalties as to enforce their learning. Houses in hundreds are still being built, in which every sanitary law is violated. The real remedy for this is, of course, sanitary education; but it must reach the point of being possessed by the public generally before it will affect the builders. As soon as houses are valued for the care taken to ensure their healthiness, then only will the builders' attention be diverted from the decorations to the drains. This education ought to be proceeding rapidly, as hardly a day passes that volumes are not published on the subject from the ablest pens. Not only are our first engineers engaged in this teaching, but to their honour be it said, no class in England are more active or more earnest in the work than the medical profession. And as they carry their knowledge from door to door, and enforce their teaching with authority, we may look to them in no slight degree for the people's education. Their efforts, supplemented by letters in the papers, lectures, and the advertising sheets of new appliances—one great disseminator of such knowledge—are all, no doubt, contributing to form this education.

In the meantime, we are, in a great degree, dependent on the powers conferred by Parliament on those entrusted with the public health, and, when trying to find out what is the state of our laws concerning building in the metropolis, I got puzzled, as laws kept coming into view, and dying away again in a mysterious way, till it appeared that the phantoms I was following were bye-laws of the London Vestries. Not that the Vestry bye-law is an *ignis fatuus*, by any means; a law wielded by the hand that makes it, cuts sharply. The reason for their disappearance is, that each law ceases to exist at the parish boundary, and nothing at all resembling it may be found for miles.

I must refer the reader of our Society's *Journal* to the valuable communications made to the Society of Arts, at the recent conference, by medical officers and others. It will be seen that an entirely different view is taken of the powers conferred by the several Acts of Parliament affecting health. In some parishes, the present Acts, supplemented by bye-laws, are deemed sufficient; the fact being that the Acts are there considered to legalise any bye-laws, and under these circumstances they are powerful enough for anything. But all do not venture to stretch the powers of the Acts so far, and in those parishes more powers from Parliament are demanded. This is notably the case in Chelsea, where some of the first principles of the Act of 1855 are resisted.

As the Act happens to be read, so men's liabilities vary in the several parishes, and any man changing his home, or adding to his house property, does so without any idea what demands may be made upon him in consequence. I fully concur with those medical officers who, considering the public health of the first importance, ask for stringent bye-laws from their Vestry, in order to bring their districts into good sanitary condition. But laws may be so oppressive as to be inoperative. The "stand and deliver system" of collection cannot be trusted permanently. Robin Hood was said to be a man of liberal charities, but he was not approved as an institution, his funds being collected arbitrarily, and his demands being too sudden on his ratepayers. Yet he limited his collection to what they actually possessed, which would not be the case were all the necessary improvements made, and the bill to be presented by the Vestry for immediate payment on the poorer landlords.

What would be the state of things if such a system was attempted under the pressure of a visitation of cholera or any other epidemic? when it would be the duty of the officer of health to correct instantly the faults of every house. By the bye-laws of some parishes, he might, in that case, insist upon the most approved system of sanitary arrangement being immediately carried out, as any house might be considered a nuisance that was in such a state as to propagate the plague; the work must be done and paid for, or failing that, penalties might be inflicted.

What seems essential is some such system as has been adopted in agricultural districts, where the necessary work of land drainage is done under Government control, to be paid for by instalments extending over a series of years.

I would not venture to suggest the great reform required in the government of the metropolis; but I may express an opinion that there is not the slightest appearance or probability of all London being brought into proper sanitary condition under the existing system. Stringent bye-laws in the hands of such earnest men as now hold office under many of the Vestries, may correct a nuisance here and there, and by degrees better the general condition of their districts. But if sanitary authorities are right, it is essential that each house should be drained and ventilated on certain principles, which would entail an expense enormous in the aggregate, and too considerable to be levied summarily on individual house-owners without serious loss to many of them. Whereas, with a system of repayment in the course of years on the security of the property, the officers of health might begin their work when there was no pressure from immediate danger, and, with their engineers and trained workmen, the cost would be reduced to a minimum; they would have a fair chance that their sanitary efforts would not be resisted, as they must of necessity be now, when it is the great object of those who cannot pay for the corrections to secrete the faults.

If this is impossible, what is possible? One thing is certain, that the work is essential to the health of London, particularly to the houses possessed by those who cannot volunteer to protect themselves. I grant that the correction of the drain and pipe system of each house in all London is something too bewildering to contemplate, but if we are to put our sanitary theories into practice, it is towards this end that we must work.

And with the vast difficulties of such a reformation as that implies now staring us in the face, surely the authorities of the present time ought in mercy to their successors, to take every possible means in their power to prevent the new streets now rising becoming a like difficulty to them. Nor will the builders have reason to complain of stringent laws, obliging them to secure their houses against the dreaded gas from the sewers, for the time must be near at hand when the value of houses will depend upon this sanitary security.

Such an experience as Mr. Eyre complains of, in his letter to our Secretary, often repeated, must have its effect. He bought a house, supposing it to be fit for his use, and, as he says, "he had to pay £200 to make a new house reasonably safe from sewer gas and pollution of its water-supply."

Once more taking up Mr. Chadwick's idea of hastening all that is objectionable out of London, I must express a wish—I would it could amount a hope—that as far as sanitary affairs are concerned, the parish boundaries may be swept away; and that these great republics should, like the nobles of Japan, give up their privileges, to form a strong and efficient government for the better protection of the health of the metropolis.

DISCUSSION.

Mr. Baldwin Latham said he had listened to the paper with considerable interest, and trusted that other gentlemen occupying the same high position in the Society as General Cotton would take an interest in this important matter. There was no doubt it was the crowning point in a system of sewerage; for engineer might bestow the greatest pains, probably, in carrying out the most perfect system of town sewerage, and yet, if the work connected with the drainage of private houses was not undertaken with some skill and attention, the whole system must prove a failure. The strength of a chain was tested by its weakest link; and the weak link in a system of sewerage was the private house-drain. If persons only knew the absolute importance of paying personal attention to this they would not, he was sure, sit easy by their firesides, thinking of those malarious gases which might be escaping from the basements, and permeating their habitations to the permanent injury of themselves and their children. It was almost impossible to mention all the matters necessary with regard to this question, but there was one thing which only recently came under his attention in connection with one of the largest houses at Queens-gate, where there were seven housemaids' closets one over the other. There was a 2½-inch lead pipe communicating with the whole of them, and ventilated at the top. He had found that a pail of water thrown down at the top untrapped everyone of the traps below. This showed the absolute necessity of not laying down any general rule with regard to a simple ventilating pipe. The effect of the pail of water was to induce a current of air—in fact, it acted like the piston of a pump, and drew out the air from the pipe, and so sucked out the water from the adjoining trap. The only way of getting security in this case was by putting in a second pipe alongside the other, and carrying it independently to a point above the highest sink. He had found the same thing happen in another case, with a tip-up wash-hand basin in close proximity to a urinal; when the wash-hand basin was tipped up it untrapped the urinal pipe, although in that case it was a large 6-inch pipe. This defect was cured in the same manner. There could be no doubt that one of the greatest evils with regard to the laying of drain-pipes was the use of clay at the joints. Apart from the qualities of the material itself, it must be recollected that if you took two ordinary spigot and socket pipes, and filled the joint with a fillet of clay, and put the spigot into the end of it, they did not fit tightly, because there was room for the clay, and considerable play, and the moment the filling was put in at the top, the weight of it forced out the clay at the bottom, and left an aperture above through which the sewage flowed into the subsoil, and thus the basement of the house soon became filled with sewer gas. Some of the best houses in the West-end were the worst drained. In many cottages the sanitary authorities looked after them, but the large houses nobody except those living in them was interested in looking after. He had seen a house where a Royal Prince lived,, and in which two Cabinet ministers had previously died, where he found a cesspool at the foot of the staircase, and a brick sewer, running from one end of the house to the other, which had not even an apology for mortar in its joints, and there was only about 18 in. between it and the flagged basement. If such was the state of matters in a royal residence, what might be expected in other houses? With regard to covering the basement with concrete, he should like to draw attention to the lectures recently delivered at Munich by Prof. Pettenkofer, in which he showed the enormous influence of aeration from the ground air, and stated that London would not be at all the healthy place it was if it were not for the fact that there were so many open basements between sewers and gas-pipes and the houses. This insensible ventilation went on with regard to every building, and he showed that the mud hut of the savage—where people were huddled together in a very crowded state—was comparatively healthy because of this imperceptible ventilation which passed through the walls. The same thing took place with regard to the gipsies' tents. Then, with regard to concrete, it was known to be extremely porous as a building material, and therefore, it would allow of a remarkable degree of this imperceptible ventilation, even from the ground atmosphere, to pass into the house; and it might, therefore, be necessary, hereafter, in the construction of houses, to cover the concrete with asphalte, and provide proper means for admitting the external air; because, if you shut out the air at one point, there was a great stress at that place, unless you made provision to admit air somewhere else. The great point was, not only to prevent the impure air getting in, but also to provide for pure air taking its place. Having himself suffered from imperfect drainage, he was convinced there could not be a point of more importance, and he could thoroughly endorse the saying that, in taking possession of a house, you should look to the drainage before you furnished the drawing-room.

Mr. Coneybeare said the importance of this subject could not be exaggerated, nor the great ignorance which existed upon it, both amongst builders and architects, as well as the general public. He had never lived in a house which was properly drained. There could be no doubt there ought to be one general system of drainage, and the sooner London was put under one management for the supply of air, water, and gas, the sooner they would be entitled to call England a civilised country. Sanitary arrangements, however, were equally wanting in country towns. He once slept in a house off the Cromwell-road, where he was terribly annoyed in the night by bad smells, and he found in the morning that all the other inmates had suffered in the same way; he should certainly have expected an attack of fever if he had remained there long. A very common evil was the use of the same cistern to supply drinking-water as served for the closets, and it would often be found that water left for any time in a jug would become exceedingly offensive. Again, it was very seldom that you found builders or proprietors had plans of the drains. Very recently, he was in a house built and owned by a most able builder in a country town, where it was found that, when the sewers were flushed, the sewage was sent up into the back premises. On investigating the matter, he found that the sanitary authorities had insisted on all the house drains being connected with the sewers, but no proper plans had been prepared, and it so happened that, in this particular case, the drain ran up-hill, so that, when the drains were flushed, the sewage naturally ran back into the house. Wherever the Building Acts were applied, there should be stringent regulations with regard to the drains; plans should be prepared and kept, and there should be a sufficient staff to see that they were properly made and connected. Ventilating shafts, again, were very important, but they should be carried up the walls, where they would do no harm; wanting that, they were better in the crown of the street than by the side of the pavement, as often happened. He knew a town where there was a large school for 300 boys, in which he had been almost poisoned by the sewer gases, from a trap opening just where twenty or thirty boys were generally standing about.

Mr. Hale thought it would be well if the Society were to offer a prize for the best treatise on house-drainage, to be accompanied by models. He should like to hear some gentleman who professed to be well up in these matters get up and say that he lived in a house where the drainage was perfect, and describe the system for the benefit of the public. He also thought it would be a good thing if a company were started to build houses on sanitary principles.

The Chairman, in reply to a remark that there ought to be public functionaries appointed to certify to the soundness of house-drains, said the law, as it now stood, required the surveyor to see that there were proper plans laid before the Local Board, and it was also his duty to see that the drains were properly constructed. There could not be the excuse that he had not time, because it was the duty of the Local Board to furnish him with such assistance as was necessary. He was sure there were surveyors present who would give the meeting their experience, which would be much better than the speculative opinions of gentlemen who had not the opportunity of knowing what the law and the practice was.

Mr. T. Porter said his experience showed that these rules were not carried out, and he could instance hundreds of houses where, if such a law were enforced, bad drains could not exist, and yet where the drain-pipes were laid with butt-joints, and with no cement. If it was the duty of the local surveyor to certify that the houses were properly drained, how was it that, in nine cases out of ten, the drainage was so imperfect? It was true that plans were supposed to be deposited with the Local Board, but there was no guarantee whatever to the purchaser or lessee that the law had been carried out. A drawing was not sufficient; but if the surveyor had to sign it as a certificate that he had examined the drains, there would be some security to the public.

The Chairman said he could not speak so positively with regard to the metropolis, because it was not under the general law which he had to administer, but under the control of the different Vestries.

Mr. Greenstreet (Surveyor to the St. Saviour's Board of Works) said he had patented a trap, which he believed would be found very useful and efficient. It was designed especially for street gullies, to meet the objections to the common block or D-trap, but would be also applicable to house-drains. He proposed to insert, about nine inches beneath the grating, a piece of india-rubber, on a frame, in which there was a slit. When the wash from the road overcame the resistance of the india-rubber, it would give way, and allow the sewage to pass, and would then close again immediately.

Mr. Knight (Surveyor to the Mile-end Vestry) was sorry to hear a number of architects denounced as being totally ignorant of house-drainage, and did not believe such was the case. No doubt, there were many cases of bad drainage, but they were mostly in old houses. In the district under his charge the practice was for either himself or his deputy to see the pipes of every house before they were covered up. He admitted that he had been guilty, like many others, of using clay for stopping the joints, but he now recommended the use of tow, coated with Portland cement, plugged in the same as in water-pipes. With regard to the india-rubber trap just mentioned, he saw it in use many years ago, but it was found that little bits of stick or straw got into it, and kept it open.

Mr. Liggins was sorry to find that the paper, interesting as it was, did not contain any information likely to be useful. There was a vast amount of undoubted facts well put together, but there were no suggestions of any practical value.

The Chairman reminded Mr. Liggins that General Cotton had not volunteered this paper, but had prepared it by request, in order to elicit discussion.

Mr. Liggins said he was just going to refer to that point. It was pretty well known that the Society of Arts had appointed a committee to go into this question, and he could not imagine a more important one, and rejoiced that they had done so, but it was important that they should not make statements which would not bear investigation. Not many months ago, a report appeared in the *Times* of a deputation headed by Sir Henry Cole waiting on the Metropolitan Board of Works, which was the sanitary authority for London. Mr. Coneybeare regretted that this Board had not the gas, water, and drainage of the metropolis under its control, but the latter was under its control, and able surveyors were appointed, who did look after the drainage as far as their powers went. Those powers, however, only extended to houses built since 1856, and the horrible state of things which had been discovered in Harley-street no doubt existed in many other places. But if the Board had power to reconstruct the drains of all old houses, he should like to ask the ratepayers how they would care to have enforced upon them the employment of such a large staff as would be necessary to carry out these sanitary arrangements. He thought something must be left to the common sense of individual householders, who would naturally have regard to the interest of their families, and see when they took a house that it was properly drained. Let each man, when he took a house, employ a surveyor, and see that it was properly drained; that was the plan he had adopted, and he had never had a case of sickness in his house in nineteen years. Sir Henry Cole had stated that typhoid fever was chronic in South Kensington, but there was not a tittle of truth in the statement. He found, from the registrar's returns, that there had not been a death from typhoid fever in South Kensington during the present year, and the Medical Officer of Health said that no such case had been brought under his notice. Sir Henry Cole had been written to, to ask if he would substantiate his statement, and he had not done so. It was a great pity, therefore, that the committee was so ill-informed as to go before a public body and make statements which were inapplicable. The law was perfectly clear with regard to new houses, and they must submit as well as they could to the evils of the past. He would venture to read a resolution, which had been passed unanimously by the Vestry of Kensington, a Vestry consisting of 120 members, amongst them baronets, general officers, officers of the Royal Engineers, and Queen's Counsel, so that it was not a little pettifogging, cheeseparing Vestry, composed of small tradesmen. It was as follows:—"That the statement made by Sir Henry Cole to the Metropolitan Board of Works, that 'typhoid fever is chronic in South Kensington' has no foundation in fact, for no death has occurred from that cause in South Kensington during the present year, and the Medical Officer of Health of the parish is unacquainted with any cases of illness from the said disease."

The Chairman said he thought this matter was hardly within the scope of the question before the meeting, and he believed it had been all published in the *Journal*.*

Mr. Liggins said Sir Henry Cole's statements had been published, but not the contradiction; that was what he complained of.

The Chairman said Sir Henry Cole had, unfortunately, introduced the word "South" before Kensington, and was thus open to correction; but he would be a bold man who would say that there had been no cases of typhoid fever in Kensington.

Mr. Liggins replied that the death-rate in Kensington was 1·4 in 10,000, while the average for all London was 2·4, and, therefore, he did not think it right for any committee to stigmatise the parish as an unhealthy one, the consequence of which was, that they saw advertisements in the newspapers headed "Typhoid Fever in South Kensington." He had lived in the parish fifty years, and believed it to be unusually healthy. In conclusion, he said he was sorry to see so much diversity of opinion as to what should be done to remedy the evil which he admitted to exist.

The Chairman said he was a resident in South Kensington, and he must say, that either the authorities did not possess the power by law to do what they ought, or they did not exercise it, for the mews at the back of the house where he had resided for 12 years was still unsewered, and the owners of the property were obliged to make cesspools if they wished to drain their stables.

Mr. Weaver (Surveyor of Kensington), said the mews in question was private property, and the parish had no power to go into it so long as the gates remained at the end. If the Chairman and other residents would send in a memorial, it was probable the works would be undertaken, and he had already made provision for a connection with a sewer he had lately constructed in the vicinity. It would not do to lay out £1,000 until they were requested to do so by some of the ratepayers. He had not heard any practical suggestion made to get rid of the evils complained of, though there seemed to be a great deal of hidden talent; and if the suggestion were followed of offering a premium, perhaps it might develop some of this latent talent. He should be very pleased to give £20 out of his own pocket to anyone who would tell him how he could look after every joint in every pipe in the 800 houses which were built every year under his supervision. To take the case mentioned at the beginning, of the seven-storied house at Queen's-gate, it would require a clerk of the works, at three guineas a week, constantly on the spot, to prevent the defects which had been mentioned, and you must multiply the sum by 600 to arrive at the cost of ensuring perfect drainage. The plan they followed was to give printed directions to every builder in the parish for his guidance, and he believed that, in the majority of instances, the man's self-interest would prompt him to make his house saleable, by taking reasonable precautions. But while land was so highly valued that no gardens were possible, and closets had to be crammed almost into the middle of the rooms, they must put up with imperfections. He was quite sure the vestries would be only too happy to adopt any reasonable suggestions for securing perfect drainage.

The Chairman said it was impossible to finish the discussion that evening, and therefore he proposed to adjourn it to Wednesday next. In the meantime he hoped that gentlemen who wished to speak would prepare themselve carefully, and especially that they would ascertain the exact state of the law. He could not agree with some of the remarks of the last speaker. The rates in Kensington had recently been raised nearly one-third; and he was satisfied that the income of the Vestry was competent, if necessary, to meet even the extravagant expenditure suggested without levying an additional rate, and it would be money well laid out if perfection in drainage was accomplished. Human life was the most valuable thing in this world, and, therefore, whatever was necessary to its security was not extravagant.

The discussion was then adjourned to Wednesday next.

In last number of *Journal*, p. 29, line 20 from bottom, for "mercury" read "fluid." It may also be well to mention that this form of barometer was invented by Huyghens.

The Bessemer steamship has been purchased from the original proprietors by Mr. W. Sugden, of Leeds, by whom she has been rearranged and refitted, so as to be adapted for sea-going passenger traffic. A trial trip will shortly be made in the Humber.

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* See *Journal*, Sept. 22, p. 945, for answer from Kensington Vestry.

CORRESPONDENCE.

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THE SEWERAGE AND WATER SUPPLY OF KIDDERMINSTER.

The *Journal* of the 10th instant reports on a recent inspection of the sewerage and water works of Kidderminster, by the Association of Municipal Surveyors.

The works, which were designed by me, and carried out under my superintendence, have been for some time in full and satisfactory operation, the death-rate having been reduced from 23 to an average of 18 per thousand since the works were completed, and last month it was only 12.

The works appear to have received the approval of municipal surveyors; but the utility of the large covered receiving tanks was questioned, and an opinion was expressed that the sewage should be pumped direct from the outfall.

As I was not present at the inspection, will you allow me the opportunity of giving some explanation regarding these tanks, which may be looked upon as the safety-valves of the sewers' outfall, the terminus of which is much below the level of the river.

While agreeing with the principle that it is better, where practicable, to pump sewage direct from the outfall without the intervention of a receiving tank, there are cases where, for safety, convenience, and economy, tanks are needed.

The Kidderminster sewage contains, besides other refuse from dye-houses and factories, large quantities of wool, hemp, and cotton fibre, which the manufacturers say they are powerless to prevent. These substances would choke the pumps, were they not arrested by screens fixed across the tanks, affording a large area for this purpose. This operation, of course, could not be effected if there were no receiving tanks.

Kidderminster is subject to frequent floods, from the precipitous nature of the district. When these occur, the storm water entering the sewers is beyond all proportion to the ordinary flow of sewage, and it was therefore necessary either to maintain expensive supplementary pumping power, to be always ready for such occasions, or to provide tanks to temporarily store the sewage until the pumps were able to deal with it, and this would at the same time render night pumping unnecessary, thus effecting a large annual saving of expense.

These and other circumstances induced me to advise the construction of depositing tanks, which have now been in use for more than two years.

These tanks are situated on the edge of the borough, away from all dwellings, and are enclosed in a building roofed over, and, if properly attended to by those in charge, it is quite impossible for them to become a nuisance.

This explanation, I think, affords another instance that a uniform system of dealing with sanitary matters is impracticable.

At the inspection named, the surveyors confined their comments to supposed defects; they accord no laudatory remarks on difficulties overcome or benefits attained, especially as to the achievement of the engineer, who, on a bare hill side, away from all wells or streams, bored down some 500 feet into the red sandstone, and found a supply of pure, soft, spring water, equal to one million gallons a day, and rising to within 50 feet of the surface of the ground, sufficient for the daily wants of 50,000 persons.—I am, &c.,

Josiah Forster Fairbank, M.Inst.C.E.

18, Abington-street, Westminster,
15th Nov. 1876.

FINANCIAL STATEMENT OF BEDDINGTON SEWAGE FARM.

It may interest your readers, more especially those who are studying the sewage question, to know the actual facts with regard to the working of the Beddington sewage farm during the past year. It will supplement the statement which I submitted to the Sewage Conference, and which appears at page 614 of vol. xxiv.

The valuation of the farm made September 29, 1875 (for the Croydon Local Board) was £5,461 11s. 3d. The valuation made September 29, 1876, was £5,928 4s. 8d. There is an increase, therefore, in the value of the stock and crops on the farm of £466 5s. 5s.

The receipts during the year have been as follows, as completed from the accounts of the Local Board:—

	£	s.	d.
Sale of vegetables	2,029	0	10
„ of milk	821	0	3
„ of farm productions, viz., hay, grass, oats, mangels	3,277	7	0
Sale of stock	1,116	15	4
Rents from portions of land let off..	140	0	0
	£7,384	3	7

The payments have been as follows:—

	£	s.	d.
Rent, taxes, tithes	4,908	2	7
Salaries, wages, commission ..	2,705	17	11
Building cart shed, &c.	231	8	6
Cost of cultivation, and sundries	1,044	12	7
	£8,890	1	7

The difference between the receipts and payments amounts to the sum of £1,505 18s. If we deduct from this sum the increase in the valuation of the farm, viz., £466 5s. 5d., we have £1,039 12s. 7d. as the actual money loss upon the farm during the year just ended. It will guide the inquirer to mention that a penny rate will produce £1,400, so that the cost of the farm to the parish of Croydon during the past year has been less than a penny rate, notwithstanding the enormous rental which has to be paid for more than 400 acres of the 466 acres which are actually under irrigation, whilst a sum of £500 is charged against the farm on account of the freehold land which belongs to the parish.

It cannot be doubted but that if the farm had been managed by a farmer for his own benefit, it would have returned a handsome profit if leased to him at a reasonable rent.—I am, &c.,

Alfred Carpenter, M.D.,
Chairman of Farm Committee.

Croydon, Nov. 14, 1876.

SWISS AND ENGLISH ROADS.

Having recently travelled on some of the excellent roads of Switzerland, I have been led to compare them with our English roads, and if you will grant me a little space, I hope to be able to show how some of our difficulties may be overcome.

The roads in Switzerland are well laid out and engineered, the gradients being much easier than our own, and this is saying a great deal for a country so mountainous as Switzerland; the main roads are kept in excellent repair, partly by the care bestowed on them, and partly by reason of the goodness of the road materials.

There is, besides, another and very important reason, and in this case prevention is better than cure.

Nearly all the carriages, wagons, and vehicles of all kinds, are fitted with screw brakes, in such manner that a pressure is exerted on the outer rims of the front or hind wheels, and so retards their speed in descending the mountains.

There are some "drag shoes" used, to place under the carriage wheels when descending hills, but these have soles, from six to eight inches wide, that cause no injury to the surface of the roads.

What happens in England? People use what "drag shoes" they like, and they are mostly less than two inches wide. Let any one watch the effect of such treatment of a road. The result is, that the surface is continually torn up, and the utmost efforts of the road-makers and menders cannot maintain a good surface.

I know not if in Switzerland any law regulates the width of the soles of "drag shoes," but if it does, it shows great good sense in those who regulate such matters in the little Republic.

In England, at the present time, the great traffic of the country is on the railways, the old turnpike trusts are passing away, the traffic on the roads is far less than in the days of stage coaches and stage waggons, and the cost of maintenance is cast on the local ratepayers. They oppose a large expenditure to keep the roads in first-rate condition; and if the cost of maintenance can be reduced, we should do our best to prevent their destruction, and keep them in good condition with as little waste as possible.

The cost of keeping good a hilly road is far heavier than a level road; therefore protect the road, and forbid any misuse that injures its surface; and forbid the use of "drag shoes" with narrow soles.

While giving all due praise to the Swiss roads, I cannot admit that they are as perfect as they can be made.

When the Swiss engineers planned their roads years ago, they had to remember that, in a country by no means rich, it was necessary to go to work economically, to get the utmost results for the money expended.

In those days the traffic was not great, and many of the vehicles were very narrow, so the roads were made no wider than was absolutely necessary for the existing traffic.

The traffic has greatly increased, and the narrow vehicles are being replaced by wider ones, more like those used in other parts of Europe; and what is the consequence? The roads are too narrow for the present traffic.

The drivers of vehicles, therefore, cannot venture to pass one another at a trot, and the speed has to be reduced to a walk, on the score of safety; and if, as frequently happens, there is a precipice many hundred feet deep on one side, their caution is by no means unnecessary.

This, however, brings us to another subject, rendering accidents more liable to happen, the loose harness, and the mode of attaching the horses to the carriages.

As a ship is handy and manageable if she answers her helm quickly, so a carriage can be driven with speed and safety if it answers the touch of the driver, communicated to it by the feel of the horses' mouths through the bits and reins.

With close-fitting harness and a fixed splinter-bar, as is usual in England, a clever driver no sooner perceives what is necessary, than his will is communicated to the carriage, through the immediate action of the pole or shafts.

This cannot happen with loose harness and attachments, which must have time and space to act, and in the meantime an accident may have already happened.

This leads me to consider the speed of travelling in Switzerland. This certainly might be improved, but several things are necessary to attain it. The roads should be at least two feet wider; the horses should not be driven such long stages; they should be better fed, and, moreover, they should be better bred. Some good English horses, and some clever and steady English coachman, with closer fitting harness, could in a few years render travelling in Switzerland even more pleasurable than at present. But the diligences being Government property and a monopoly, there is no competition to force on improvements, and any advance must come from the intelligence and public spirit of the Swiss Government, willingly supported by the heads of the department that conducts and controls the conveyance of passengers on the public roads of Switzerland.—I am, &c., H.

OBITUARY.

W. Bollaert.—The papers announce the death of Mr. W. Bollaert, F.R.G.S., on the 15th of November, aged sixty-nine. While yet a student of chemistry, he volunteered, under Queen Donna Maria, in the Miguelite War, for which he received the Tower and Sword and the war medal. He became the historian of this and the Carlist War in a work in two volumes. He went to Peru on a geological mission, and long continued connected with South America, for which he was a kind of literary consul. Besides publishing memoirs on the mineralogy and geology of South America, he particularly applied himself to the antiquities of Peru and Central America. In connection with the Ethnological Society, of which he was a Corresponding Member, he published various contributions on the interpretation of Mexican and Maya, and on the Calendars. In 1853, Mr. Bollaert received a medal from the Society of Arts, for an essay, "On Common Salt; the source from whence obtained, and the processes involved in its manufacture, with observations on the origin of salt and other saline bodies." The essay is printed at length in the first volume of the Society's *Journal*.

NOTES ON BOOKS.

Amongst Machines.—By the Author of "The Young Mechanic." London: Trübner. 1876.

This is a book for boys, intended to give them some insight into various manufacturing processes, and the mechanical means by which they are carried on. Among the various industries treated may be mentioned the manufactures of steel pens, pins, sheet-metal goods, paper-making, glass-making, &c. There are also chapters on wire-drawing and wood-working machinery, tube-making apparatus, and other special classes of machines. Throughout the subject is treated in the simplest and elementary way, without taking for granted any previous knowledge on the part of the reader.

Saving Life and Preventing Suffering in Cases of Disaster at Sea. By William Smith, C.E. London: Stanford. 1876.

In this pamphlet the chief aim of the writer is to bring before public notice the simple remedy which would be provided against the most terrible of all sufferings among a shipwrecked crew—thirst, if every ship's boat was obliged to carry an apparatus for producing distilled water, fitted with a lamp such as could easily be used in a boat. This apparatus, it is proposed, should be fitted in the bows of the boat, where it would be out of the way, and could be easily covered in.

The aggregate admissions to the Centennial Exhibition were 9,789,392, of which 8,004,325 have paid. The receipts amount to 3,813,749 dols.; the average daily admissions were 61,568.

GENERAL NOTES.

Brussels Exhibition.—The Admiralty, the War Office, the Board of Trade, and the Corporation of the Trinity House, have received through the London committee the diplomas and medals of the first class, for their exhibits of objects, and models of objects used, in the saving and protection of life.

American Patents.—The total receipts of the United States Patent-office, in the year ending September 30, 1876, were 787,697 dols. The total expenditure of the office in the same period was 661,638 dols. In this latter total salaries figured for 437,280 dols., contingent expenses for 54,351 dols., and photo-lithographing back issues for 66,025 dols. There were 22,408 applications for patents received during the year, and 15,911 patents were issued in the course of the twelve months; 3,613 patents were allowed but not issued, the final fees not having been paid. There were also 1,037 trade marks and 499 labels registered during the year, and 2,943 caveats were filed in the same period. Only two patents were extended during the year.

South African International Exhibition.—A meeting of City merchants and others desirous of promoting the success of the forthcoming South African International Exhibition, to be held at Cape Town, took place at the City Terminus Hotel, Cannon-street, on Friday, the 24th ult. It was stated that the space at the disposal of the Exhibition Committee had been nearly all disposed of. Applications for space had been voluntarily made in various towns in England, also by manufacturers in different cities on the Continent and in America. The sections which would be best represented at the exhibition would be those comprising food, chemicals, textile fabrics, and clothing of all kinds, pottery, musical instruments, saddlery, guns, watches, galvanised iron, Sheffield and Birmingham wares of all sorts, telegraphy, fire-engines, boats, carriages, and agricultural implements. The latter would represent, in the matter of area, quite as large as large a space as the other sections of the exhibition taken in the aggregrate. Resolutions approving the establishment of the exhibition, and expressing wishes for its success were passed, as also was one requesting that the opening of the exhibition should be deferred for a month later than was originally proposed.

NOTICES.

Ordinary Meetings.

Wednesday evenings at eight o'clock. The following arrangements for the meetings before Christmas have been made:—

December 6.—"The Construction of House Drains," by Major-General F. C. Cotton, C.S.I. Adjourned Discussion. On this evening Robert Rawlinson, Esq., C.B., will preside.

December 13.—"A New Process of Printing a Number of Colours at One Impression," by E. Meyerstein, Esq.

December 20.—"The Philadelphia Exhibition," by Professor Archer.

Cantor Lectures.

Monday evenings at eight o'clock. First Course, on "The History of the Art of Coach Building," by George A. Thrupp, Esq.

Lecture III.—December 4.

Carriages from 1770 to the present time.

Lecture IV.—December 11.

Ancient and modern travelling, and public carriages of Europe.

Lecture V.—December 18.

Rules of coach building and theories applicable to the carriages of the future.

MEETINGS FOR THE ENSUING WEEK.

Mon. ...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. George A. Thrupp, "The History of the Art of Coach Building." (Lecture III.)
Farmers' Club, Caledonian Hotel, Adelphi-terrace, W.C., 5½ p.m. Mr. C. S. Read, "The Agricultural Labourer, his Position and Prospects."
Royal Institution, Albemarle-street, W., 2 p.m. General Monthly Meeting.
Society of Engineers, 6, Westminster-chambers, 7½ p.m. Mr. W. McNaught, "The Rolling of Ships."
British Architects, 9, Conduit-street, W., 8 p.m. 1. Prof. Donaldson, "A Notice of the Recent Travels of Lieut.-Colonel Playfair, H.M. Consul in Algeria and Tunis." 2. Mr. Thos. N. Laslett, "A Description of the 'Metroscope' (an Instrument for Measuring the Height of Inaccessible Buildings)."
Medical, 11, Chandos-street, W., 8 p.m.
Victoria Institute, 10, Adelphi-terrace, W.C., 8 p.m. Mr. W. R. Cooper, "The Myth of Ra."
London Institution, Finsbury-circus, E.C., 4 p.m. Professor T. H. Huxley, "Some Recent Additions to our Knowledge of the Pedigree of the Horse."

Tues....Women's Education Union (at the House of the Society of Arts), 6 p.m. M. Edmund Andrade, "The Galin-Paris-Chevé Method of Teaching Music." (Lecture IV.)
Froehel Kinder Garten Society (at the House of the Society of Arts), 8 p.m. (Annual Meeting.) Address by Mrs. Grey.
Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Discussion on "The Chalk Water System."
Pathological, 53, Berners-street, Oxford-street, W., 8 p.m.
Biblical Archæology, 9, Conduit-street, W., 8½ p.m.
Zoological, 11, Hanover-square, W., 8½ p.m. 1. Mr. Andrew Anderson, "Corrections of and Additions to 'Raptorial Birds of North Western India.'" Part III. 2. Dr. Francis Day, "The Fishes of Yarkand." 3. Mr. Martin Jacoby, "Description of New Genera and Species of Phytophagous Coleoptera."

Wed. ...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. Adjourned Discussion on the Paper by Major-General F. C. Cotton, "The Construction of House Drains."
Geological, Burlington House, W., 8 p.m. 1. Mr. W. J. Sollas, "*Pharetrospongia Strahani*, a Holorhapidote Sponge, from the Cambridge Coprolite Bed." 2. Mr. Etheridge, jun., "A New Species of *Eurypterus* from the Carboniferous of Scotland." 3. Mr. W. Topley and Mr. G. A. Latour, "The Intrusive Character of the Whin Sill of Northumherland." 4. Mr. W. Morgan, "Mineral Veins," communicated by Mr. W. W. Smyth.
Microscopical, King's College, W.C., 8 p.m.
Pharmaceutical, 17, Bloomsbury-square, W.C., 8 p.m. Mr. A. Bottle, "A new way of making Grey Powder."
Archæological Association, 32, Sackville-street, W., 8 p.m.
Entomological, 11, Chandos-street, W., 7 p.m.
Obstretical, 53, Berners-street, Oxford-street, W., 8 p.m.

Thur. ...Royal, Burlington House, W., 8½ p.m.
Antiquaries, Burlington House, W.C., 8½ p.m.
Linnean, Burlington House, W., 8 p.m. 1. Dr. Francis Day, "Geographical Distribution of Indian Fresh-water Fishes." 2. Mr. J. R. Jackson, "Note on the Uses of a Species of *Thyllostachys*." 3. Dr. F. Buchanan White, "On the Male Genital Armature of the European *Rhopalocera*." 4. Mr. J. S. Baker, "A General Systematic Arrangement of *Iridaceæ*."
Chemical, Burlington House, W., 8 p.m. 1. Professor Church, "Analysis of a Species of Erythrophyll." 2. Dr. Witt, "Phenylenediamine." 3. Mr. Hannay, "Calcium Sulphate."
Psychological, 11, Chandos-street, W., 8.30 p.m.
London Institution, Finsbury-circus, E.C., 7 p.m. Dr. W. B. Carpenter, "Mesmerism, Odylism, Table-turning, and Spiritualism Considered Historically and Scientifically." (Lecture I.)
Royal Society Club, Willis's Rooms, St. James's, S.W., 6 p.m.

Fri.......Charity Organisation (at the House of the Society of Arts), 4 p.m.
Astronomical, Somerset House, W.C., 8 p.m.
Quekett Club, University College, W.C., 8 p.m.
Clinical, 53, Berners-street, W., 8½ p.m.

Sat.......Trades' Guild of Learning and National Health Society (at the House of the Society of Arts), 8.30 p.m. Prof. W. H. Corfield, "The Laws of Health." Part I. (Lecture IV.)
Royal Botanic, Inner Circle, Regent's-park, N.W., 3¾ p.m.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,255. Vol. XXV.

FRIDAY, DECEMBER 8, 1876.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

THE LATE S. T. DAVENPORT.

The youngest son of the late S. T. Davenport (formerly for so many years the financial officer of the Society), is now a candidate for admission to Christ's Hospital. Should any member be in a position to nominate a boy to the school, he will confer a benefit on the child of an old and tried servant of the Society by nominating him, and this fact must be the excuse for thus bringing the matter before the members of the Society.

PROCEEDINGS OF THE SOCIETY.

NATIONAL TRAINING SCHOOL FOR MUSIC.

The Council have nominated Percy H. Mull to the Society of Arts Scholarship, vacated by the election of Miss Hélène Heale to a Royal Scholarship. Mr. Mull was one of the candidates recommended for scholarships by the examiners at the first examination for the Society's scholarships.

CANTOR LECTURES.

The third lecture of the course by G. A. Thrupp, Esq., on "The History of the Art of Coachbuilding," was delivered on Monday last, the 4th inst.

FOURTH ORDINARY MEETING.

Wednesday, Dec. 6th, 1876, Robert Rawlinson, Esq., C.B., in the chair.

The following candidates were proposed for election as members of the Society:—

Alleyne, Sir John Gay Newton, Bart., M.I.C.E., M.I.M.E., Butterley Car, Alfreton.
Baker, George (Mayor of Birmingham), Bellefield, Birmingham Heath, Birmingham.
Blackie, Robert, 17, Stanhope-street, Glasgow.
Blakeley, Mrs. Harriet, Forest-end, Sandhurst, Wokingham.
Duncombe, Hon. Cecil, Nawton-grange, York.
Heidemans, M., 11, Spring-gardens, Charing-cross, S.W.
Lucas, S. Bright, Tenby-villa, Stratford-road, Sparkbrook, Birmingham.
Martin, William Holt, A.I.C.E., 15, College-street, Nottingham.
Mayer, Leonard, 32, Lawrence-lane, E.C.
Myers, W. Beswick, Bankfield, Burley, near Leeds.
Parker, John, Woodstock, Oxford.
Way, J. Thomas, 9, Russell-road, Kensington, W.
Webster, William, jun., Wyberton-house, Lee, S.E.
Williams, Charles S. 90, Cannon-street, E.C.
Wollerstein, Edward M., 3, York-villas, Walton Brech-road, Liverpool.
Woods, Arthur, A.I.C.E., 8, St. Martin's-place, Charing-cross, W.C.

The following candidates were ballotted for and duly elected members of the Society:—

Ashbury, Thomas, A.I.C.E., M.I.M.E., 424, Stockport-road, Manchester.
Dyer, Colonel H. C. S., 44, Chorlton-street, Manchester.
Frazer, Daniel, J.P., Cumbernauld-house, Cumbernauld, by Glasgow.
Hemsley, Alexander, Castle-hill, Ealing, W.
Hilman, Reginald Arthur, 1, Fairmead-villas, Albert-road, Peckham, S.E.
Stallard, Josiah, D.L., The Blanquettes, near Worcester.
Vaizey, John Robert, Attwoods, Halstead, Essex.

And as Honorary Corresponding Member,

Stab, Captain Simon, Smyrna.

The adjourned discussion on General Cotton's paper on "House Drainage," was resumed:—

The Secretary read the following letter from Mr. Baldwin Latham:—

7, Westminster Chambers,
Victoria-street, Westminster, S.W.
6th December, 1876.

Sir,—As I shall not be able to attend the discussion on "House Drainage" this evening, will you allow me to make a correction in the paper of Major-General Cotton? It is stated that to Mr. Roe we are indebted for the improvement in the form of sewers. This however, is a mistake, as the improvement in the form of sewers is due to Mr. John Phillips, who was then the engineer to the Metropolitan Commissioners of Sewers. This is very clear from the report of the Health of Towns Commission. This fact, however, should not detract from the merits of the late Mr. John Roe's genius, in all matters relating to sewerage and house-drainage, for to him we are indebted for the mode of flushing sewers, and for the first practical exemplification of how a house-drain should be ventilated, as well as other matters relating to the theory and construction of sewers. To Mr. Robert Rawlinson, C.B., are we indebted for one of the greatest improvements in modern times, relating to sewers, and that is, the construction of sewers in perfectly straight lines, with lampholes and manholes at the points of lateral or vertical deviation.

It may be of interest to some of your members to know that, seeing the great difficulty the public have of acquiring sound information as to the proper construction of house-drains, Messrs. Henry Doulton and Co. intend shortly to open, on the Albert Embankment, a permanent museum of sanitary and other appliances, so that we shall have in this museum a great aid to sanitary education, as every person will then have an opportunity of seeing the latest improvements with reference to public works of sewerage as well as of house-drainage.—I am, &c., Baldwin Latham.

P. Le Neve Foster, Esq., M.A.,
Society of Arts, Adelphi.

The Chairman, in opening the proceedings, said:—Sanitary science is new, though the Levitical laws are old. The Romans sewered their towns and drained their baths, and probably other public buildings, but we have no evidence that the houses in Rome were drained as we understand house-drainage. Water-supply is as old as civilisation, but not in the fullest acceptation of the term, as practised in England. Water was not laid on under pressure to each house, as in London, to the total abolition of water-carriers. The progress of modern sanitary science may be said to have commenced with Drs. Mead, Lind, and Sir John Pringle; the great start of executing sanitary works, dates, however, from about 1840. Who invented oval sewers cannot easily be settled; but most certainly no person belonging to the present generation, as there are oval sewers, that is culverts, beneath some of our oldest canals. Earthenware pipes have been made and used in the East from remote time, principally for pure water conduits, but very old drain-pipes have also been discovered beneath the mounds of Babylonian ruins and at the Coliseum. If land-drains or house-drains had ever been extensively used they would have been found. The Roman power, in its extent, is known better by its buried pottery than by any written records of history, and we, in our land-draining and town-sewering, are writing history in some senses more permanently than the literary historian. Water, an emblem of purity, has been regarded with superstitious reverence in all ages; it is a solvent, a purifier, and a power, it is a prime necessary of life, and the sheet-anchor of civilisation. A land without water is a barren desert. A town without pure water is a place of sickness, misery, and plague. Water in abundance should be brought into a town, and proper means for it to flow out should be provided. Such conduits we term main-sewers and house-drains. The waste water of a town sewage may, for a population of twenty thousand, be about 600,000 gallons per day; the entire excreta will be 5,000 gallons, or, 1 to 120 of sewage. Any sewers which will take the one will take the other. Towns must be sewered, houses must be drained, and the human excreta, which is nearly all fluid, if passed into the drains, will flow away with the sewage; it should, therefore, be the duty of engineers and architects to learn how to plan and construct proper town-sewers and house-drains. To say that architects have not attended to house-drainage need not be considered a very severe censure, because, as previously stated, the science is new, so new that it cannot yet be said to have been established, although definite rules have been laid down, which, however, are termed "suggestions." It would, indeed, have been most wonderful if all men had accepted these suggestions, and acted upon them. The main principles may be recapitulated as being that surface water, as much as possible, should be discharged over and off the surface. Sewers should be for sewage, and drains should be tributary to sewers for drainage from houses. Neither sewers nor drains should traverse the basements of public buildings nor houses. Sewers and drains should be true in line, in gradient, and in cross-sectional form. Sewers and drains should be fully ventilated; there should be ample means for flushing and for inspection by side entrances, by man-holes, and by lamp-holes. Sewage out-fall works should be provided for interception of solids and silt, as also for clarification or for purification of sewage, so as to prevent the pollution of inland streams and rivers. To indicate that eminent architects have transgressed every suggestion—which, however, are suggestions after the buildings had been executed—I may name a few instances. The new Houses of Parliament, Westminster, where the main sewer, of large dimensions, traverses the basement longitudinally, below the level of the River Thames, and all the tributary drains fall into the sewer. Buckingham Palace was in a similar condition. Marlborough-house the same. In both these cases the sewers have been altered and ventilated. Windsor Castle did drain into fifty-three cesspools up to the year 1844, all within the basement. Noblemen's houses in the country were no better. Alnwick Castle, Northumberland, in 1850, was traversed by large old rubble drains, in which rats swarmed. The old drains in the town of Alnwick were of a similar character. The rats in this town were, however, discriminating and fashionable, as, when the ducal family was at the castle the rats were at the castle, and when the family was from home the rats patronised the town. Rats about any town or house are a certain indication of bad sanitary conditions, as in perfect sewers and drains they cannot exist, there being no lodgment for them. At Hawick (Northumberland), the seat of Earl Grey, the sewers were of very large dimensions, and for each sink and water-closet a cesspool had been provided; the house, when inhabited, was pervaded with sewage gases. At Bowood, the seat of Lord Lansdowne, large absorbent sewers and cesspools occupied the basement; there were about forty water-closets, the entire contents from which had been absorbed or evaporated from the day they were first used up to about 1856. Gwydyr-house, Whitehall, the offices of the first Board of Health, 1848, was found on examination to have nine cesspools, full and overflowing, within the basement. The new public offices, Whitehall, have had the basement beneath the Home-office flooded with sewage. It cannot be pleasant for noblemen to have their houses pointed to as frightful examples. There is, however, this consolation, namely, all of those I have named have now been effectively drained and ventilated, and may be pointed to as good examples, the old drains have been removed, and Alnwick Castle has been sewered with an outlet earthenware sewer 12 inches in diameter. The Houses of Parliament retain the central sewer. Dr. Percy, however, takes care, by ventilation, that no injury occurs to the members. In Paris, Brussels, Ostend, and some other Continental towns, there are cesspools and sewers, which is a costly and dangerous arrangement; the cesspools are compulsory, and are beneath courtyards, or beneath the basements; these overflowing and trickling into the sewers, the escaping gases from them make the houses most offensive and dangerous. There has in past times been neglect in not providing correct plans of town-sewers and house-drains. I have never in any case to which my attention has been called found a correct plan of the sewers and drains. I have never, however, undertaken a work of sewerage and drainage that I have not prepared and left a complete plan, with a fully written description and key to the works, so that flushing may be attended to. Full and correct plans should be insisted upon in each case.

Mr. Adams wished to bring before the meeting a work recently done at the Army and Navy Club, Pall-mall, with the object of showing the value of cast-iron pipes as against earthenware. For a long time there had been a great deal of annoyance experienced there from offensive smells in the basement, and about 18 months ago Mr. Birch was called in to advise. He found, on examination, that many of the sockets of the drain pipes had become loose, so that sewage had soaked into the earth and accumulated. Another evil was, that the drains were nearly stopped up with fatty matter from the kitchen department. Mr. Birch took up the whole of the drains, and substituted cast-iron pipes, similar to those used for gas and water, except that they were coated with Dr. Angus Smith's patent solution, which, being put on when the pipes were hot, formed a complete glazed lining, as smooth as that of earthenware pipes. These were laid in straight lines, provided at intervals with man-holes, or cleaning places, so that they could be got at at any time. The smallest pipes were 3 inches in diameter, the main pipes 6 inches, and the largest of all 7 inches. All the main pipes were carefully ventilated by 4-inch pipes carried up to the top of the building, provided with Banner's ventilating cowls to draw off the air. To prevent the accumulation of grease, an intercepting box was constructed; and the baths, sinks, and waste pipes from the cisterns were cut off from the drains, and discharged into gullies in the areas, so that there was no chance of sewer gas getting into the house. Another difficulty, arising from the accumulation of steam, was obviated by collecting it all into one pipe, where it was condensed. Other minor particulars were attended to, which he would not stay to describe, but the result was, that when he opened the drains about ten days ago, he found they were as clean as the first day they were put down. The solution was intact; there was no trace of rust or oxidation, and the interceptors were nearly full of grease, showing that they had done their work effectually. The committee thought at one time that they would have to spend a great deal in ventilation, but they found that, under the new system of drainage, no further expenditure was required.

Mr. R. W. P. Birch said, with reference to the question of back-drainage, he did not think he could do better than quote from a paper which he had read two or three years ago. He then proceeded to read from the paper, showing that by laying the sewers at the back instead of the front, the total length of pipes, as well as the labour, was reduced to a minimum.

The Chairman thought they had hardly met to hear a paper read, and believed the meeting were perfectly aware that the subject of back-drainage was not new, for it was a rule laid down in the first regulations under the Board of Health, and had been carried out in hundreds of cases. He was sorry to say that two of the most eminent engineers in London had made affidavits before one of the Vice-Chancellors to prove that back-drainage ought not to be allowed.

Mr. Birch said his object in calling attention to the paper was to overcome the prejudice which at present existed against back-drainage.

The Chairman said the prejudice arose from the circumstance that back-drainage necessarily involved the drains going through adjoining premises, and if any mistake occurred, Mr. A. might block the drains of Mr. B., and Mr. B. might be put to the inconvenience of breaking up his drain, and pay the expense of repairing mischief caused by Mr. A. If drains were laid in straight lines, with proper man-holes, for the purpose of examination, every drain could be cleansed without trespassing on other people's property.

Mr. Birch said if pipes were caulked up with tarred yarn, there could be no leakage. Reference had been made to concrete as a safeguard, but he did not think it would stop leakage in short earthenware pipes. By using cast-iron pipes, an opening could easily be made and closed again with an ordinary gas-pipe joint, which was not possible with earthenware pipes. He had seen the drains opened, after ten months working, at the Army and Navy Club, and they appeared to be in as good a condition as when first laid.

Dr. A. Carpenter said General Cotton had assumed that sewer gas was a necessity of sewers, but such was not his opinion, for if sewage were removed immediately, they would not have the production of sewer gas to deal with. The great point was to keep the gas out of sewers. In London, the chances of it finding its way into houses was unfortunately very great, and one of the canon laws for preventing its so doing, was that there should be no direct communication between the sewers and the interior of the house. To keep houses pure there should be a constant supply of water in connection with the sewage arrangements, and landlords should be compelled to provide a sufficient supply to every house. The General having stated that it was necessary that the arrangements in connection with the sewers of a house should be inspected by the local authority, he might mention that there was a law to that effect at the present time, though it was not possible to make the local authorities carry out the law. The inspectors, on whom devolved the duty of seeing the sewer arrangements properly carried out, received a little "palm oil" from the contractors, and consequently did not look very sharp after things. Until people were educated in the first principles of sanitary science, with reference to the necessity of keeping these matters out of their houses, they would not be able to avoid the dangers which arose from sewer gas, or imperfect sewers. Unless some one were paid a proper salary to look after these things, the law, in his opinion, would not be carried out. It was requisite, therefore, that the public should be educated in the necessities of the case, and to this end the paper read by General Cotton and such discussions as the present would be very valuable. The points now brought forward were not new; they had been discussed over and over again, particularly at the time that the Prince of Wales was suffering from typhoid fever, when there was a perfect *furore* in the press about the dangers of sewer-gas. Still it was only a nine days' wonder, and the bulk of the public were not much wiser now than they were before. Every now and then they got a fright, and then perhaps a person set his house in order, and was content, leaving the drains to get out of order again, as they always would in time, if not looked after. Then they were surprised to find that the measures they had adopted failed, but they failed simply from neglect. He knew to his cost how difficult it was to get people to understand the true principles of drainage, though they were very simple. The first canon was that sewers should not be sewers of deposit, but the excreta should be got rid of, out of the town and on to the land, as quickly as possible, and if that were done in two or three hours, there was no chance whatever of sewer-gas developing. And it was acknowledged now that the excreta of human beings, even of those suffering from infectious diseases, was not infectious until a few hours after discharge, until in fact it had undergone certain changes analogous to fermentation. If the excreta were got on to the land before the change took place, no danger would arise. The result was, that as far as epidemics arising from decomposing sewage were concerned, they might be entirely prevented. The next point was, that there should be a total separation between the water supply and the sewers, otherwise the water would readily become poisoned. The water-pipes, therefore, should be on the opposite side of the street to the sewer. Another canon was, that there should be no communication between the interior of the house and the sewer. If this alone were attended to, there would be no evil from sewerage. It was extraordinary to find how difficult it was to get the true principle of drainage carried out, for they had actually seen, within the last twelve months, a metropolitan authority had been calling on a large and important company to take up their drains, which were constructed in the very best way, because it was a case of back-drainage, and to reconstruct them, carrying them under the house to the sewer in front. The main point, then, was to get the principles understood, and matters of detail would follow in due course, and without much differing.

Mr. Ford complained of the reflections made by Dr. Carpenter on Officers of Boards of Health.

The Chairman said he was sorry Dr. Carpenter had made the remarks referred to. He must, from his position and experience, know more of the surveyors of Great Britain than Dr. Carpenter, and, though he knew there were some who were not so careful as might be wished, no solitary instance had come under his notice, either directly or indirectly, of the use of "palm oil."

Dr. Carpenter said his observation had no reference to surveyors, and he was sorry if it was so understood; but he could not withdraw it, because he knew it to be true. His reference was to the covering-up of house-drains, which was supervised by a class of house-inspectors who were paid a guinea a week, and that was not sufficient to command the services of men who would do their duty properly.

Mr. Ford thought the meeting ought to concentrate its attention on the point brought before it in the paper, and not discuss the merits of the goods of individual manufacturers. He respected Messrs. Doulton's firm, but others were equally good, and he wanted to see the subject discussed in its broad, general bearings. One of the matters spoken of by the chairman was the draining in Windsor Castle; and he was afraid it conveyed rather a reflection on Mr. Menzies, a most eminent engineer, for he carried out the work there under the immediate supervision of the late Prince Consort, who unfortunately lost his life in consequence of its imperfections.

The Chairman said Mr. Menzies was as innocent of the Windsor Castle drainage as any person in South Africa. The late clerk of the works, Mr. John Turnbull, proposed and executed the drainage under the supervision of the late Prince Consort.

Mr. Ford said, coming to the question of the joints in drain-pipes, much might be said in favour of iron pipes, and also of the folly of using them without their being coated with a preparation similar to what had been mentioned; however, after all, that was not the grand secret. It was well known gas and water pipes all leaked. Was it necessary that attention should be wholly concentrated on the joining of small pipes? He thought not, unless you neglected the grand question referred to by Dr. Carpenter, namely, the ventilation of sewers. If the Metropolitan Board had succeeded in carrying the "Amending Building Act," this difficulty would have been avoided, because they proposed to ventilate by means of rain-water pipes. But, unfortunately, their surveyors had no control over the form of the roofs, or where the water-pipes should be placed. At the present moment every one contrived to shut off the gas, and the consequence was to bring a great force to bear on every joint in the pipes; he did not think, however, that much fault could be found with the drainage in new houses. Where the surveyor had power over the arrangements, it was very seldom that imperfections were to be found, but principally in old houses. And he believed there were many metropolitan parishes where the drains were laid down in such a way that no imperfections could be found. One gentleman stated last week that he had discontinued using clay, and resorted to other materials; but he thought the general practice was to use clay, and, putting a facing of Portland cement, it might succeed; but there was no material which could make the joints as safe as could be desired. The great point was to remove the pressure inside the pipes, and then ordinary stopping would be sufficient. It was a very common error that there were two currents of air passing through the drain-pipes, and if you put a light at the outlet into the drain of the sewer, one current would blow the flame into the sewer; but if you raised the candle above the level of the sewage, it would blow back into the pipe; but following that out further, it would be found that it took place at the point of intersection, because the current of air was obliged to flow into the drain-pipe, to fill the vacancy created by the sewage flowing out. He thought the old method of unglazed pipes was the nearest to perfection, because they were made with a compound socket, the result being that, after the pipes were placed at a proper inclination, the weight of the soil tended to close them and keep them tight.

Mr. Collins said his experience in the Vestry of Paddington, where he had been on the Sanitary and Highway Committee for many years, led him to an entirely opposite conclusion to Dr. Carpenter's. They had occasion to employ a large number of inspectors, at salaries not so high as could be wished, but still as high as the means afforded, and he could honestly state, having had every opportunity of judging, that a more honest, straightforward body of men did not exist than the inspectors in that locality, and he had no doubt they were the same in other parishes. He thought the subject for discussion was not so much that of the ventilation of sewers as the best mode of perfecting house-drainage, how the present state of legislation affected the question, and what means existed for ensuring it. It was stated by one gentleman at the late conference on this subject, that no means existed for compelling proper attention to this matter, but that statement was hardly borne out by the authorities then present. Dr. Tripe said they did not require further legislation; Dr. Whitmore endorsed what Dr. Tripe had said with regard to the efficiency of the Acts, if they were carried out, to provide efficient house-drainage; Mr. Elkington, of Bermondsey, said that, after 22 years' experience, his own view of the Acts of Parliament was that they had proved perfectly sufficient; and Mr. James Lovell, of Hackney, agreed with those remarks. Dr. Liddle gave a qualified opinion, and only one gentleman, who was comparatively a novice, took an adverse view. The powers of the Act were both prospective and retrospective, the former being comprised in the Metropolis Local Management Act, the 18 and 19 Vic. cap. 120, sec. 73, where houses were directed to be drained into sewers, and water supply was considered. The 79th section referred to alterations in drainage, and the 75th positively stated that it should not be lawful to occupy houses unless they were properly drained and sewered to the satisfaction of the local authority. Cap 102, sec. 67, said there should be an inspection during progress, and sec. 82 gave power to enter and inspect. Under sec. 134 of cap. 120, the Vestry had the power of exercising the Nuisances Removal Act, and under sec. 202 they had power to make their own bye-laws. He, therefore, considered they had ample legislative powers to ensure perfect drainage. He must, however, differ from the last speaker with regard to there being no imperfections in new houses, for only that morning he had had to inspect some houses recently finished near Lancaster-gate, one of which a client of his had purchased. He there found a combined system of drainage, which he could not agree with, because, if the drain of one house became stopped, all the others suffered in consequence. There were four or five in a terrace, all connected together, and on examining the drains he found the joints were made with clay, and very imperfect. He insisted that the whole should be taken up, but he found great difficulty with the surveyor he had to meet, and ultimately his client had to agree to bear half the expense. Sir Henry Cole, besides passing some strictures on the metropolitan vestries, which, in his own case, he could not agree with, spoke in praise of the system adopted in Germany, but his own experience was that the state of affairs in that country was infinitely worse than in either France or Belgium, the defects of which the Chairman had clearly pointed out. Whenever he went abroad he always came back to his own country perfectly satisfied that, as far as they had gone in sanitary science, they had the best information, and that it was carried out in the best way. No doubt there were many imperfections, but after all there was no great difficulty in getting the Acts carried out, for even in Westminster, which perhaps presented more difficulties than many places, the surveyor informed him that he published plans and instructions, and that the builders were most willing to carry them out without any compulsion at all. The truth was, that "evil arose from want of thought, as much as want of heart," and neither builders nor the public were sufficiently aware of the importance of proper drainage, nor of the principles on which it should be carried out. When they were, the public themselves would insist upon it, and he, therefore, rejoiced at every effort made by this and other societies to spread abroad sound information on this most vital question.

Mr. Botly could not at all agree with a remark made by one speaker the previous week, that General Cotton's paper contained no practical suggestions. He could only say that one point in particular, that relating to the stoppage of drain-pipes with grease, was of great practical importance, and he had had it read aloud to his servants. He had had his attention called to that point many years ago, and only very recently a case occurred of a young gentleman being near the point of death, and the whole household being ill, from that very cause. He never engaged a servant without impressing the necessity of the scullery pipe being kept free from grease, because he felt that unless people looked after these things themselves, all the efforts of architects and builders would be thrown away.

Mr. Collins desired to add that if they wanted better educated vestries in the metropolis, he thought the qualification should be raised. He considered a £40 ratal far too low.

Mr. Rogers Field, as an engineer, had been very much pleased with General Cotton's paper, and though, as he had said, he had brought forward nothing new, no one acquainted with the subject could fail to appreciate its value. Every word which had been said by the chairman and others as to existing faults was absolutely true, and instead of going too far, they had not gone far enough. One gentleman said the defects did not exist in new houses, but he had had considerable experience, and yet he had never examined a single house, new or old, where the drainage could be considered satisfactory, and he did not set up too high a standard by any means. Taking only one single point, which had been mentioned by Dr. Carpenter, that there should be no direct connection between the sewer and the house, you might go into hundreds of new houses and find it neglected, the sink being connected in a way which every one who had studied the subject knew to be radically wrong. Drains ought never to go underneath the house if it could be helped, but, unfortunately, in London it could not always be avoided, though it could in many instances. When he came across a case of that kind, his first care was to ascertain if the drain was water-tight, by stopping up the lower end, and then digging down to the upper end, and trying to fill it with water. He had never yet found a drain which could be filled with water in this way. Sometimes people fancied it ran away through some other outlet, but when the floor was taken up, and the drain examined, it would be found that the water came out from the joints in little fountains. Unless the drains were laid with iron pipes, and properly tested, they were sure to be defective; but there was only one safe rule—if the drain must go under the house, it must be made water-tight. It very often happened, however, that the drain need not go under the house, and there it should be avoided altogether. He could fully confirm what Mr. Rawlinson had said with regard to many large houses being in a very bad condition, in a sanitary point of view, from his own observations. About two months ago, he was called in to inspect the drains of an hospital in Manchester, and on inquiring for a plan of the drains, he was informed they had no plan. He found the soil-pipe of the water-closets were carried upwards through the water-cistern, and ended in a sort of trap, which allowed the gas to enter the water, thus causing illness. Particular attention should be paid to the fastening of the joints of the pipes, for if this were not done there would be a continual escape of sewer gas into the house. In one instance he had found the foot of the soil-pipe let into a dip-trap, which collected the deposit, and every time the water-closet was used, the water coming down stirred up the deposit, thus causing a smell all over the house. In the case where plans of the drains of a house were deposited with the Vestry, they were very often found to be faulty, and this arose from the builders giving a sketch plan before they built the drains; they showed where they intended to put them, but forgot to do it. This might be remedied by the plan being given after the drains were made. The way to remedy the various defects was by directing public attention to the matter. The two plans on the wall showed two ways of connecting the sink with the drain; the first was the ordinary method in common use, where the sink-pipe terminated in a small cesspool inside the house, into which the drain entered; and in the second one, the drain did not go into the house; the sink was at the top, the metal pipe from the sink was carried down through the wall, and discharged outside the house, and by this means all smells were avoided. In one case, where complaint had been made of the sink not being in proper order, the Sanitary Inspector had written a letter to the *Times*, stating that the bell-trap having become dry, there was necessarily an escape of sewer gas. With a proper outlet there should be no escape of gas into the house, even without a bell-trap. At Dorking the owner of eighteen cottages was summoned on account of the drains not being in proper order, and the magistrates dismissed the summons as to seventeen of the houses in which the bell-traps were in proper order, but one of the eighteen being out of repair, they ordered it to be set right, at the same time stating that they should be glad to have a higher authority upon the point from London.

Mr. Turner said in the case referred to, the evidence of the medical officer was to the effect that it was likely to be injurious to health; he did not go so far as to say that it was injurious.

The Chairman remarked that, whatever he might have said, one thing was quite clear, namely, that attention was drawn to the danger which might arise from having the trap out of order.

Mr. Turner said the magistrates administered the law as it then existed.

Mr. Field said, he would not pursue the point further; but he might mention that at Uppingham, through the kind assistance of the Local Government Board, a series of bye-laws and suggestions, with a plan showing the readiest method of doing all that was necessary, had been drawn up, and sent to the various builders; and one of the laws was that every sink and waste-pipe should go out in a certain manner, as there explained.

Dr. F. Churchill said it seemed to be agreed that in connection with large towns the water-carriage system was essential, and that sewer gas was a necessity; therefore they had to consider how best to get rid of the nuisance. As traps did not secure an immunity from sewer-gas, they must provide some other means. General Cotton said they should ventilate all the sinks, but not the closet, and this was the one thing they had not yet found a means of disconnecting from the house. On the black board he had drawn a sketch of a closet, by which it was possible to bring in the closet along with all other systems of drainage in the one law of disconnection or isolation from the drains. There was no receiver or container, which all would agree was a source of nuisance, and there was a full current of pure air; any form of valve was applicable, and air was supplied through an iron grating at the back. Referring to the bad effect of clay joints, he might mention a case where a person who has his drains thoroughly attended to, found that the roots of a large tree had found their way through the joints, completely blocking up the drain, which had to be re-laid in consequence. As to the question of ventilating house-drains at frequent intervals, he considered that that system was completely carried out by his plan.

Mr. Ford asked what would be the condition of things in a closet so designed on a cold, frosty day, when the air within the house, being considerably warmer than that outside, there would be of necessity a considerable in-draught?

Mr. Churchill replied that there was no possible chance of air from the outside entering the house, because the chamber would be hermetically sealed.

Dr. Burn said it was a shocking thing that builders should be allowed to lay the drains of new houses in the way they did. At one time he occupied a new house at Kensington, built upon a good gravelly soil, and yet the escape of sewer gas was something frightful.

Mr. Williamson, referring to Mr. Field's plan, asked what would be done with a sink inside the house, where it was not connected with the outer wall.

The Chairman replied that it would have to be carried in the best way possible to the outside, but he understood Mr. Field would, if possible, remove the sink to the outer wall.

Mr. Williamson said they had to deal with sinks as they then existed.

Mr. Field said he had never yet seen a sink which he had not been able to deal with.

The Chairman thought they must be content to work earnestly in the matter, and not think that they were injured because people did not pay attention to what they said. Although Christianity had been preached for nearly 2,000 years, still there were very many yet unconverted, and in the same way they should go on calling attention to this subject. Even if they were satisfied that to a great extent they had been beating the air, that would not justify them in living in idleness and leaving the matter where it was.

General Cotton, in replying, said he was satisfied that at least his paper had been of value in provoking a discussion, and he merely took the subject up in order to get people to devote attention to such an important subject. The point on which he had particularly wanted information was, as to what could be done to ensure some result from all their sanitary knowledge, because, in many instances, whole streets of houses were being built with defective sanitary arrangements. He was told that there was a law sufficient to prevent this being done; but, however that was, the fact remained that the drains were wrongly constructed. He wished to instil into the minds of builders the requisite knowledge for improving the drains of houses. The general opinion seemed to be that Acts of Parliament were sufficient; but if they were sufficient, there should be some unity in carrying the matter out in London. Great good might be done by having a conference occasionally, in order to connect the vestries; and he ventured to say that, if the matter were brought to the attention of the vestries, they would try and assimilate the bye-laws, in order that what was requisite might be accomplished. The great thing was to have an abundant supply of water, and, in his opinion, the discharge of sewage and the supply of water should be under one authority. The great danger appeared to arise from the nominal supervision exercised in the matter of laying drains, though he hoped this would be shortly remedied. If great changes were to be made in London, he thought there should be some means of providing the money for the purpose, instead of coming upon the householders for a large sum of money down at once. As many of the remarks made had been answered already, he would not further occupy their time, considering the lateness of the evening.

A vote of thanks to General Cotton, on the motion of the Chairman, having been unanimously passed, the proceedings terminated.

The number of awards thus far made by the Centennial judges are divided between America and foreign countries as follows:—Ores and metals: America, 351 medals; foreign exhibitors, 253. Manufactures:—America, 1,610; foreign countries, 1,702. Machinery and inventions:—America, 510; foreign exhibitors, 152. Agriculture, live stock, and miscellaneous products:—America, 864; foreign exhibitors, 1,809. Education, science, and music:—America, 350; foreigners, 728. Fine arts:—America, 105; foreigners, 463.

Among the objects now being exhibited at the Agricultural Show is a horizontal engine, with high-speed governor, etc., all finished and complete, made by apprentices, under 21 years of age, in the works of Messrs. Robey and Co., the engineers, of Lincoln.

MISCELLANEOUS.

NOXIOUS VAPOURS FROM ALKALI WORKS.*

By Edward Davies, F.C.S.

Any one who has had occasion to visit St. Helen's, Widnes, or any other centre of alkali manufacture, or who has even passed near these places in travelling, will have a lively recollection of certain odours, varying in character and intensity, but all bad, and of dense vapours which, in damp weather especially, rolled along the ground in clouds. He will also recall the features of the landscape, if we may give that name to fields without a green leaf in the hedges, trees with no more life than a clothes-prop, and in the immediate vicinity of these towns, vegetation all but extinct. And as these smells and sights offend the nose and eyes, the traveller will certainly feel disposed to invoke the interposition of a benevolent Legislature, to clear the atmosphere and restore the fair face of nature, that is, if he be in no way interested in the manufacture in question. The landed proprietors in the neighbourhood, who, perhaps, have no beneficial interest in the works, and who see trees which have graced their domains for ages struck down whilst still strong and sound at heart, whose flower gardens can no longer be a source of pride or pleasure, and who cannot at once or without a pang sever their connection with spots which their forefathers for generations have inherited, and with which historical ties have bound their name and reputation, are sure to resent the intrusion of these upstart outcomes of modern science, and to call upon them to depart, or cease to be a nuisance.

No one who has not had a practical connection with an alkali works can take a general and fair view of the subject; and if, like myself, he has ceased to have intimate relations with such works, he will form as impartial a witness as the circumstances of the case will allow.

In view of, no doubt, impending legislation on the subject, we cannot, as a chemical association in the close vicinity of such works, do better than strive to attain correct views on this subject; and with this view I have brought the question on for discussion this evening.

I propose to treat it in the following manner:—

1. To describe the various vapours, noxious to animal or vegetable life, which escape from alkali works, with their effects.
2. To show how these vapours get into the atmosphere by causes preventible and non-preventible.
3. The methods for diminishing or preventing such escape.
4. The probable effects of stringent legislation, and the possibility of enforcing it.

The first part of my subject will probably be old to many here, and I must beg their indulgence whilst I speak to those who are less acquainted with substances which to others are as household words.

Sulphurous Acid Gas.—This gas, familiar to all who have burnt a sulphur match (which, by the way, is now almost a thing of the past) arises almost exclusively from the burning of sulphur, either free or combined with iron or copper. In the manufacture of sulphuric acid vast quantities of iron pyrites, FeS_2, are annually burnt, and by combination with the oxygen of the air, converted into peroxide of iron and sulphur dioxide, or sulphurous acid gas. In the burning of coals also, the sulphide of iron contained in the coal, and especially in the inferior qualities used in the alkali manufacture as fuel, is decomposed in like manner, yielding the same gas.

Sulphurous acid gas is a dense gas, thirty-two times heavier than hydrogen, and two and a quarter times heavier than air. It has a pungent smell, and when in large proportion in air produces coughing. It does not appear to be injurious to health when inhaled in small quantities, and has been found useful in affections of the throat, for which, *à priori*, we should have supposed it most unsuitable. It is also a powerful disinfectant, and one of the oldest known.

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* Read at a meeting of the Liverpool Chemists' Association.

On vegetable life it exercises a most baneful influence, due, no doubt in part, to its direct action, but more to the formation of sulphuric acid by its oxidation in presence of moisture.

I cannot find any information with regard to the rapidity with which this oxidation takes place, but I believe that it is more rapid than is usually supposed.

Hydrochloric Acid, arising in the first process of alkali manufacture from the decomposition of salt with sulphuric acid, is a gas not so dense as SO_2; but, from its forming clouds of visible vapour by combining with the moisture in the air, is more visible. To this gas the public attribute the injury resulting from vapours from alkali works almost entirely, no doubt from the fact that, before the Alkali Act, manufacturers who did not make bleaching powder had no compunction about sending the gas into the atmosphere in appalling quantities, and also that the Act deals only with this gas.

This gas has no doubt a very irritating action upon the lungs, especially when concentrated, but my own experience in a works does not tend to show much injury from it.

A few months before going to an alkali works I had a severe attack of bronchitis, and entered upon my duties in December. During a large portion of the time which I spent there (four years) I had to walk three miles to and from the works over very exposed roads, and in one or two very severe winters.

The works (it was before the Alkali Act) were rather out of repair, and such volumes of hydrochloric acid gas used to come down at times that I was driven out of the laboratory, and had to take refuge on the canal bank. Yet I had no return of the disease, nor was I, from any cause due to ill-health, absent one day during the four years.

The manager, a young Scotchman, who, when he came, appeared to be a certain victim to consumption, suffering from continuous cough and night sweats, gradually recovered strength, and lived there for about eight years. He, when absent from the works, got thoroughly wet, caught cold, and died in a few weeks; but when I left the works, his own opinion was that their influence had been beneficial. In the works, I made careful inquiries as to the general health of the men, and, although I have no statistics, I found that rheumatic affections arising from exposure in the long walks to the works, and alternations from heat to cold, were the prevailing complaints. As to its action on plants there is no doubt that it is most destructive when in a concentrated state; but as I cannot meet with any researches on the comparative action of SO_2 and HCl, I am unable to say which is the most destructive. *A priori*, I should think SO_2, not so much on account of its own specific action as on account of the H_2SO_4 which it generates. Water containing HCl on leaves as it volatilises will take the acid with it, but H_2SO_4 concentrates as the water evaporates and is left behind.

Nitrous Fumes.—These must amount to a very considerable amount, as almost all the nitrogen of the nitrate of soda (except that retained by the sulphuric acid sold away from the works) will ultimately find its way to the atmosphere in this form. These fumes, consisting of $N_2O_3 + N_2O_4$ are by moisture converted into nitric acid, which is well known to have a peculiar corrosive action, and also acts chemically on organic matter in a manner different to the acids named above. These gases are decidedly injurious to health, and when inhaled in quantity have been known to act as a specific poison, and not merely by the local injury which they produce. As to their action on vegetable life we have no specific details, but no doubt it is injurious; against which may, perhaps, be set the manurial value of nitrates when the nitric acid is washed into the ground by rain.

Sulphuretted Hydrogen.—This gas, emanating from the vast heaps of waste which accumulate so fast as a byeproduct in making soda ash, is one which calls attention to itself by its strong and offensive smell. In the concentrated state it is speedily poisonous to animal life, but in a dilute state those who have the misfortune to work much in a laboratory must hope that its poisonous action is slow. Certainly it does appear to cause headache sometimes; but except as it may gradually sap the foundation of health, and imperceptibly bring on disease or a susceptibility to disease, it does not otherwise cause alarm.

To plants it does not appear injurious to anything like the extent of the gases previously named.

Chlorine.—In the manufacture of bleaching powder the production of this gas is yearly increasing. It is a heavy greenish gas, and perhaps the most injurious which escapes from the works.

Its influence on man is well known to any who has had practical experience in an alkali works, as resulting in violent irritation of the air passages, causing coughing, together with a directly poisonous action manifested by diminished action of the heart, exhaustion, and pallor of face and extremities. Alcoholic stimulants are apparently necessary for the treatment of this unpleasant affection—at least I remember having to supply large quantities when I was at a works.

On vegetable life it is no doubt equally potent, as it, like nitric acid, has a chemical action on organic matter.

The only thing to be said in its favour is, that it is a disinfectant, and that it and H_2S, if they get mixed, neutralize one another with production of $HCl + S$.

Ammonia is the only remaining emanation from alkali works, being produced in the manufacture of caustic soda; but it cannot be considered as a noxious vapour, as it neutralises any acid with which it may mix. It sometimes intensifies the dense appearance of vapours by the formation of ammonia salts.

The second head may, perhaps, be best treated by taking these vapours in the same order as before.

Sulphurous Acid Gas.—I give the pre-eminence to this gas, as in the atmosphere of our alkali districts it far exceeds the hydrochloric acid. Dr. R. A. Smith, in "Air and Rain,' gives the following figures:—

	HCl		H_2SO_4
St. Helen's	1	..	3·48
Glasgow	1	..	7·82

This gas escapes from the works when it arises from the combustion of pyrites almost entirely from preventible causes. I have seen it blowing out from the kilns in consequence of insufficient draught, and in a galo an old leaden chamber will give it off from every crevice, and they are sometimes many.

The renovation of an old chamber is an expensive affair, and there is a strong temptation to patch it up as long as it will hold together. Then, under the united influence of heat and acid, tunnels and pipes will leak every now and then, and intermittent loss is inevitable; but its amount should be small, and, as it represents money value, good management will repay itself. But as regards any valuable effect to result from the checking this source of evil, I fear that it will be imperceptible; for whilst we stop the leaking tap the gas from another source is escaping, as by the bunghole. I allude to the SO_2 from the pyrites in the coal and slack used as fuel. In Widnes I am informed that 1,000,000 tons of coal are used in one year. These contain about 2 per cent. of sulphur, but suppose, allowing for waste, etc., that 1½ per cent is converted into SO_2, this will equal 15,000 tons of sulphur, or 30,000 tons of SO_2, equal to about 46,000 tons of sulphuric acid annually set free in the atmosphere. Here, in my opinion, is the true source of mischief, everything else being subordinate; and this at present is non-preventible. We may completely burn our smoke, and thus prevent carbon escaping, but this has not the slightest effect in mitigating the mischief, and at present no means are known which will remove this gas from the products of combustion. To some extent, lofty chimneys may afford the means of diluting the gas, by sending it into the upper strata of the atmosphere, but the problem of absorbing the SO_2 without injuring the draught of the chimney is unsolved.

Another source, entirely preventible, is the production of SO_2 from burning waste heaps; and, where this is permitted, the gas, being evolved at the level of the ground, does immense mischief.

Hydrochloric acid is so completely under control from the conditions under which it is produced, that, with the exception of accidental break-downs, but little need escape. The condensation in most cases is within the government limit of 5 per cent., and as the inspectors have given their undivided attention to this gas, we may suppose that almost as good results are at present attained as are practicably possible. In drawing the charges there is an escape, which, however, does not amount to more than a small fraction of the gas produced. Here, again, the difficulty of preventing leakage in the pipes which convey either the gaseous or liquid acid is great, owing to the action of heat and acid. By alternate cooling and heating, contraction and expansion loosen the joints and crack the earthenware tubes, whilst the cement does not appear to have been found which will stand the continuous action of hot acid.

The adoption of Hargreave's process appears to do away with much of the escape of hydrochloric acid vapours. No loss from broken pots can be experienced; and, so far as I have seen, the charges, when drawn, do not evolve any perceptible amount of gas. Here the only point of danger is the condensers, and as these are easily surveyed any escape can soon be detected.

Nitrous Gas.—In the style of working adopted when I was in an alkali works, the amount of nitrous fumes that escaped by the chimney was considerable, as Glover towers were not invented, and Gay-Lussac towers were rather out of repute. By the improved methods now in use the amount of nitre is diminished by two-thirds, and consequently so much less remains to escape. Possibly, still more perfect means may be adopted, so as to make the sulphuric acid process as perfect in practice as it is in theory; but in any case the proportion of this gas to others is small.

By Hargreave's process, again, all nitrous fumes are done away. What does escape at present is generally sent up the tallest chimney of the works.

Sulphuretted Hydrogen.—This arises from the waste heaps, either by action of the CO_2 of the air intensified by the acid fumes contained in it, or from acid liquors finding their way upon solid waste, or the liquid running from the heaps. The action of the air upon the heaps may be prevented by covering the waste as soon as possible with soil, and making the sides as smooth and compact as possible; but the liquid, highly charged with sulphide of calcium, which drains from the heaps, is more difficult to dispose of, especially as acid liquids are almost sure to get into the drains which carry it off. The amount of the liquid naturally draining away is rather small to be worked to a profit, but I think that it might be decomposed, and nuisance prevented, at no great cost.

Chlorine.—This most deleterious gas should, from economical reasons, be narrowly watched. Under the present system of bleaching powder making, no doubt a good deal escapes, both from the pipes which convey the gas, and also in packing the chambers. The former difficulty will continue to be felt until some material for pipes is discovered, unacted on by chlorine, non-fragile, and capable of being made in long lengths. The second evil may be greatly diminished by syphoning off the surplus chlorine from the finished powder, and perhaps may be some day removed by some kind of mechanical packing.

As to my third head, namely, the prevention of the escape of these vapours, I think that the previous remarks will have shown that, with the exception of SO_2, from coal, they result from leakage or imperfection of apparatus. Any one who knows the difference between perfectly new works and old ones, will at once see that this is the case. Again, with the exception of H_2S, all these gases represent a value in money, and at first it would appear that self-interest was all that need be invoked to cause them to be arrested. On the other hand, it must be remembered that to save a shilling at the cost of eighteenpence does not leave a profit, and in many cases it pays much better to patch and have a little loss than to repair thoroughly and have none. Accidents, again, will unavoidably happen as long as earthenware pipes and lead constantly acted on from the inside are the most prominent materials in the construction of apparatus, and as this is at present unavoidable in many of the processes, these accidents must be taken as part of the system.

In my opinion much injury has arisen from the concentration of works in a small area; and to check the natural tendency in this direction, however hard it may be, is, I think, of paramount importance. When the vapours of one works mix with those of another, and then of another, a process of concentration goes on, and vapours in themselves almost harmless, when increased in density in arithmetical proportion, appear to do mischief in geometrical proportion. In works grouped together it is most difficult to apportion the measure of blame, and each hopes to escape under cover of the rest. As the escape of vapours to so large an extent depends on imperfections of apparatus attendant on wear and tear, if the government take this matter in hand, as they seem paternally disposed to do, the first requisite will be an army of inspectors furnished with fullest powers. Literally despotic sway will have to be given, with authority to order the removal of this, and the renewal of that. Attendance of the inspector, almost as constant as that of a Customs officer in a bonded warehouse, will be needed, so that the perversity of the British workman may be in some measure checked.

It is to be hoped that in this way, whatever expense the manufacturer may be put to, he will not, as in the past, be left in the lurch after all, and compelled to pay any damages an enlightened British jury may assess, although he has done all he was called upon to do. He may fairly, I think, demand that he be furnished with a certificate of immunity, and, with governmental supervision and management of his works, he will feel inclined to ask them to kindly take the whole thing into their own hands, and allow him a small pension to look on.

I am utterly opposed to this paternal government and meddling interference in minute details. If crowding of works is permitted, then let the damage inflicted by a given area be paid by that area, and thus a direct impetus be given to each to look keenly after both himself and his neighbours. Let damage be assessed by independent men, who will give some consideration to broader views than damage to an isolated field, and will take into account the advantages which accrued to the neighbourhood, as a set-off to some extent.

Fourthly.—If stringent legislation does follow, what effect will it have? In my opinion not much that will be perceptible in the vegetation around a group of alkali works. Where several works unite their vapours in one dense cloud, trees will still be objects of pity for a couple of miles around, and occasionally a delicate nose will detect an acid whiff at perhaps three miles. All that unavoidable accidents and coal smoke can do will still be done, and it will be hard for the closest inspection to keep pace with the ever-increasing area of the works. If works are still allowed to crowd together, I suppose a certain area must be given up to them, as in the Black Country, and the landowners indirectly recompensed by increased value of land and produce in their neighbourhood. If stringent regulations and continual inspection are to be the order, then increased price must be the result of increased expense, independently of the cost of the inspectors and their reports, and English manufacturers will be weighted in their competition with other nations. I do not say that they will therefore be defeated, but I do think that they should not be more hardly dealt with than the iron manufacturer, and the salt boiler, who in much the same way create a desert around them. Minute regulations as to the manner of carrying on the business, infraction of which would incur penalty and responsibility, would tend to discourage improvements, and act on the alkali trade as old excise rules did on the manufacture of glass. When we consider that the tendency of modern improvements in this branch is all towards the doing away with vapours, Hargreave's process diminishing $HCl + SO_2$, and doing away with nitrous fumes altogether, the ammonia process almost removing all the vapours and making no waste, and Mond's process utilising the waste in the present process, I think that we may trust competition and small profits to put down waste, and the march of modern science to attack and destroy the evils which remain, without binding the hands of the manufacturer with endless governmental red tape, or smothering his responsibility by setting up a standard beyond which he will have no inducement to go.

MUSEUM OF THE DECORATIVE ARTS IN FRANCE.

A national subscription has been opened by *L'Art*, a French illustrated weekly review, for the foundation and organisation of a French "South Kensington Museum;" that is, a Museum of the Decorative Arts, under the care of the "Union Centrales des Beaux-Arts appliqués à l'Industrie."

The following is a translation of an article on this subject, which lately appeared in this periodical:—

Twenty years ago, the superiority of France in every application of art to industry, was indisputable. The state of affairs is now much changed; we need but turn to one of the best informed papers of Paris, *Le Temps*, in its correspondence from Philadelphia, of the 25th July, we read:—

"After America comes England. The former occupies 187,705 square feet in the main building. England and its numerous colonies take up about 144,000 square feet. We come next, but at a considerable distance, with 43,314 square feet. According to the opinion of many observers, chiefly American, this British section is the most 'substantial' part of the exhibition. If we are effecting improvements, so also are the English manufacturers, and indeed most rapidly. The diligent study of the models of the South Kensington Museum, reproduced in a great number of schools of design, and of the fine arts applied to industrial purposes, is daily refining their taste, and elevating the character of their works. In ceramic art, especially, is their progress exceedingly marked; it threatens our makers with a severe competition."

The correspondence from Rome, which *L'Art* has recently published (see vol. vi., p. 186), shows us that Italy actually possesses a "South Kensington Museum,' an institution for which France has, for so long a time, wished in vain. Another of our neighbours, Belgium, has this very year failed in an attempt to found a similar institution; but this little nation is persevering and practical; the idea has not been abandoned, it is gaining ground, and the new museum will become a reality, in all probability, much sooner than it is thought. In England, that London should have museums of this kind, as those at South Kensington and Bethnal-green, does not satisfy the public; not only must every large town have its museum of art as applied to industry, but even every centre of any importance; hence at this very moment, the admirable exhibition of art-treasures at Wrexham. It is these continual and vigorous manifestations of private enterprise that effect the marvellous revolutions in taste, which the blind alone now fail to perceive.

Competition becomes each day more formidable, and the time can be foreseen when we shall no longer be able to cope with it. The statistics of the Ministry of Commerce show that the total of our exports, coming within the class of products of artistic manufactures, is diminishing most sensibly, whilst that of competing nations, and particularly of England, is rising rapidly.

While the question for France is her artistic glory, the question of several hundreds of millions of francs a year must not be overlooked. What must be done to recover our superiority? That which England has done to wrest it from us, to propagate in all directions, the feeling and the taste for the art, by means of an intelligent education, and by gathering masterpieces in museums where they can be seen, and compared, and studied by all.

England has founded the South Kensington Museum; let France found the Museum of the Decorative Arts. This will be the natural complement of the efforts made for the last twenty-five years, by the Union Centrale des Beaux-Arts appliqués à l'Industrie," to abolish that routine system of instruction which now condemns our decorative arts to sterility and to perpetual repetition.

Three hundred thousand francs is sufficient for the commencement of this work.

Let us no longer expatiate on the subject, but let us act; it is high time. The French "South Kensington Museum" must at length be a reality, and in 1878 it must be one of the leading attractions of great festival of art and science which will invite the whole world to Paris. To insure success we must rely solely on private enterprise.

1. Because it is best to manage one's own affairs one's self. 2. Because the interest of the whole country is at stake, and this patriotic interest is the most powerful of all levers. 3. Because time is short, and in order to gain an object promptly it is especially desirable not to have to pass through administrative circumlocution.

The Museum of Decorative Arts will be established—as is already the Union Centrale—in the chief industrial quarter of Paris. It will be governed by those liberal and fruitful principles, which have been tested at South Kensington, by placing the institution in constant communication with the whole country.

Money paid by subscribers will bear no interest; it is a free gift to the Union Centrale, for the above-mentioned object; but contributors will be entitled to free admission to the museum for certain periods, in proportion to the amount of their subscription. Subscriptions are received at the office of *L'Art*, 3, Chausée d'Autin, Paris; also M.M. Delamotte, Bénilau et Cie., banquiers, 56, Rue des Petites-Ecrires, au crédit de M. A. Ballue, Administrateur de *L'Art.*

The models adopted in England are excellent, the instruction is well organised, the resources, so to speak, unlimited, and the South Kensington draughtsmen show, by prodigies of patience, what personal energy can do when stimulated by encouragements of all kinds; but their conscientious efforts, which can be traced both in the mathematical, accurate, and scrupulously finished copies and in the clumsy compositions of beginners, lose all value by the side of the broad and bold designs of our workmen. By the arrangement and balancing of masses, by the intelligent sacrifice of minute details, by the true perception of the line, and shape, and of the relative value of tones, these latter often seem to have instinctively understood the fundamental laws of art. In bearing witness thus to the merits of our fellow countrymen—and they are perhaps too much accustomed to such testimony—we must insist on pointing out the remarkable progress of their competitors, and we warmly urge those persons who may be blinded by an exaggerated confidence in the traditional superiority of French workmen, to think of the fable of the hare and the tortoise. Have we always been an artistic people? And whilst we heartily invoke the day when France will sing like Germany, by what right can we deny to England the flattering hope of drawing as we do? Let us think of our faults, rather than of our merits. Let us not forget that the unfortunate caprices of the public obtrude themselves sometimes on manufacturers, and act more forcibly than is supposed on the character and the tendencies of contemporary art. To avoid a danger which might become serious, the instruction of drawing must be refined, and fortified, and generalised, and good medals must be distributed as much as possible.

"In England and in Belgium schools of design and drawing schools are regularly inspected from an artistic point of view. Our municipal schools do not enjoy the same advantage. We may add that, if children do draw in the primary schools of Paris, it is not under the direction of special professors; and in this respect drawing is not so well treated as singing and gymnastics. It may further be asked whether it would not be expedient, at least for the more important towns, to include elementary drawing among the obligatory subjects of primary education? In this summary and necessarily incomplete work, we cannot do more than hint at the delicate questions which this subject gives rise to; we can consider neither the supply of teachers nor the establishment of suitable centres, nor the financial question. We will but call to mind, with regard to the latter, that expenses which are incurred for instruction in drawing are, like all others which concern popular education, essentially productive, and in this case economy would be more ruinous than extravagance."

The words we have just quoted are those of M. Charles Robert, Maître des Requêtes au Conseil d'Etat, in his official report on instruction in artistic drawing and modelling, with a view to their application to industrial purposes. (See vol. vi. of the reports of the members of the French section of the International Jury on the general view of the London International Exhibition of 1862, published under the direction of M. Michel Chevalier, President of the French Section of the International Jury, pp. 151, *et seq.*) His colleague, M. Rapet, Inspector-General of Primary Instruction, did not express himself less clearly, in considering the state of instruction among the various nations represented at the Exhibition. (Same work, same vol., pp. 47-48.)

"The study of drawing in primary schools in England does not date further back than ten years. Up to that time there had been a privileged instruction, reserved exclusively for the richer classes. But the Exhibition of 1851, which brought forward in a most striking manner the superiority of France in those products which demand taste, and whose value depends upon a knowledge of design, revealed to England the reason of her inferiority. With that ardour with which she pursues an object, as soon as she believes that its attainment would be of general utility, she set to work, almost immediately after the close of the Exhibition, to establish schools of design (*écoles de dessin*) throughout the whole country. Since that time she has followed up her work with that perseverance which is one of her characteristics, and without recoiling before sacrifices which an enterprise in which everything had to be created demanded. A new branch of the Council on Education was formed, under the title of the Department of Art; its special province is to foster the establishment of schools of design, in which the teachers receive a direct salary from the Government, as well as an allowance in proportion to the number of students to whom they give lessons.

"At the same time, a normal school was established to supply masters, and a system of prizes and rewards was organised to encourage the study of drawing on the part of the students who frequent the schools. A museum of art-objects was likewise founded, to promote this instruction, and the Art Department itself had models made from the very outset, to be used for instruction in the schools. Its example has been followed since by publishers, who have already begun to issue important collections of drawing models. It would be out of place to expect, from a system which is yet in its infancy, such progress as has been made in countries where it has for a long time been in operation; nevertheless, in surveying the English Exhibition, it cannot be denied that England has largerly profited by the experience of other nations. She has, in particular, borrowed much from France, whose publications of models are frequently to be found in the schools. Looking to the results of these efforts, and without losing sight of much that is yet wanting in them, it is impossible to conceal from ourselves that France must prepare to encounter a severe struggle in this quarter, and that, should she be lulled into a false security, our country would run the risk of losing that superiority to which such numerous branches of her industry owe their importance and their brilliance.

"It will not, perhaps, be useless to mention here, that in this respect, England is competing with us in another manner, by carrying off our designers, her manufacturers having for several years past secured them, by means of the high remuneration which their services obtain. But it is a most remarkable fact, that after having spent some time on the other side of the channel, these artists have often lost that superiority of taste which so distinguished them. It will, nevertheless, be readily understood that this effect is diminishing day by day, as taste is improving in England."

The danger is pointed out in even more forcible language by M. Prosper Mérimée, and by M. du Sommerard, Conservateur-Ammistrateur des Musée des Thermes et de l'Hôtel Cluny, in their report on Class XXX., Furniture and Decoration (same work, same vol., pp. 271, and following):—"During these last years notable and important progress has been made by English makers in the manufacture of furniture. . . . . Successful efforts have given to this branch of industry a great impulse in a new line; the art-workmanship evinces a pure and refined taste. . . . . Their works are to be esteemed, not only for their perfect execution, but especially for the beauty of form, fine arrangement of lines, and happy choice of motives for decoration."

"The progress made by English manufacturers in furniture and decoration is considerable. We repeat it, and it is not merely owing, as has been somewhat lightly asserted, to the help of French artists established in England, who, it is said, assist some of the principal manufacturers to a very great extent. This progress must be attributed, in the first place, to the industrious tenacity and to the intelligence of makers who have known how to give the right direction to their manufactures, and who have completely abandoned the method they had been pursuing up to that day. This progress is also due to institutions which have recently been founded in England, and to which we have thought it our duty to call attention in a special report, the object of which was the examination of the state of art in that country."

"The help given to English manufactures by our industrial artists has undoubtedly had a large share in bringing about the results obtained; but we have been able to convince ourselves that, where this aid has not been seconded by an intelligent direction, the progress made is hardly perceptible, and only shows itself as an isolated fact.

"We must admit that English artists themselves are not wanting in their manufactures, and many among them, especially in these latter years, afforded support both active and powerful. Mr. Owen Jones, the skilful architect, whose constructions and important publications have rendered his name as popular in France as in England, Mr. (afterwards Sir) Digby Wyatt, not less known by the works of which he directed the execution, than by his studies and publications on industrial arts and manufactures, may be mentioned in the first rank of English artists, whose efforts have exercised a happy influence on the industry of their country; and if their names do not appear in the list of those on whom rewards were conferred by the International Jury, it is because they would not compete, being members of that jury."

It is now fourteen years since all the above was written; it is fourteen years years since all the reporters of the French Section spoke in similar language; it is fourteen years since Mérimée drew up—at the request of his colleagues—"that special report" entitled, "Considerations on the application of Art to Industry at the Universal Exhibition," an admirable statement, to which we shall have to return presently, for it cannot be quoted too often. And what results have been obtained by this illustrious writer, who acted the part of a loyal citizen in saying the truth aloud and courageously? *Vox clamat in deserto.*

Who would dare to affirm, with sincerity, that what he printed in 1862 has ceased to be true?

"Is instruction in the fine arts in France what it ought to be? Without any hesitation we must answer in the negative.

"It is not on such a footing as the greatness of the nation, the disposition of the people, and the requirements of industry demand that it should be. If we take into account its glory and material welfare, and if we consider, on the other hand, what the administration spends to encourage them, it cannot be doubted that, by sowing with less parsimony, a far more abundant harvest would be reaped." (Same work, same vol., p. 260.)

Certainly, M. Waddington, the present Minister of Public Instruction and Fine Arts, has resolutely struck out in the right direction, and his acts render him worthy of the most legitimate popularity; but monetary necessities tie his hands, and, considering the actual state of financial affairs, and the considerable taxation which the country has to bear, he cannot carry out at once all his excellent intentions. In the meantime, there is danger in delay, a danger this time most serious for industrial art. Private enterprise must avert this danger; it is high time for it to give proof in France of manly strength.

The English phrases, self-help, self-respect, deserve to be naturalised in France. If we truly comprehend them, the French "South Kensington Museum," the Museum of Decorative Arts, will very shortly be an accomplished fact, bearing fruit throughout the entire country.

PROFESSORSHIPS IN DRAWING IN FRANCE.

The authorities who have the direction of all matters connected with public instruction in France, always desirous to improve and systematise art education, have instituted diplomas of "Professor in Drawing," and certificates of aptitude in the teaching of drawing. The plan has been for some time under consideration, but it is now fully matured and included in a decree of M. Waddington, the Minister of Public Instruction. The diplomas are to be granted by the National and Special School of the Beaux Arts, to those of its pupils who may satisfy the examiners. The professorial diplomas are of two kinds, for teaching artistic drawing, and for architectural, scientific, and mechanical drawing. Candidates for the professorships must have previously been admitted either in the section of painting or sculpture; they must have obtained honourable mention in the public competitions of the school in anatomy and perspective; and they must have won in painting or sculpture at least a third-class medal for a drawing after nature, and like medals for drawing after the antique and ornament. All these preliminaries being fulfilled, the candidates for diplomas will be admitted to the competition, and will have (1) to make a drawing after nature, and life-sized, called "tête d'expression;" (2) to execute an elementary ornamental composition from a given programme; (3) for sculpture, a study from life and another from the antique; and (4) to correct in the presence of the jury a certain number of drawings and models submitted to them, and to state their reasons for the proposed corrections.

Candidates for the professorship of scientific drawing, must have passed through the second class in architecture, obtained in that class honourable mention for descriptive geometry and perspective, and two honourable mentions in the analytical elements of architecture and ornamental design.

The examination of this class of candidates, includes: 1. A free-hand sketch in geometric and linear perspective from the same object; a drawing in geometrical perspective in given elements, with outlines and shadows washed in; 3. Drawing of a head from the round; 4. Composition of an ornament after a given programme; 5. Correction in presence of the jury of drawings appertaining to the preceding subjects, and statement of the reasons for such correction.

The candidates for certificates of aptitude for teaching are submitted to less rigorous examination: in the case of art drawing each must have obtained in the school honourable mention in ornamental design, and a third-class medal in antique. At the examination each must execute drawings in anatomy and in perspective, and give explanations of them; draw a nude study, from nature or after the antique; draw from nature, and life sized, a head with given expression; and correct drawings as above.

For certificates of aptitude to teach scientific drawing, each candidate must have been admitted in the second class of the section of architecture in the school, and obtained two honourable mentions in the analytical elements of architecture, and one in ornamental design. The competition requires proofs of knowledge, in descriptive geometry and perspective, of the essential points of plan drawing and levelling; the execution of a drawing in geometrical perspective from given elements with shadows in outline and washed in; and the correction of drawings as in other cases.

COMMERCE AND AGRICULTURE OF NORTHERN ZANZIBAR.

The experiences gained by Mr. Holmwood, Vice-Consul at Zanzibar, during a recent mission to the northern coast of that hitherto unfrequented country, have been embodied in a report by Capt. Prideaux, the British Political Agent, the commerce and productions of each district being, as far as possible, considered separately. He states that the district of Mombasa and Takaunga contains the town of Mombasa with 12,000 inhabitants, mostly Swahilis. The British subjects consist of the Indian community, numbering 96 houses, namely, 52 Bohras, 30 Memons and Scindis, and 14 Hindoos, and the members of the two mission stations at Ribe, numbering 11 Europeans, including children. The town is situated entirely in the island of Mombasa, or Mvita, as it is called by the natives, a small island about three miles long by one-half broad, lying in a deep bight, well sheltered at all seasons of the year. The creeks which separate it from the mainland are deep and accessible to the largest vessels, forming, north and south, harbours capable of accommodating a fleet of men-of-war, and affording the—on this coast—unusual advantage of safe landing during the whole year. The creeks branch out above the island, and give great facilities for bringing down the produce from the Wanyika country, about twelve miles inland. The town is built along the banks of the north harbour, which alone is now in use, though that to the south is more commodious. The exports consist of millet (*holcus*), Indian corn, ivory, copal and sesamum (oil-seed). Rice, and a few other cereals, also manioc (cassava), and sugar-cane, are grown for home consumption chiefly. Wax and India-rubber might be exported in large quantities, but the natives are everywhere wanting in that enterprise which would lead Europeans at once to prepare these valuable products from the raw material. Takaunga, however, is quite taking the place of Mombasa as a grain port. It is situated about thirty miles to the north, and if information received can be relied upon, this place is rapidly rising to importance, and is likely to become one of the future granaries of East Africa.

At Malinda, a town of about 5,000 inhabitants, the bulk of the trade is in millet (*holcus*), and sesamum (oil-seed). As many as thirty large dhows leave during September and October, laden with the former, principally for Makulla, and in February, March, and April, from fifteen to twenty are loaded with the latter. The millet harvest is over early in September; the sesamum gets ripe early in November, and is finished gathering towards the end of the year. The plantations extend for about twelve miles inland, and nothing but the fear of the Galla and Wasania tribes that surround them prevents the cultivation from extending as far as at Takaunga. The soil is extremely fertile, without being either heavy or damp. Bush-land, after being roughly reclaimed by burning, produces heavy crops for five consecutive years without any kind of dressing; the sowing, however, is carefully performed, and weeds are kept under. Insects are not troublesome, but enormous flocks of small birds are the pests of the farmer, and were the only things greatly complained of when conversing with proprietors of land. The sesamum seed, which is all of the black variety, grows as cleanly as the grain, and one may walk for miles through fields closely and regularly planted, without being able to notice a spot of blight, or a patch destroyed by insects. The millet is shipped off at once for Makulla and Zanzibar, but the sesamum is mostly stored till the beginning of the south-west monsoon, when it is shipped to Arabia, but part is sent to Zanzibar during the north-east monsoon.

Lamo is another town of about 6,000 inhabitants, situated 2½ miles from the entrance of what is believed might be made a very fine harbour for steamers. The principal exports are ivory, hides, millet, orchilla, sesamum, rafters, and cattle. Most of this produce finds its way to Zanzibar, through the hands of the Indians. Orchilla weed is procured from the numerous damp creeks in the locality, many of them running ten to fifteen miles inland. The Indians, and even European merchants at Zanzibar, contract with the owners of 'Mtepes, who send crews to gather cargoes of this lichen, receiving an advance in signing the contract; but this trade is rapidly falling off, in consequence of the low prices at present obtaining for the dye in Europe. Zanzibar rafters are generally in demand, and are usually contracted for in a similar manner. 'Mtepes are the only vessels suitable for carrying such a cargo. Abundance of bees-wax, and doubtless other products, might be brought down from the interior; but its present state is entirely unfavourable to commercial enterprise. Mauda Bay, at the north end of Lamo Channel, is nearly land-locked, but has a good entrance, and a stretch of deep water close to Mauda Island, which forms a safe anchorage for the largest vessels. The north shore of this bay is formed by the southern coast of a large island, which contains the towns of Patte, Siwy, Paza, Zingatini, and Tundua. The former is interesting only in an archæological point of view, still containing the ruins, within well-preserved walls, of a town of about 100,000 inhabitants, but at present having only a population of about 100 souls. The soil of the island is extremely light and friable; though not generally sandy, it has everywhere a substratum of porous limestone rock, probably of coralline formation. Though not suitable for cereals, it seems all that could be desired for tropical fruits and vegetables; and though skilful cultivation has only been carried on for a few years, the effects have surprised the natives. The great drawback at first was want of water, but a good supply is now readily obtained by sinking wells about twelve feet into the rock. They have begun to import camels, by which means the regular system of irrigation, similar to that employed at Muskat, is already commenced. Oxen are not found strong enough here for this work. The products now successfully cultivated are tobacco, tambun, cocoa-nuts, bananas, and dates, besides water-melons, and nearly every kind of tropical fruit. Tobacco is largely exported to the towns on the coast, and is of a fine quality and flavour: it is likely to become a staple export. Tambun (pan), a leaf much used in conjunction with betel-nut by all natives and Indians, grows more readily than in any part of the Sultan's dominions. There are large gardens of it, and during the north-east monsoon it is even sent as far as Zanzibar, where it is found difficult to rear. Cocoa-nuts grow in profusion, and are principally used to brew the native beer (tembo), which from Lamo to Tula is generally used as a beverage, even by strict Moslems. Bananas are largely grown, and form almost as general an article of diet as millet, in fact supplying the place of manioc (cassava), which is but little cultivated at this spot. The luxuriant growth of the date palm is the most notable feature connected with agriculture in this district. The date has been tried throughout the Zanzibar dominions, and has rarely been found to fruit. At Siwy, however, this palm seems to prosper as completely as in the Persian Gulf. Large herds of cattle and flocks of sheep are reared; the latter are very fine specimens of the Somali breed, and are largely exported, as is also Sumli, or ghee, which is preferred by the Hindoos on the coast, who use it with all their food, to that from any other district. The towns of Tundua and Zingatini on the eastern and north-eastern sides of the island are small, and the inhabitants devote themselves almost entirely to the breeding of cattle, sheep, and goats.

In this, his first report, Vice-Consul Holmwood states that his object has been to give a general sketch of commerce and agriculture on this coast, hitherto so little visited. He has, however, carefully prepared the way for obtaining, in future years, reliable statistics, having spared no pains in impressing upon Customs' masters, and other influential British subjects, the responsibility incurred in giving other than accurate information to British consular officers visiting their districts, which advice has generally been received as appropriate.

CORRESPONDENCE.

TRADE OF TRIESTE.

In your *Journal*, of September 29, 1876, I read an able *critique* on the "Trade of Trieste," by Mr. Thomas A. Weldon, who is, I am told, one of a large City firm of accountants, and whose remarks are therefore valuable. I see that he has confined his notice to the first paper of my paper (Sept. 15); and, as the whole may some day be re-published, I hope he will kindly review the conclusion, in your number of September 22.

Mr. Weldon is quite justified in pronouncing the mistakes to be "of a very serious character." Curious to say, the misprints, for such they are, escaped the author's notice in the two German and the two Italian editions of his work. I have been delayed in procuring the necessary corrections, and have only just received from Mr. Superintending Engineer Franz Rziha an answer to my inquiries. He writes to me from Vienna (III., Reisnerstrasse, 49), as follows:—

"You must not forget that my work was written in 1872, and that its statistical tables were those of the decennial period 1860–1870; moreover, that the object of the paper was rather to prove the national and imperial importance of the Port of Trieste than to serve for statistical data. Since those years the figures have considerably changed, and Trieste has lost much ground, especially in the grain trade, which is now in the hands of Russia and America. I have printed the latest information in a technical study on the Saint Gothard Railway (Die Bedentung der St. Gotthardbahn. Vortrag gehalten am 27 April, 1875, in der K. K. Geographischen Gesellschaft zu Wien. Carl Finsterbeck in Wien).

"I send you the following corrections of errors which escaped my notice, &c."

"As regards the table of cereals (*Journal* p. 936, line 9), for 'the late years' read 1870; and for millions of centners' read millions of francs. Correct also the figures as follows:—

Chile	not	5	million francs	but	50
Zollverein ..	„	5	„	„	50
England ..	„	80	„	„	800
France ..	„	340	„	„	140
Switzerland	„	4	„	„	140
Netherlands	„	57	„	„	87
Italy	„	58	„	„	28."

With respect to wine, the figures are taken from Kolb, but they shall be verified by reference. Southern Austria, Hungary, Dalmatia, and the Adriatic Archipelago, are mostly wine-growing countries, and many of the islands supply hardly anything but wine. As Mr. Weldon justly remarks, the statement that "the produce of Austria more than doubles that of Spain and Germany taken together," deserves to be prominently brought out.

Regarding silk (p. 936, line 17), a remarkable *lapsus calami* has crept in. While coal, iron, cotton, and wool are valued by centners, silk should be corrected to pfunds (or Austrian lbs. = 1·2 avoir). It may interest you to know that political events are greatly influencing the silk trade of Trieste, and the following figures, kindly supplied by M. A. Cuzzeri, a silk merchant of this port, may be relied upon.

Greggie (*Raw Silks*).

	Numbers.	Italian lire (francs).	
Italiani classiche	10—12;	120	per kilometre.
Buone correnti ..	10—13;	115	„
Do. ..	11—13;	114	„
Do. ..	11—14;	112	„

Trame Nostrane (*Country Trams.*)

	Nos.	Italian lire (francs).	
Buone correnti ..	22—26;	117	per kilogramme.
Do. ..	24—28;	114	„
Do. ..	24—30;	113	„
Do. ..	26—30;	113	„
Do. ..	30—38;	107	„
Do. ..	30—44;	105	„

A tre Cape (*Thrown silk of three singles.*)

	Nos.	Italian lire (francs).	
Belle correnti....	30—34;	129	per kilogramme.
Similar..........	34—38;	124	„
Seconds	30—34;	121	„
Do.	34—88;	118	„

Organzine Strafilati (*Organzines of more than three singles.*)

	Nos.	Italian lire (francs).	
Classici	18—12;	136	per kilogramme.
Sublimi	do.;	132	„
Buoni correnti ..	18—22;	129	„
Sublimi	20—26;	126	„
Do.	22—26;	123	„
Do.	24—28;	121	„

"Credit" in German, really signifies the medium of circulation in general.

The *Depositen* deposits are thus given by Dr. H. Neumann for the year 1871:—

Bank of England	213·3	millions of florins.
Prussian Banks	112·7	„
Russian Reichsbank....	?	„
Bank of France	12 ·6	„
Austrian National Bank	?	„
Italian „	19·9	„
Belgian „	55·2	„
American National Banks	1,243·4	„
Total......	1,771·1	or 1,771,100,000

This total refers only to the establishments here noticed; and the figures were derived from a trustworthy source.

Mr. Weldon doubts the utility of inserting the sketch of ancient trade-routes, which considerations of space have rendered so imperfect. Evidently, Mr. Rziha's object was to trace the gradual obliteration of great central emporia into the main zones of universal commerce, and this, I venture to opine, is ably done. The line along the Mesopotamian streams is drawn, not to the Gulf of Persia, but to the Indus. Mr. Weldon would certainly not ignore the connection of the great Indine valley, whose ship traffic and transit, opened by the Macedonian invader, was so well known in the days of the earliest Caliphs, when traders from Ceylon, Broach, and the other chief ports of Western India, coasted along the shores of Sind, *en route* to the Euphrates. Marseilles is mentioned, whilst Rhodes and Corinth are disregarded, because the former was the chief land-terminus of the North Mediterranean trade, and the two latter were mere intermediate stations. The line through the wastes east of Syria to the Levant, of course connected India and China with the Mediterranean. And in one point I must join issue with Mr. Weldon. The "utility of showing ancient trade-routes" cannot be called "trifling," when, since 1840, we, travellers and geographers, have been striving our best to restore the "first overland" by a Euphrates Valley Railway. Our failure in this matter is the more regretable at the present moment, when a Russian invasion of Turkey, through the comparatively defenceless lines of Asia Minor, connecting the Caucasus and the Hellespont, is generally discussed. A Euphrates Valley Railway would not only have consolidated the Eastern possessions of the Porte, it would also have served as an admirable base line for military operations. No other nation but ourselves would have disregarded and despised a work so necessary to the safety of British India; and the intrigues, Russian and Turkish, which opposed its inception, should have been additional inducements to push the project through. Perhaps it is not too late, even now, to agitate in this matter. Mr. Andrew will take note.

I quite agree with Mr. Weldon that the author should have indicated "what routes came under the titles of South Germany, Saxony, &c." But Mr. Rziha informs me that he has supplied the deficiency in the first part of his latest work on the "Official Communications of Railways" (Officiellen Austellungsbericht über Eisenbahn—Ober und Unterbau Wien, 1876; to be in three parts). On page 176 he has discussed the Arlberg Railway, and, further on, the latest project of M. de Lesseps for connecting Samarkand and Peshawar, *via* the Hindu-Kush.

Again requesting you to excuse this long delay,—I am, &c., R. H. Burton.

Trieste, Nov. 21, 1876.

LIFEBOATS.

I regret that I was unable to attend the meeting last Wednesday, when the Rev. E. L. Berthon, M.A., read his paper on "Collapsible Boats."

I recollect seeing, at the "Collection of Inventions for Saving Life at Sea," held at the "London Tavern," immediately following the loss of the *Northfleet*, a model of Mr. Berthon's apparatus, and was struck with its simplicity and apparent practicability. I was also particularly struck by the model of a peculiarly-shaped lifeboat, consisting of a conical buoy of hollow metal at each end, connected in their centres by a strong iron bar, on which swing the boat or cradle.

It is somewhat difficult to explain the invention from memory, and without the advantage of a model or drawing. The two ends are very buoyant watertight compartments, and may be either of the shape of an ordinary lifeboat bow, or cigar-shaped. The latter is preferable, because a valuable part of the patent consists of an iron flanged belt around the midship end of each, by means of which the apparatus and its freight are launched on rails from the skids, or the bridge, broadside on. These "ends" are connected by a strong iron bar in their centres. Upon this bar swings the cradle, hammock fashion.

To illustrate my meaning more clearly, I will imagine a couple of empty water-tight casks connected from the centre of each head by a strong bar, on which a boat or cradle shall swing.

The patentee, whose name I have unfortunately forgotten, claims, and very reasonably I think, the following advantages:—

1st. The weight of the passengers in the cradle tends to keep it always stationary, and however boisterous the weather, it must, if ever capsized, continually right itself.

2nd. There is scarcely a possibility of its being stove in by coming in contact with the ship's sides, as the iron belts protrude some inches beyond the sides of the cradle and naturally act as "fenders," both to the cradle and the ends; but if even the cradle were stove in it would matter but little as the entire buoyancy is contained in the ends.

3rd. It can be filled when on the bridge or skids, and launched away to leeward at once with the comparatively slight inconvenience to its occupants of a momentary immersion if in a heavy sea.

4th. Whilst the conical shape of the ends will permit it to be easily rowed, the pivot, or bar, running through the centre of the cradle, affords a good holdfast to the passengers. Of course the two main elements are buoyancy of the ends and strength of the bar or pivot. The apparatus can be made large or small. I think there were six fixed on the skids of the model I saw which could be unchocked and launched in a minute. Possibly the ends might be safer if made of cork shavings instead of being hollow iron cones, but this is a mere matter of detail. As a shipowner, it has continually occurred to me as worse than oversight on the part of the Government in allowing any ship to sail without a number of unsinkable boats sufficient to save every person on board. Take the little coasters exposed continually to the greatest danger. Although their crews may consist only of four to eight hands, none of these ships carry lifeboats, and the long boat, in nine cases out of ten, would be perfectly useless to weather a sea if even it could be divested of its load of lumber and launched at once. But how much worse is the case of an emigrant or passenger ship with 300 or 400 souls on board, two-thirds of whom must be left to perish if even every boat got safely away and full of passengers!

Shipowners are harassed with Board of Trade surveyors disputing as to which deck plank, &c., is sound or unsound, but here is a matter of the gravest importance passed by entirely. Nay, if a shipowner wishes to put an extra lifeboat on board, he is deterred from so doing by the fear that it will be said he did so to induce his crew to abandon the ship. This is, I think, a fitting subject for our Society to memorialise the Government upon.—I am, &c.,

William Mead Corner, F.R.G.S., &c.

105, Leadenhall-street, London, E.C.,
November 27, 1876.

COFFEE-LEAF TEA.

The infusion from the merely dried leaves of the tea tree is very poor and insipid, in comparison with the flavour with which we are all acquainted. The tobacco leaf, which is but merely dried, is by no means to be compared with the prepared leaf of commerce. If only so treated, both of them would be considered as so much rubbish, and both owe their peculiar flavour to a slight degree of fermentation, on which nearly all depends.

The famous Bilsa tobacco of India, besides being cultivated in a highly-manured field, on which depends the amount of nicotine, is prepared generally as follows:—A few of the leaves are tied up in a bundle by their stems, and are placed over a line to dry, under cover, so as to be protected from rain by day or dew by night, and are thus gradually dried. As the climate is hot, about the third day the partially dried leaves are arranged in their flats until about a foot high; then a wooden cover is placed over them, and weights are placed on it. The leaves then rise in temperature, and a slight fermentation ensues; about the second day the leaves are re-arranged, so that the leaves previously on the borders should be in the centre, by way of equalising the same degree of slight fermentation throughout. Then they are thoroughly dried, and we have the prepared leaf. If they afterwards are compressed it is on account of portability, and to exclude air and moisture.

The two points to which I particularly wish to call attention, in the production of this most esteemed of Indian tobaccos, are, 1st, a gradual drying, which naturally takes place in a hot climate; and 2nd, a gradually induced fermentation under a slight pressure—the whole producing a very superior tobacco.

Tea, on the other hand, is prepared on a method, which I trust I may be pardoned for terming the harum-scarum—get done with it, and sell it for cash in Mincing-lane as soon as possible—principle. It is as follows:—Some of the leaves are placed in small pans over a fire, to effect the process of partially drying. Then, in a semi-fried condition, a portion of them is formed into a ball, which is manipulated to and fro, or kneaded to encourage speedy fermentation. Thence into the pan again, and it is then worked and finally dried, when it becomes the tea of commerce.

In mechanics we have the law, viz., the greater the rapidity the less the power; and in commerce we have the fact, the greater the rapidity of production, the worse the quality. In the article of leather for soles, for instance, doubtless we have all noticed the immense difference between the leather prepared after the old plan, but which requires time and commands a high price, and that prepared by the modern, quick method, and which is but slightly superior in durability to pasteboard in dry weather, and on a par with it during the prevalence of rainy weather.

Manual labour with the Chinese was both plentiful and cheap, and, on the other hand, the demands of commerce were great, and knowledge was but scant; hence the Chinese mode of preparing the tea-leaf. Their method is slavishly followed by our Indian tea planters, who, I really believe, have but a foggy idea of the *rationale* of so making tea. First, fire is used to hurry up the process of drying, which, besides being a bad plan to produce a superior tea, gives rise to all those peculiarities stigmatised by Mincing-lane brokers as "burnt" or "badly burnt" tea, with all its variations. And, secondly, manual force is used to hurry up the process of fermentation, and here zeal, or its due application, give rise to another series of things all depreciating to its quality.

I feel somewhat sure that a most superior tea could be made in a hot climate without the aid of a fire, and without any kneading process by the hands, a matter which I really believe is well worth the attention of the Society, for its value to our Indian tea-planters primarily, and the vast body of the public secondarily, could not well be estimated, even in round numbers. It is in the determination of such things which may totally alter the balance of trade between country and country, that the great value attaches to botanical gardens, which bring the plants of commerce in contact with the skilful minds at work in the laboratories of England; for the gratification of mere curiosity in beholding tropical plants is but at one extreme of value.

Your lady correspondent will see, from the foregoing, the reason why she failed to obtain an aromatic beverage from the merely dried coffee-leaf, and the same reason which led her to condemn it, influenced also everyone else apparently, or, long before this, the infusion from the properly-cured coffee leaves would have been, I believe, at least as important an article of commerce as tea. From reports, it appears that when the two sorts of leaves are both nearly dried, thence pulverised (not merely broken), the infusion from the coffee leaf is very superior to that from the other; and there seems to be no sound reason why its original superiority could not be maintained throughout. Any one who has even tasted the infusion from the merely dried or non-fermented tea-leaf, would marvel what there was in it to delight the human palate, and would come to the conclusion that almost any other sort of leaf would make a more agreeable beverage. The coffee berry itself is very poor until roasted, and then, further, it has to be well pulverised; and, strange to say, connoisseurs hold the opinion that the berry, when pounded or pulverised, is superior to the same when ground in a mill. Perhaps it is well also to call attention to a fact, viz., that the older the tea-tree, the better the tea; from which I make the deduction, that the young leaves from an old tree are better than the old leaves from a young tree; and, therefore, that the value of a tree plantation increases —like wine and knowledge—with age. Our tea-plantations in India and Ceylon are young, but, notwithstanding that drawback, by some careful preparation and selection, and the avoidance of adulteration, both with foreign leaves and substances, and used tea-leaves and stalks, their produce is steadily increasing in estimation, while Chinese tea, like a drowning man, desperately clutches at everything to obtain public support by cheapness.

I may also say that, in favourable situations, as regards climate and soil, the tea-tree yields from 15 to 25 flushes or pickings per year, and there is no reason why the coffee-tree should not far exceed in marketable produce in value the single crop of berry (occasionally in some places double), which, as your other correspondent truly observes, is not a reliable crop. Like the apple harvest in England, much depends on the weather when the trees blossom; for if, at that critical time, any cause spoils it, farewell to the crop of berry.—I am, &c.,

J. F. D.

London, Nov. 28th, 1876.

I am much interested in the matter of your correspondence relative to "Coffee-leaf Tea," more particularly from having for many years tried for something healthy and palatable as a supplementary household beverage to the few in use in this country.

If "J. T. D." had been anything of an agriculturalist he would have avoided trying for a beverage from the leaves of a tree already producing a fruit for a domestic beverage, for two reasons, one is that the berry of the coffee-tree leaves the leaf with scarcely any good extractive property; this fact of the concentration of the properties of vegetation is so well-known, that I wonder at the attempt, more especially as the defoliation of the coffee-trees at budding time would injure the fruit crop.

My aim in trying to obtain a really healthy and cheap drink for the community led me to experimentalise on such growths as are to be readily obtained in Great Britain, without displacement of existing crops under cultivation.

About twenty years ago, I made tea from the leaves of the *Chimonanthus fragrans*, a hardy shrub growing plentifully here and there, in all the southern counties of England, and capable of cultivation on the patches of ridge land not accessible to the plough. It is a bold-looking garden shrub, and the leaves may be picked twice in the season, if needed. It produces a beverage much like the best tea, and has a refreshing effect on the tired energies of those who work hard with hand or brain. It is alluded to in the romantic poem of "The Epic of a Day," thus:—

> "From chimonathus fragrant sun-dried leaves,
> A healthful drink was handed to each guest,
> Now grouped in clusters' neath the shady caves,
> Commingling genial converse with sweet rest."

In conclusion, I have but to say, try these leaves, and you may in a small sunny garden with sandy soil, grow enough for your family's consumption.—I am, &c.,

J. Charles King,

4, Piercefield-street, Hampstead, N.W.
December 2nd, 1876.

From the very concise letter of your lady correspondent, I gather that she dried the coffee leaves, and then poured boiling water over the broken pieces of them. If so, she could not have extracted much of the flavour. Leaves like those of the tea, coffee, and maté trees, have a somewhat tough epidermis, which enables them to resist the influence of water. Maté is prepared by drying the leaves, and then pulverising them into particles like ground coffee. On the application of boiling water, an infusion of the colour of brown sherry, and of a pronounced flavour, is readily obtained. I hope she will give the well-pulverised leaves another trial, for I think she will find that the infusion, even from the non-fermented leaves, would be an agreeable beverage, and one not to be despised at a time like this, when it is very difficult to obtain good tea free from adulteration, a matter which anyone would soon realise should they spread out on a sheet of paper a spoonful of the leaves after being used in the teapot.—I am, &c.,

Omnium Gatherum.

28th November, 1876.

NOTES ON BOOKS.

Theory of Colour, in its relation to Art and Art Industry.—By Dr. Wilhelm von Bezold. Translated by S. R. Koehler, with an introduction by E. C. Pickering. (Boston (U.S.): L. Prang and Co., 1876. London: Trubner.)

It is somewhat remarkable how comparatively recent have been nearly all attempts to apply strictly scientific principles to the practice of the arts of painting and working in colours. It was only by the researches of one of our own time, M. Chevreul, that the laws governing the combinations and contrasts of colours have been made known, and the principles on which artists have been unconsiously working for centuries have been formulated for the first time. Even at present it is probable that few artists, still fewer designers for purposes of art-industry, care to study the ultimate laws of their pursuit, preferring to work partly by instinct, and partly by a prescription resulting from the experience of former generations.

It appears to be the aim of the author of this book and his translators to attack this ignorance, and to substitute for it, at all events, a knowledge of the elementary principles of the theory of colour. Beginning at the beginning, the first chapter deals with light, and explains the way in which the sensation of colour is produced. The composition of the solar spectrum is described, and the character of its colours explained. The second chapter treats of "inherent colours," and shows how certain pigments, coloured glasses, &c. absorb or destroy certain rays, reflecting or transmitting the rest. Such subjects as the optical effects of different fabrics, silk, velvet, damask, are also treated here. The phenomena of polarisation are explained so far as they are connected with the subject in hand. With chapter three may, perhaps, be said to commence the more special portion of the book. It is devoted to "The Mixture of Colours and the System of Colours," the latter comprising an elaborate description of the "colour chart," and its extended development, the "cone of colours" in which all possible colours are arranged in an imaginary figure. In the fourth chapter the same subject is carried further on, as the theory of contrast. After stating and discussing the now well-known fact that, when surfaces of different colour are juxtaposed, each of them is so effected by the presence of the other as to undergo an apparent change, the writer goes on to illustrate this by examples, such as the effects of full contrasts, "small differences," those produced by underlines, &c., or the different shapes of the adjacent surfaces, and the like. The fifth and last chapter, "The Combination of Colours," may be said to give the practical application of the preceding rules. It is divided into two parts, "Decorative or Ornamental Art," and "The Art of Painting." The book, besides being fully illustrated, has at the end a number of coloured plates, illustrating different effects of contrasted colours, &c. Some of these consist of black letters on grounds of different colours, intended to show that such figures show a slight tinge of the colour which is complementary to that of the ground. To bring this out, a leaf of tissue-paper is interposed between the pages, so that, on looking at the letters through the thin paper, the mixture of white light resulting from this device may assist the production of the required effect.

Les Richesses de la Nature. Par P. L. Simmonds. Traduit de l'Anglais par Dr. J. Morel. Gand, 1877.

Under this title Dr. Morel has published in Belgium, a French translation of Mr. Simmonds's well-known work on "Waste Substances and Undeveloped Products?" While following the arrangement of the original matter, Dr. Morel has added a good deal of fresh information, so that the book assumes the character rather of a new edition than of a mere translation of a work already existing.

GENERAL NOTES.

Education in Belgium.—In writing to a friend in England, M. C. Buls gives the following information concerning the proposed additions to the model school established by the Ligue de l'Enseignement, of which he is the general secretary:—By next spring it is hoped that the building for a scholastic museum in connection with the school will have commenced. The building it is estimated will cost 600,000 francs (£24,000). The museum is intended to contain examples for object lessons of every sort. It will comprise departments for textile manufactures, pottery, metallurgical operations, wood working, zoology, anthropology, geology, and mineralogy, hygiene, mechanics, a physical and a chemical laboratory, besides a large hall for machinery. There will be two lecture-halls, the larger capable of accommodating 400 persons. School fittings as used in different countries will be exhibited in another department. It is hoped that the whole will be completed in about four years.

NOTICES.

Ordinary Meetings.

Wednesday evenings at eight o'clock. The following arrangements for the meetings before Christmas have been made:—

December 13.—"A New Process for Printing a Number of Colours at One Impression," by E. Meyerstein, Esq.

December 20.—"The Philadelphia Exhibition," by Professor Archer.

Cantor Lectures.

Monday evenings at eight o'clock. First Course, on "The History of the Art of Coach Building," by George A. Thrupp, Esq.

Lecture IV.—December 11.

Ancient and modern travelling, and public carriages of Europe.

Lecture V.—December 18.

Rules of coach building and theories applicable to the carriages of the future.

MEETINGS FOR THE ENSUING WEEK.

Mon. ...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. George A. Thrupp, "The History of the Art of Coach Building." (Lecture IV.)
Society of Engineers, 6, Westminster-chambers, $7\frac{1}{2}$ p.m. Annual Meeting.
Medical, 11, Chandos-street, W., 8 p m.
Asiatic, 22, Albemarle-street, W., 3 p.m.
London Institution, Finsbury-circus, E.C., 5 p.m. Mr. R. H. Scott, "Weather Knowledge."
Royal Colonial, 15, Strand, W.C., 8 p m.
Tues....Women's Education Union (at the House of the Society of Arts), 6 p.m. M. Edmund Andrade, "The Galin-Paris-Chevé Method of Teaching Music." (Lecture V.)
Medical and Chirurgical, 53, Berners-street, Oxford-street, W., $8\frac{1}{2}$ p.m.
Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Discussion on "The Chalk Water System," and, time permitting, Mr. I. J. Mann, "The Testing of Portland Cement."
Photographic, 5a, Pall-mall East, S.W.
Anthropological Institute, 4, St. Martin's-place, W.C. 1. Mr. H. H. Howorth, "The Ethnology of the Germans. Part I.—Saxons of Nether Saxony." 2. Mr. W. Laws, "Kitchen Midden." 3. Mr. W. J. Knowles, "Classification of Arrow-heads." 4. Mr. W. J. Knowles, "Prehistoric Objects at Portstewart."
Royal Geographical Society, University of London, Burlington-gardens, S.W., $8\frac{1}{2}$ p.m. 1. Capt. Sir Geo. S. Nares, "North Circumpolar Sea." 2. Capt. A. N. Markham, "Sledge Journey towards the Pole."
Wed. ...**SOCIETY OF ARTS**, John-street. Adelphi, W.C., 8 p.m. Mr. E. Meyerstein, "A New Process for Printing a Number of Colours at One Impression."
Graphic, University College, W.C., 8 p.m.
Royal Literary Fund, 10, John-street, Adelphi, W.C. 6 p.m.
Royal Society of Literature, 4, St. Martin's-place, W.C., 8 p.m.
Thur. ...Royal, Burlington House, W., $8\frac{1}{2}$ p.m.
Antiquaries, Burlington House, W.C., $8\frac{1}{2}$ p.m.
South London Photographic (at the House of the Society of Arts), 8 p.m. Annual Meeting.
Royal Historical, 11, Chandos-street, W., 8 p.m.
London Institution, Finsbury-circus, E.C., 7 p.m. Dr. W. B. Carpenter, "Mesmerism, Odylism, Table-turning, and Spiritualism Considered Historically and Scientifically." (Lecture II.)
Inventors' Institute, 4, St. Martin's-place, W.C., 8 p.m.
Mathematical, 22, Albemarle-street, W., 8 p.m.
Fri.......Philological, University College, W.C., 8 p.m.
Sat.......Trades' Guild of Learning and National Health Society (at the House of the Society of Arts), 8.30 p.m. Prof. W. H. Corfield, "The Laws of Health." Part I. (Lecture V.)
Physical Science Schools, South Kensington, S.W., 3 p.m.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,256. Vol. XXV.

FRIDAY, DECEMBER 15, 1876.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

THE LATE S. T. DAVENPORT.

The youngest son of the late S. T. Davenport (formerly for so many years the financial officer of the Society), is now a candidate for admission to Christ's Hospital. Should any member be in a position to nominate a boy to the school, he will confer a benefit on the child of an old and tried servant of the Society by nominating him, and this fact must be the excuse for thus bringing the matter before the members of the Society.

PROCEEDINGS OF THE SOCIETY.

PATENT LAW REFORM.

The petition to the Lord Chancellor on this subject, which was given in the *Journal* of the 1st inst., is still available for signature by members of the Society and others interested in the subject. It has already been very largely signed, and has received the adhesion of the principal patent agents, and of a large number of those whose names are best known in connection with the subject of Patent Law Reform. A great number of signatures from Working Men's and other Institutions throughout the country have already come in, and many more are expected.

Members can sign the petition at the Society's House on any day during office hours.

AFRICAN COMMITTEE.

A meeting of this Committee was held on the 4th inst. Present—Vice-Admiral Erasmus Ommanney, C.B., F.R.S. (in the chair), Dr. Badger, J. Bergtheil, Hyde Clarke, Trelawney Saunders, and the Rev. Horace Waller, with P. Le Neve Foster, Secretary, and Dr. R. J. Mann, Secretary of the African Section.

INDIAN COMMITTEE.

A meeting of this Committee was held on the 11th inst. Present—Hyde Clarke (in the chair), Sir George Campbell, K.C.S.I., M.P., Andrew Cassels, W. Maitland, and J. T. Wood, with P. Le Neve Foster, Secretary, and Col. Hardy, Secretary of the Indian Section.

CANTOR LECTURES.

The fourth lecture of the course by G. A. Thrupp, Esq., on "The History of the Art of Coachbuilding," was delivered on Monday last, the 11th inst.

JUVENILE LECTURES.

Two lectures, suited for a juvenile audience, will be given on Wednesday, January 3, and Wednesday, Jan. 10, by R. A. Proctor, Esq., F.R.A.S.

Lecture I.—January 3rd.

"The Sun and his Family."

Lecture II.—January 10th.

"Comets, Meteors, and the Stars."

The lectures will commence at 7 p.m., and will be fully illustrated. As the number of seats is limited, Members can only avail themselves of these lectures for their families by obtaining tickets from the Secretary. These will be issued strictly in order of application, and only to the extent of the accomodation available. When sufficient tickets to fill the room have been ordered the issue will be discontinued. Subject to these conditions, each Member is entitled to a ticket admitting one adult and two children. Tickets are now ready for issue.

FIFTH ORDINARY MEETING.

Wednesday, Dec. 13th, 1876, Major-General Fred. C. Cotton, R.E., C.S.I., in the chair.

The following candidates were proposed for election as members of the Society:—

Abbey, John Henry, Huddersfield.
Barran, John, M.P., Chapel Allerton Hall, Leeds.
Berry, Thomas Hope Green, A.I.C.E., City-hall, Manchester.
Bovill, Frederick Anderson, 2, Vinery-villas, Park-road, Regent's-park, N.W.
Davis, George Edward, F.C.S., 10, Greenway-road, Runcorn.
Fletcher, W. R. B., 107, Cannon-street, E.C., and 34, Courtfield-gardens, South Kensington, S.W.
Josland, Thomas Pearse, 7, Falcon-square, E.C.
Kierzkowski, Charles Ferdinand de, 7, Collingham-road, Cromwell-road, S.W.
Kinch, William Hubert, Harewood-hill, Darlington.
McClelland, James, J.P., 32, Pembridge-square, W.
New, George Beazley, 62, George-street, Portman-square, W.
Rheims, Francis Henry de, 2, Caxton-villas, Granada-road, Southsea.
Smart, Mortimer Colebrook, Bolton-lodge, Belsize-park, Hampstead, N.W.
Zapata, His Excellency Don Felipe, 12, Weymouth-street, W.

The following candidates were ballotted for and duly elected members of the Society:—

Brown, Edward, 25, Church-street, Spitalfields, E.
Brunlees, John, 5, Victoria-street, Westminster, S.W.
Coates, George, A.I.C.E., 30, Great George-street, Westminster, S.W.
Frost, Francis Aylmer, J.P., Spring-hill, Reddish, Stockport.
Hooker, John, F.C.S., 104, Upper Thames-street, E.C.

McCarter, James Wilson, Foyle-street, Londonderry.
Mead, Arthur, A.I.C.E., Chelmsford, Essex.
Oetzmann, John Robert Augustus, 67, Hampstead-road, N.W.
Stayton, G. H., C.E., Vestry-hall, Chelsea, S.W.
Swindells, Rupert, A.I.C.E., F.M.S., Old Trafford, Manchester.
Willis-Bund, J. W. B., 3, Old-square, Lincoln's-inn, W.C.

The Paper read was—

STENOCHROMY.*

A New Process for Printing a Number of Colours at the Same Time.

By **E. Meyerstein.**

The invention which I wish to bring under your notice to-night, and about which I desire to give some explanation, is called Stenochromy, a word derived from the Greek. Let us consider the invention from a scientific, artistic, and commercial point of view. Its main object is to produce—that is, to print—an unlimited number of colours, or, more correctly speaking, shades of colours, by one impression.

Colour printing, if I am not mistaken, was originally invented by Senefelder, towards the close of the last century, and since then innumerable attempts have been made to print more than one colour by one impression; the more noteworthy attempts in that direction were made by Laurent, Muller, Macready, and latterly by Messrs. Johnson, whose mode, I believe, consisted of piecing together a number of small colour-blocks similarly to a child's puzzle; but when impressions were taken from such a combination of blocks, every outline was distinctly visible, and the impression looked like the back of a child's puzzle. Unless I am much mistaken, this system has now been abandoned, being found impracticable. It would lead too far if I were to enumerate the many frauds that have been practised by persons professing to have discovered a mode of printing various colours by one impression, or the numerous impracticable attempts that have been made in that direction. The problem has at last been solved by Mr. Otto Radde, of Hamburgh, and that he has solved it I think I shall be able to demonstrate to you presently.

Those who are conversant with colour-printing know how many fruitless attempts have been made to attain that object, and how hitherto every experiment has ended in failure and disappointment. They will also be able to appreciate the immense mechanical difficulties that had to be overcome, and will scarcely be astonished to hear that the present invention is the result of many years' study and uninterrupted costly experiments.

Before I show you any specimens produced by the stenochromatic process, I think it will be advisable to give a short outline of the chemical and mechanical appliances required, and of the manner in which stenochromes are produced. I have only once seen the process in operation; if, therefore, my explanations are not as lucid as I should wish them to be, I trust you will ascribe this defect rather to my want of ability than to a desire of keeping anything back; for there cannot be any motive for secrecy, since every part of the invention has been patented; and, if I mention that the specifications have been drawn up by one of the most experienced and careful patent-agents, it is needless to add that they fully and fairly describe the process. I may say that the chief difficulty to overcome was to produce colours of equal consistency or yielding power, and though the recipe was simple enough when it was known, it was only discovered after years of persevering researches, which necessitated the building of a colour-mill and of a large printing establishment, for it occurred several times that, when the inventor thought that he had solved the problem—experimenting at that time with small quantities—he found himself as far as ever from the goal when he followed up his theory on a large scale.

Respecting the composition of the colours employed for stenochromatic printing, I think it would on this occasion be out of place to go into minute technical details; suffice it to say that various fatty and oleaginous substances are mixed with ordinary colours—but colours of the very best quality—in such a manner, that a kind of soapy pigment is obtained. It is, however, indispensable that these pigments should possess the following qualities:—

1st. They must melt, when exposed to a certain degree of heat, and when cooled, after being rendered fluid by heat, they should solidify to about the consistency of butter on a cool day.

2nd. Whatever the colour of the pigments, they must all be of identically the same specific gravity and yielding power. This requirement was one of the greatest stumbling-blocks in perfecting the invention, and to overcome this difficulty, the ingenuity and the patience of the inventor were taxed to their utmost limit, during several years' persevering experimentalising, for I have no occasion to tell you how much the colours ordinarily in use vary in specific gravity and yielding power.

3rd. They must, under all circumstances, retain their original brilliancy and softness of colour, so that neither sun-light, heat, nor the action of the atmosphere can effect, any change whatever.

The composition, or, as I shall now call it, the colour, is always used in a fluid state produced by heat, the required quantity of solid colour being placed for that purpose in a tinned copper-pan with a handle, and a spout or nose for pouring the colour out.

The operator now takes a frame of about two inches in depth, and adapted in its dimensions to the size of the object to be produced, and proceeds thus:—Supposing the groundwork of the picture about to be copied to be black, a certain portion of the interior of the frame is filled with a black colour, which is prevented from running all over the surface by inserting within the frame some thin protecting plates or slips. The colour solidifies quickly; the outlines of the picture, or a portion thereof bordering on the ground-work, is traced on the colour, the slip is removed, and the colour is cut away to outlines by means

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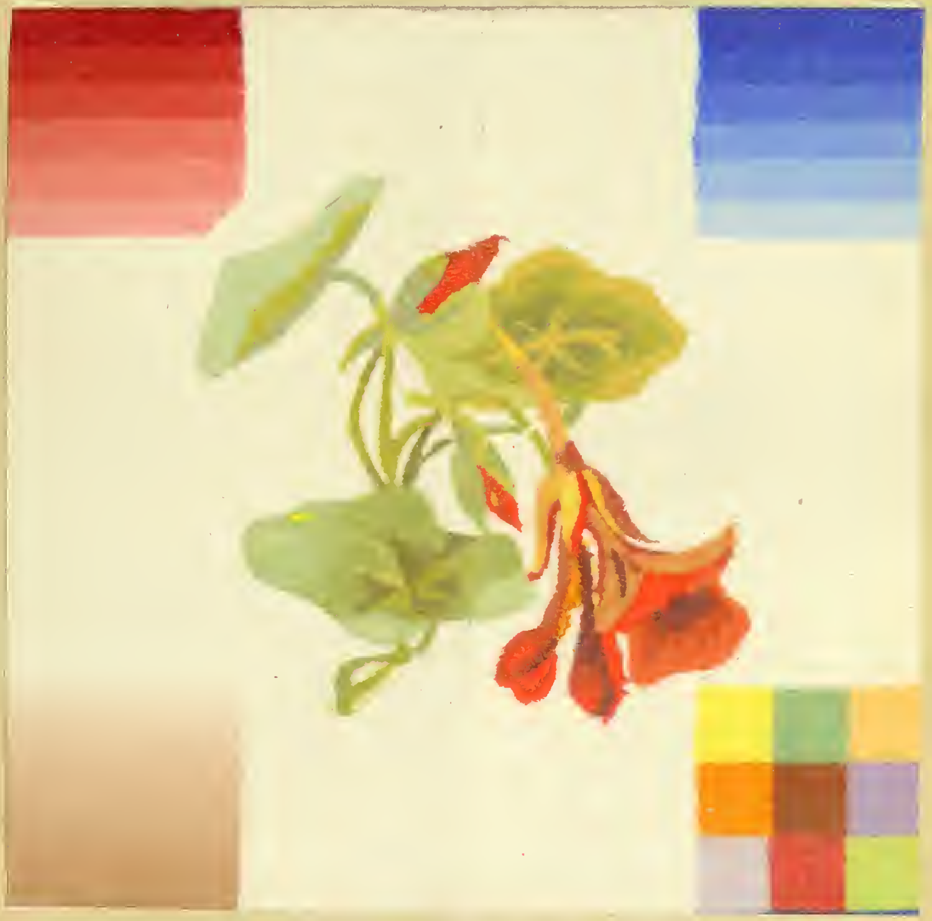
* The accompanying little sheet is a specimen of quick colour-printing, containing between thirty-five and forty distinct shades of colour; 6,000 sheets were printed—including the time for preparing the design—in twelve days—and it is stated that, had they been required, 60,000 copies could as easily have been printed within the same time. It must be understood that this example is only intended to show what can be effected by a single printing. To make a finished picture an "overprint" is required, which would give the outline and shading.

STENOCHROME

Produced by ONE single impression



By means of the Patented

STENOCHROMATIC PROCESS.

of a sharp knife, which acts in a vertical direction. Another slip is then applied, another colour is poured in and allowed to cool, the required outline is again traced thereon, the slip removed, and the knife cuts again according to the tracing.

These operations are repeated until the entire picture is reproduced. The frame is of wood, and to enable the operator to vary the depth of the colour-substance according to the number of impressions required to be taken, it should be a double one, so as to slide up and down telescopically.

The cutting knife is held in a jointed frame like a lazytongs, or similar appliance, which, whilst ensuring an exact vertical direction, allows the knife to travel in any desired latitudinal direction. To ensure a true vertical direction, which is of paramount importance, a spirit level may be attached to the holder of the knife.

The table upon which the work is done should be of marble, and adjusted by means of a spirit-level. On its surface, or otherwise attached to it, is a strong arm, supporting the lazytongs and the knife held by them. Since it is necessary for the purpose of correctly tracing the outlines of the picture upon the colours, that these should be level, a levelling knife, preferably of triangular cross-section, is passed over the frame, and the colouring matter is thus reduced to a fairly even surface.

To obtain correct outlines of the original to be copied, a tracing medium is used; when the outlines are traced thereon, they are perforated, and by means of chalk, charcoal, or other suitable material, transferred to the colour-block.

When the picture, or rather the colour-block, has been so far finished, it is taken to the press, where, by means of a horizontal knife, it is first levelled; then the material upon which the impressions are to be made is placed over the colour block; a zinc plate is lowered, rollers working in a groove on either side are, with slight pressure, passed over it, and a stenochrome is then produced. By means of mechanical contrivances, the colour-block, after an impression has been taken, is raised sufficiently to yield the same amount of colour for every consecutive impression. I suppose I need scarcely mention that the mechanical contrivance for raising the colour-block regularly by almost infinitesimal degrees, was not easily constructed. The engineers, I am told, had to alter the mechanism again and again, and more than one engineer gave up in despair the attempt to carry out the ideas of the indefatigable patentee.

The paper for stenochromatic purposes should be made from clean cotton rags; it should be very absorbent and even in texture, and free from all starch and chemicals.

At one time the inventor almost despaired of ever obtaining suitable paper. Both in this country and in Germany a number of paper manufacturers tried to produce the required material, and for months met with nothing but failure, until at last a London firm solved the problem, and produced a paper that was all that could be desired. I take this opportunity of expressing to them, on behalf of the inventor, my very best thanks.

The paper, or other material, employed for the stenochromatic process, is, previous to being used, damped with a special resinous solution, and is afterwards passed over a heated surface, so as to allow any excess of moisture to evaporate.

Allow me now to direct your attention to some stenochromatic productions, and to show you, first and foremost, these three sheets, each of which contains 72 distinct shades of colour. If they look a little soiled, the cause of this is because I have kept them for months exposed to the action of the heat of a fire, for the purpose of ascertaining whether the colours would fly, which they certainly do not. I doubt whether any colour-printer would undertake to produce such sheets, and if he did undertake it, whether he could do so in a practical manner—I mean with regard to £ s. d. You will notice that each column ends in a white square: the white in every instance, if examined closely, will be found to have a tinge of the respective colour above it. This printing of a white colour, as I have been informed by several practical printers, is in itself a great novelty in colour-printing.

The next three sheets I shall show you were produced with the intention of fixing a colour-gauge, which might serve as a standard for the whole world; and it may interest you to hear what led to the conception of the idea, and how the inventor intended to carry it out. In every trade or profession in which colours are used, it occurs frequently that persons wish to order some coloured material from a merchant or manufacturer living in a different town or country; not having a specimen or sample of the particular shade required—let us say, a green—they obtain the nearest shade to that which they desire, and then write to the merchant, perhaps, as follows:—Please let the colour be of a rather bluer, or yellower, or deeper, or lighter, tinge than the sample. The manufacturer accordingly uses his own discretion, and supplies what he thinks will please his correspondent. But, in most such cases, he will find that he has made the shade too yellow, or too blue, or too deep, or too light, or *vice versâ*. Hence, disappointment and troublesome litigation only too often arise.

To remedy these evils, the inventor has devised the plan of the colour-gauge; but to render such gauge of any value, and of artistic as well as commercial utility, it was found necessary to elaborate the details of its composition with very great care. He divides or graduates each of the seven colours of the spectrum into about ten colours; and each of these he shades off towards the top in eleven equal gradations into black, and towards the bottom in the same number of equal gradations into white. Thus seventy-three colours each, in twenty-one gradations, are obtained.

These are the sheets; they were produced a considerable time ago, for the purpose of demonstrating that a vast number of colours can be printed simultaneously; but now I show you six gauges, ranging from vermillion to orange. It is proposed to treat all the colours of the spectrum in this manner. The whole will then form a set of 80 colours each, in 21 gradations from black to white. Every card will bear a distinctive number at the top, and will be lettered from A to V down the side. Supposing a London merchant wants to order some coloured cloth from a firm in Glasgow, it will suffice if he writes colour number so and so, shade letter so and so, provided, of course, that both have got this colour-gauge. If it is necessary to ascertain which is the shade of colour according to the gauge for a given sample, this little instrument, one of which will accompany every set of colours, will be very useful. You see these moveable slides cover each a shade, and by opening these in turn until the correct shade is found, the proper designation can be given to the shade in question. This system of a standard colour-guage would have little to recommend it were it not for the two important facts that, firstly, the stenochromatic colours never fade or change, and that, secondly, any and every shade of the proposed gauge can be reproduced with mathematical exactness after any length of time.

I now come to one of the most interesting and important parts of stenochromy, viz., in its relation to science and education. Any one that has ever written a work on the theory of colours and kindred subjects, as well as the publishers of such works, know the almost insurmountable difficulties they found in giving the correct coloured illustrations. Of this I have convinced myself on the occasion of a visit to Professor Benson, who, as you are doubtless aware, has made the theory of colour his especial study. That gentleman showed me a number of diagrams he had coloured by hand to serve to illustrate a work he had written; the publication, however, had to be abandoned, because no printer that could produce the correct colours of the spectrum was to be found. It is surely not sufficient for the tuition of colours to show to the pupil some random shades which the printer pleases to designate as red, yellow, blue, or green. The fact, however, is that this is done, and the result is a surprising amount of colour-blindness. The late Dr. George Wilson, in his work entitled "Researches on colour-blindness," expresses himself on this subject, as follows:—"The variety of colour-blindness, where the nicer shades of composite colours are mistaken, would appear to be very common, the rule rather than the exception in the majority of persons, at least in the male sex, in this country; but it is a matter of doubt how far it may not be referable to imperfect cultivation of the sense of colour." Stenochromy affords a remedy against this evil, for one of its great merits is, that by its means the scientifically correct colours of the spectrum (as shown on this sheet) can be produced. I am of opinion that the subject is treated with too much indifference in our public schools. Some time ago I showed this very sheet to the authorities of one of our great educational institutions. On mentionthe price for supplying copies, the gentleman whom I addressed said that he could obtain all he required at a cheaper rate, and thereupon produced some coloured diagrams in proof of his assertion. In reply to my remark that none of these colours appeared to me to be the true colours of the spectrum, he said that that was of no consequence, for the diagrams were used only for young children, and all that was needed was that there should be some red, blue, yellow, and so forth.

Surely this is tho way to propagate colour-blindness, if we are to believe Dr. Wilson; for when he wrote, in 1855, the passage referred to just now, there was, I believe, very little tuition about colours in our schools; and now that this subject is taught, the eyes of the pupils are, from the very beginning, misdirected by incorrect colours.

The stenochromatic process has also been applied to the printing of maps, and has the advantage over the ordinary mode of printing them that the names of towns, rivers, and so forth stand out in greater relief; for the black part of the map is printed over the colours and is consequently not rendered indistinct; while under the old system, I believe, the colours are generally printed over the black, and thus more particularly the names that are printed in small letters are rendered very indistinct. For the printing of geological maps where a variety of shades is often desirable, stenochromy will doubtless soon be employed. This map, which was printed by Mr. Radde, for the Royal Agricultural Society of North Germany, demonstrates how useful stenochromy would be for such purposes. I show you the under-print as well as the finished map; there are about 35 colours in it. The specimens I have now shown you were all printed on calico or paper, but the material of the next specimen I produce is a thick woollen cloth, and shows the second stage of the invention. It was the first attempt to produce what I may term a design, and deserves no particular mention, except to direct your attention to the fact that there are close upon 300 shades of colour in this sheet, and that it furnished a proof that the process could also be used for printing on woollens.

The inventor next made it his aim to copy something in the style of a picture, and rough as this specimen may appear, it satisfied him that stenochromy could be applied to such purposes. These four bouquets printed respectively on calico, on a thick woollen cloth, on a rep, and on a fine furniture gobelin, were the next attempts in that direction, and then followed this little sheet. On a closer examination of these specimens, you can convince yourselves, that they were produced by one single impression. I dare say you noticed the brightness of colour in these two specimens, but now observe, if you please, that productions like these form very effective transparences, in which the effect of the colour is decidedly heightened, while ordinary coloured prints fade when put to such a test.

For the purpose of having what I might call a phenomenon in colour-printing, the inventor, after producing the specimens you have seen, asked his designer to paint some fancy subject, and to introduce into it as many shades of colour as his imagination could suggest; the result was a picture which I have been told (I have not counted the colours myself) contains upwards of 800 shades.

This one is printed on paper, this one on a coarse furniture rep. When one of the first London publishers had seen the specimens I have brought under your notice, no doubt was, of course, left upon his mind as to the importance of the invention. Desirous to know, however, whether stenochromy could be utilised for the reproduction of works of art, he handed me a copy of one of Mr. Miles' water-colour sketches, and requested me to inquire of the inventor whether he thought that he could copy similar subjects. I soon received an affirmative reply, with the remark that the stenochromatic print would require an over-print, to make a finished picture.

The first attempt in this direction was the copy of a placard, and I show you here, first, the under-print, the stenochrome; this is the over-print, which for purposes of demonstration has been printed on a separate sheet of gelatine; and here you have the finished placard, where the over-print has been printed direct on to the under-print.

I next received this picture, the copy of Mr. Miles' sketch I have just now referred to, and here likewise I show you the under and over-print separately.

Respecting over-prints, I wish to mention that, where a high finish is desired, two, three, or even four over-prints—or, as they are termed, blending plates—are employed. For the printing of show cards, tapestry or wall decorations like the bouquets, and the harlequin I have shown you, a single impression will certainly suffice—and I think hangings like these bear criticism. You must, however, bear in mind that since those specimens were produced, a much greater degree of perfection in preparing the stenochrome has been attained, as I shall presently demonstrate to you. This specimen, for instance, has two over-prints, one of a brown, the other of a greyish shade, which, you see, give quite a different appearance to the picture.

This specimen is a copy of a chromo-lithograph bought from one of the first publishers in London; and, considering that this, like all the specimens you have seen, is only an experiment, I think the inventor need not be ashamed of his productions. This little cottage has only one over-print. The picture I now produce is a copy of a painting by Tiddeman, a German painter, and entitled, "No one is born a master;" it has one over-print. But here I must point out a peculiarity of the stenochromatic process, viz., that it can be used in combination with photography. This gelatine plate bears a photograph known as the Woodbury type, and this, when printed over the stenochrome, produces a really finished little picture. Observe, also, if you please, that the stenochrome can be printed upon both sides with almost equally good effect. This branch of the invention will doubtless soon be brought to great perfection, for I have it on the best authority that Mr. Woodbury is continuing his experiments with that intelligence and indomitable perseverance for which he is so well known.

I dare say you have been struck by the brightness and purity of the colours I have shown you, and this is due to the fact that each colour, as it were, maintains its own ground, and is not, as in the ordinary process, dimmed by repeated over-printings. This in itself stamps stenochromy as a process quite distinct from any of those now in use. It is not an improvement merely on chromolithography or on oleography; it is an entirely new mode of producing coloured designs and pictures. This purity and freshness of colour is more particularly observable in the flesh-tints produced by the stenochromatic process. In these, above all, the productions of oleography and chromo-lithography are weak, in consequence of the many manipulations they have to undergo. It is a general complaint, more particularly against oleographs and similar productions, not only that after a comparatively short time they fade, but, what is worse, that colours like yellow, brown, and chrome become more glaring, while flesh-tints and other delicate colours become paler. Hence it is frequently seen, that what was at first a very creditable production becomes after a while a perfect caricature. I have here a picture, produced by one of the best oleograph printers, of which the centre has been kept covered up for only 14 days, while the sides were exposed to the action of ordinary light in a room. Look at the change which in so short a time has taken place. Such a change—in fact, no change—of colour will ever take place in any stenochrome. As long as there is a shred of one left, the original tints will retain their original brightness and softness.

I will now show you what the inventor calls his first really successful picture. It is a copy of a painting by Mr. Kinnaird, and demonstrates above all, the remarks I made about the softness and freshness of the stenochromatic flesh tints. I have seen the original painting in the *atelier* of the inventor, and can assure you that the copy is a mathematically correct one. The same remark applies to these copies of two water-colour paintings by Mr. Robert Huttula, of London. You see that, particularly in this one, Mr. Huttula has not been sparing of colour, and I have it from his own lips that these two pictures are not only mathematically but also artistically correct reproductions of the originals. Of this, however, you can convince yourselves by comparing the copies with the originals, which I now produce.

This picture represents the new Orangery at Sanssouci, of which I likewise show you the under-print, as well as impressions on a thick cloth and a furniture gobelin. These specimens only reached me about an hour ago.

I abstain from any comments on these two landscapes; if they do not speak for themselves, my doing so will scarcely benefit them; but I invite you to examine any or all of them at your leisure. When M. de Leeuw, the artist, by whom the originals were painted, saw these reproductions, he frankly owned that he had never seen a better rendering of an artistic subject; and pointed out how soft and natural the colours were (more particularly in this winter landscape), and how all the stiffness and hardness usually observable in printed copies was avoided.

Let me now show you an enlarged copy of an oil-painting, which a firm of London publishers placed in my hands for the purpose of reproduction. If this picture is from no other reason deserving of some notice, it is so from the fact that it was produced in seven weeks and three days; this alone should render it interesting. The patentee received the order on September 17th last, and dispatched this picture on November 6th. This is the under-print, which of course has been produced by one single impression. And I further show you here an impression on a gobelin and two on a thick woollen cloth.

I also received to-night copy of a picture by Melbye, entitled "Sunset near Constantinople;" but Mr. Radde informs me that this picture will yet require one more blending plate before it is finished. This is the stenochrome proper, produced by one impression, and this is the same with the addition of one blending-plate.

The specimens you have seen have doubtless convinced you that a multiplicity of colours, however great it may be required, is to stenochromy no obstacle, and that by its means shades as delicate and pure, if not more delicate and purer, than any that have hitherto been produced can be obtained. The peculiar manner in which, as I have explained, stenochromes are produced, gives to the process another immense advantage over chromo-lithography and oleography. As long as sufficient colour is left to yield an impression, there cannot be any difference in the appearance of the stenochromes; they must, one and all, be exactly alike. But this is different with pictures produced by the old system. If the printer in the course of passing his inking roller over 20 or 30 stones puts too much or too little colour on one or more of them, the consequence will be a want of harmony in the picture, and amongst a hundred such copies a great variety of shade and tone will therefore always be observed. I greatly doubt whether any printer of chromos or oleographs would undertake to produce 100 copies of any subject, and to guarantee their being all exactly alike. Unless I have been grossly misinformed—for I do not speak of my own personal knowledge—such a thing would be impossible. That is an advantage scarcely to be overrated from an artistic point of view, but commercially, likewise, stenochromy has made a great stride in advance of the old colour-printing system.

Supposing a picture measuring 39 in. by 27 in., the size of this, is to be produced, and required 25 to 30 printings, the same number of lithographic stones measuring 45 in. by 33 in. would have to be prepared, and separate impressions to be taken from each of them. I believe I am within the mark when I name eight months as the average time required under ordinary circumstances for the completion of such a picture, and if after all this labour and expense has been bestowed upon it, and a first impression has been obtained, the printer finds that there is some want of harmony in his production, it is no light task to discover which of the stones requires an alteration. This serious drawback does not exist in stenochromatic printing, for, as I have explained to you, the artist while composing his subject can see whether he works correctly or not. Again, when printing under the old system, there is a large number of spoiled copies, in consequence of what is termed faulty registration. For when a sheet of paper has to passed 25 or 30 times over as many stones, and has to be adjusted each time with such nicety that it does not change its position by even the fiftieth part of an inch, it stands to reason that a slight misplacement, and consequently spoiled copies, must often occur. This loss in stenochromy is of course likewise avoided.

Not being a practical printer myself, I refrain from quoting figures in detail respecting the cost of producing such a picture, but the result of my most careful inquiries is, that the total cost of printing 300 copies would not be short of £500. If the picture should, unfortunately, not please the public, and only a few hundred copies be sold, the loss would be a very serious one indeed. To produce, however, a subject like this by stenochromy, not more than about eight weeks' time is required; and, since only three or four over-prints are needed, the loss, in the event of the subject proving a failure, would be very insignificant, for the colours employed could be used again.

Publishers can best appreciate the importance of being able quickly to copy a given subject; frequently, they would feel disposed to bring out a picture of this or that locality or episode that is attracting public attention for the time being, but they are deterred from doing so, because, by the time a picture could be produced by means of the old system, the interest in the subject in question would most likely have faded. This is, however, scarcely to be apprehended after so short a time as two months.

A further advantage stenochromy offers lies in the fact that there is no occasion or inducement to print more than 1,000 copies of any one subject, for it makes no difference in the cost of the production whether one, ten, or a hundred thousand copies are ordered.

The reason for this apparent anomaly I demonstrated when I explained to you the manner in which the stenochromatic colour-block is prepared. The causes do not concern me, but the fact is well known that, when a new print is published with a guarantee that only a stipulated number of copies shall be issued, the public are more eager to subscribe to or to buy such a print, than when no guarantee of a limited publication is given. But with the plates and stones in good working order, and with the certainty of materially increasing his profits, the printer is not always proof against the temptation of issuing a few hundred or thousand more copies, if he should find a demand for them. The temptation is next to *nil* to the stenochromatic printer, for after every 1,000 copies he must begin his work afresh from the very commencement, and consequently he does not thereby cheapen the copies he has previously produced.

I have now described to you as clearly as I could the principal advantages of the stenochromatic process, and also the manner in which it is worked. There are many minor peculiarities which I should have been glad to have pointed out, but I am afraid I have already trespassed too long on your time and your indulgence. For this indulgence, allow me to tender you my best thanks, and to say that I shall be happy to give all the information in my power to any one interested in the subject of stenochromy.

DISCUSSION.

The Secretary exhibited a specimen of an invention of a somewhat similar character, namely, that which was shown at the Exhibition of 1872, by Messrs. Johnson. They proposed to print from a single block of colour, but it was produced in a different manner to that now described. He also showed specimens of a somewhat earlier process, which indeed had led to this one, by which a coloured block was produced, but not intended to print from. It was produced in thickness, and then thin veneers were cut off from the surface and placed upon a board; but it was evident that if an impression could be taken from this, a similar result would be produced to that by Messrs. Johnson's process. The specimens shown resembled what was known as Tonbridge ware, very small squares being produced by the ends of small sticks of pigment, which themselves were produced by being forced through a mould.

Mr. Dickes asked how the over-prints were produced?

Mr. Meyerstein said he believed they were produced from a lithographic stone, in a similar manner to chromo-lithography, but the full details were given in the specification of his patent. Not being a practical printer he could not answer precisely any technical question. Any he could answer, however, he should be happy to reply to.

Mr. Dickes said that the manner in which these overblocks were prepared would greatly affect the expression and artistic touch. He had been much delighted by the explanation given by Mr. Meyerstein. It was a marvellous invention, and seemed to bear out the idea he had always entertained that the German was an exceedingly close, painstaking mind. It seemed that in the production of these blocks was exhibited a wonderful power of application on the part of those who prepared them; and they deserved great praise for it. But it seemed to him there was one fallacy in the whole thing, which was this. Mr. Meyerstein seemed to think that a picture was to be made by a mosaic, as it were. Now, he admitted the marvellous results which had been shown, but he doubted if with the second, third, or fourth block a picture could be produced. These over-prints were required to take away the mosaic laid down as a base, and change it into a picture; and this second, third, or fourth print was a monochrome. And there he thought it was a mistake to speak slightingly of the mode adopted in colour-printing, ordinarily, of putting colour over colour. He thought there was an advantage in it, as by that process, was obtained, to a far greater extent, that infinite variety of tint, both in the colour and shading, which one saw in nature. In wall paper or in ornaments, you might see very bright colours, but you could not see them in fields, or any true picture. Pure colour was obtained by laying line by line, as in a mosaic, and then putting over it a monochrome; and there it did not seem to him they were attaining the height which as artistic printers they should attain. They wanted to give, not only the form, but the feeling of the picture; and he feared by this mechanical mode the feeling might be lost, while the form would be maintained.

Mr. Hanhart said Mr. Meyerstein had remarked that chromo-lithographs were not permanent, but he should like to know whether the same materials were used to prepare these blocks of colour as were employed by lithographers, because, if so, he was quite sure the colours must equally fade. They knew that the ochres, and colours of that class, were permanent, but when you come to lakes and carmines, if they were produced with the same materials as were ordinarily used, their permanence could not be secured. The picture which had been shown, part of which had been covered up, had, no doubt, been affected in the exposed part by the smoke of a London atmosphere.

Mr. Meyerstein said he himself did not expose the picture. It was sent to him from abroad with a letter stating that the sender had, for experimental purposes, kept, for about a fortnight, the centre covered, and the sides exposed to the ordinary action of light in a room.

Mr. Hanhart remarked that prints were not usually exposed in that way. Any water-colour drawing would fade if exposed to the sunlight. It appeared to him that unless you could get almost an original painter to take these vague impressions produced from the original block, and make the over-print, you would never get anything like a picture; therefore it was not the process which gave the merit of the artistic production, but the hand which did it. It was the same in a chromo-lithograph, the effects all depended on the artist who prepared it. If the draughtsman was merely a mechanical one, a mechanical picture would be the result. Therefore it was not so much a question of the means as of the way in which they were used. Lithography was not so mechanical as engraving on wood or copper, but wonderful effects were produced by these processes; by simple lines and dots. In lithography there was an immense variety of means at command, but the artistic merit depended on the way in which the picture was put on the stone. Very often a chromo-lithograph was too bright in colour, the great difficulty being to get them soft; but if it was properly put on the stone in the first instance, almost any number could be produced, which would not vary perceptibly. He was much pleased with the way in which the subject had been brought forward; but it appeared to him that the real merit must lie in the over-print.

Mr. Vincent Brooks said he had paid great attention to the paper, but he did not quite gather how the last process was effected, and this, it seemed to him, was the most important part. As to the first part of the process, he did not see very much difference between it and that exhibited by Mr. Johnson, though the latter had not produced anything like so perfect a result.

Mr. Pearsall remarked that Mr. Meyerstein had spoken in a very bold way of the permanence of his colours, which, he had no doubt, would be justified by an examination of the patent. He suggested it would be an immense boon to artisans and manufacturers to be shown how the microscope and spectroscope might be employed for this purpose. But something more easily accessible was required for the purposes of practical men, and the guages which had been described would, no doubt, be very useful. Some time ago Mr. Spottiswoode had brought before the Royal Society a paper on the production of colours by polarised light, and in his treatise on "Polarised Light," published by Macmillan, he showed how 255 shades of colour could be produced in any part of the world, with the certainty of their being always the same. And he had not overlooked the low-toned colours, which caused nearly all the difficulty, and which were now so much used. In fact, the best artist was he who could produce the most harmonious picture with the standard set of colours which had been described. In some cases it was extremely difficult to find a standard of colour, and sometimes disputes arose involving a very large amount. You might say one sample was white, and another was white, but when two or three whites were brought together one would be seen to be a blueish, another a yellowish, and a third a greenish tinge; and the only true standard was a natural product, such as snow. When that was used, he had been astonished to find how dingy and dirty samples which had previously passed for white appeared. In some cases precious stones, such as the sapphire and topaz, had been used, cut into slices, as the standard of colour, and Mr. Sorby had lately made use of the spectrum itself. There seemed a great mystery with regard to the permanence of pictures, for it was astonishing to find how brilliant and permanent were those of really great artists. Whether you went to the old pictures of Van Dyck, or to some of the water-colour drawings of the present century, it was wonderful how they had resisted all atmospheric influences. He could bring little works, of which he knew the history for thirty or forty years, quite unchanged by either sunlight or gaslight. Whether it was that the finished artist did not rely on lumps of colour, but used so small a quantity that the number of reflections was infinitesimal, or that the light decomposed and recomposed it, he could not say, but it was undoubted that these thin films of colour did resist the ravages even of the English climate.

The Chairman said they must all admire the modest manner in which this subject had been introduced, though they might not be prepared to admit that chromo-lithographs were to be cast aside. With regard to the permanence of colours, he could not but hope that some really valuable lessons would be gained from this process.

Mr. Stinton drew attention to a white pigment prepared from antimony, under a patent of Mr. Stenhouse's, which did not form a chemical combination with the oil, as was the case with lead, and which he had used very successfully. It was manufactured by Messrs. Hallett, of Rotherhithe. The ochres also produced mischief from their deliquescent nature.

Mr. Golding said Mr. Meyerstein had referred to a chromo-lithograph of twenty or thirty prints taking something like eight months to prepare, but he thought there were plenty of practical printers who would produce one in less than half that time. He should like to ask what would be the comparative saving, both in money and time, in producing such a picture by the new process.

Mr. Meyerstein, in reply, said that when he spoke of chromo-lithographs he never intended to refer to productions such as those of Mr. Hanhart, because they ranked amongst the highest in the world. He was speaking of what were ordinarily termed chromo-lithographs and oleographs. One speaker seemed to assume that they worked liked machines, and had no occasion to use their brains or any artistic sense; that the whole was a mechanical process, whilst to produce chromo-lithographs artists are required for the over-print. Now, for a stenochrome, one, two, or three over-prints are required, and of course these must be prepared by an artist; but in a chromo-lithograph, when you had twenty or thirty printings, you must have the same number of artists, because every stone was virtually an over-print, and if they were not all artistically prepared the whole picture would be spoiled. He did not think the specimens he had shown were very dull and hard, although they were the first finished pictures which had been produced, and they were making improvements every day. He had shown the so-called mechanical stenochrome, and the same thing with one over-print, which he contended gave a fair reproduction of the painting. At any rate, the artist who painted it was very well satisfied with the result, and said that it not only was a mathematical copy but that the very pencil touches seemed to be given, and that the spirit of his picture had been rendered correctly. With regard to the question as to the permanence of the colours, he thought that was hardly the place to go into the minute details of the patent specification, which could be obtained by any one interested, for a shilling, at the Patent-office. He might say this much, however, that the colours selected were of the very finest quality, and they were then mixed with certain fatty substances in such a manner that they became of one specific gravity and density. He had had some of the sheets exposed for months and months to the sunlight, and to a stove fire, without their changing in the slightest degree. He believed the reason why common chromo-lithographs faded was that the printers used rubbishing colours in order to save expense, and Mr. Hanhart's and similar productions would doubtless stand well, because good materials were used. With regard to the over-prints, he could only say that he believed they were drawn and printed in the ordinary manner for lithographic stones, though not being a practical printer, he could not pledge himself to that. With regard to the cost, he could assure the questioner that the stenochromatic printer could, if he desired, work at a much less cost than the lithographer; he did think at about one-third or one-fourth. Many gentlemen present would know something of the cost involved in making experiments with machinery, and consequently they did not mean to work cheaper than the best chromo-lithographers; because, though it might appear presumptuous to say so, he was satisfied they could produce results equal to the best chromo-lithography.

The Chairman, in proposing a vote of thanks to Mr. Meyerstein, said it was very satisfactory to find that this process was so much cheaper, because it must produce economical results in the future, whatever must be the case at first. If the man who could produce two blades of grass where one grew before deserved well of his country, he was sure that he who could produce such beautiful pictures as those they had seen that evening was equally worthy of their hearty thanks.

The vote of thanks having been passed,

Mr. Meyerstein, in acknowledging it, said he had invited many persons, even those who would naturally be most inimical to the invention, to his office to see his specimens, and he should be always happy to afford anyone all the information in his power in regard to it.

MISCELLANEOUS.

LOAN EXHIBITION AT SOUTH KENSINGTON.

Meteorological Instruments:—Thermometers, Hygrometers, and Rain Gauges.

By Dr. R. J. Mann.

The aneroid barometer, in which the varying pressure of the atmosphere is measured by the greater or less yielding of the rigid sides of a vacuum chamber, and by the movement of levers and hands, which are so attached to these yielding sides as to mark the amount by a long hand sweeping, like a clock-hand, round a circular scale, are general favourites, on account of the compactness of their form, and the ease with which they can be carried about, and placed in any position. They are valuable instruments also in a scientific as well as in a popular sense, when they are used as the tenders and supplementary allies of their mercurial kindred. But they are scarcely yet to be trusted in independent scientific work, on account of their liability to shift their readings, from accidental derangement of their delicate mechanism. They are about as reliable in the indications they give as well-made watches, but can scarcely be said to be less prone to shift their rates. They answer, however, admirably when it is only comparisons of different readings at short intervals which are required, as in measuring heights, or in employing them as weather glasses, or when their performance can be frequently checked by reference to the more reliable mercurial standard, which is given to the same class of deviations.

A very good illustrative series of aneroids is contained in the collection; they are placed together in a horizontal glass case, nearly opposite to Sir Isaac Newton's reflecting telescope. No. 2,816*a*, comprising three instruments, is a somewhat interesting historical group. The larger of the three shows the size in which the aneroid was originally made; the other two are specimens of the first reductions in size, which were accomplished by Negretti and Zambra, under the suggestions of the late Admiral Fitzroy, the medium size being less than three inches in diameter, and two inches in thickness, and the smaller having about the same dimensions as an ordinary watch. The upper part of the case shows how other ingenious makers have followed since in this line. There are seven good specimens by Pastorelli, and three by Pillischer. Two of these latter, by Pillischer, numbered 2,816, are remarkable for their exceedingly small size, one being not more than an inch, and the other only five-eighths of an inch in diameter, and probably the smallest aneroid ever yet made. 2820*a*, by Casella, is an excellent aneroid, not more than two inches and a half in diameter, contrived by Mr. Field for engineers' surveying. There is also one small open aneroid by Pillischer, which allows the corrugated vacuum case and part of the associated levers to be seen. Of the larger aneroids, there are good characteristic specimens by Davis, of Derby, by Pastorelli, and by Casella; the largest of the group is by Pastorelli, and one instrument by the same maker, in a brass-bound mahogany case, like the one which is ordinarily adopted for chronometers, is a good, serviceable-looking instrument. In the case of the Meteorological-office, the useful form prepared for the navy, by Elliott, is shown. In 2,817, Deutschbein, of Hamburgh, exhibits two open aneroids with a peculiar system of mechanism. There are also some very delicate Swiss aneroids, by Goldschmid, of Zurich, in two of which the reading is taken by micrometers and microscopes, and three in which the scale is contained upon a cylindrical arm projecting at the side. These instruments have elaborate scales and tables appended to them for temperature corrections.

The aneroid lends itself very readily to the purpose of self-registration, as little more is needed than to connect the registering apparatus to the levers that already form part of the mechanism of the instrument. 2,885 and 2,882, very similar instruments, by Pastorelli and by Elliott, which stand in the large case to the south of the general group of aneroids, illustrate the simplest way in which this is effected. The end of a lever, projecting from the case of the barometer, lifts and drops a pencil grooved upon a sliding rod, so that its point leaves a trace upon the papered surface of a vertically-revolving drum, which turns round once in a week, and is divided by ruled columns into seven days, and by horizontal circles into three inches of atmospheric pressure. In these instruments the drum stands up in the centre of the case, and the driving clock and the aneroid are ranged symmetrically on either hand. The case is intended to be placed in the hall or library, and a self-registering maximum and minimum thermometer is, on that account, contained in it with the barometer. Upon a pedestal between the two windows near to these instruments, the large self-registering aneroid of Mr. Pillischer, No. 2,872, is based upon a somewhat similar plan. It differs principally in the matter of size, and in the fact that the clock, aneroid, and drum are ranged vertically over each other, instead of being placed side by side. The dial of the aneroid is two feet across, and a steel chain is dropped vertically from it to the pencil, which rests against the drum. The drum also has fourteen perpendicular lines ruled upon its paper, and is carried round once in fourteen days instead of in seven. The pencil, however, does not rest upon the paper, but is pressed for a brief instant against it, at short intervals, by a movement of the clock, and so makes a dotted line instead of a continuous trace. Upon a similar pedestal near at hand, a somewhat elaborate instrument, by Breguet, contains another very ingenious arrangement for the automatic registration of the aneroid. In this instrument a battery of four vacuum cases, placed over each other, lift by a direct thrust a stud against the short end of a very long brass lever. This lever terminates in a point, which rests upon the face of a revolving drum covered with black paper. As the drum revolves, the point scratches a white trace upon the dark ground, and this trace is raised and depressed conversely with the movements of the vacuum cases of the barometer portion of the apparatus. The revolution of the drum is managed in a very neat way. Its upper rim is composed of a series of fine teeth, and a small-toothed pinion, upon a horizontal bar projecting from the clock, rests upon this rim, and turns the drum round as it revolves.

The instrument which is almost universally employed to mark the temperature of the air is the mercurial, or spirit, thermometer. Mercury is used in the constructon of this instrument, on account of the facility with which it contracts and expands under change of temperature, of the largeness of its expansion on the addition of heat, and of the fact that it only solidifies in very extreme degrees of cold. Between the temperatures of freezing and boiling water, this liquid expands rather more than one fifty-fifth part of its bulk. In the construction of the thermometer this circumstance is turned to practical account by enclosing the mercury, which has to expand and contract, in a hollow glass ball, or bulb, continued above into a narrow tube. With a bulb four-tenths of an inch in diameter it is easy to arrange a tube which shall be filled to a length of several inches, by a fifty-fifth part of the mercury that can be held in the interior cavity. In order, however, that this simple instrument may be capable of giving the exact indications that are required for the purposes of science, it is essential that the bore of the tube should be of even size throughout, that the points in it at which the mercury will stand at the freezing and boiling of water should be very carefully ascertained and marked, and that very trace of air which would hamper the free movement of the liquid metal should be expelled. When these several conditions have been secured with the utmost attainable care, the instrument is held to be of "standard" excellence. But other thermometers can then be compared with this standard, and so be made of scarcely inferior authority as instruments of close observation, when their comparative performance has been thus ascertained. The fine series of instruments which are contained in the first large case of the Room L, at the south end, well illustrate the skill of the best makers of the day in this particular department.

Two instruments, one by Casella, No. 2,826*g*, and one by Elliot, on the front of the case, show the form which the most carefully made standard thermometers assume. Both have elongated bulbs, and the best proportions of column to bulb for ensuring quick response to changed temperature, and sufficient length of indication in the column. The scales are indelibly cut upon the glass of the tubes, as is now invariably done with all the best instruments. In Elliott's standard these divisions are carried to half degrees. The scale ranges from 15° to 125° of Fahrenheit. In both instruments the tubes have been carefully tested for accuracy of bore, by measuring a small fixed quantity of mercury in all parts of the tubes, and the tubes have then been filled, and left for some months to consolidate their glass, before the process of graduation was performed. The Fahrenheit scale, which is employed, and which is used with most English thermometers, was devised by Gabriel Fahrenheit, of Dantzic, who adopted for his zero points the greatest cold observed in Iceland. The advantage of this scale, which makes it retain a strong hold upon the favour of English meteorologists, is the great number of the divisions between the boiling and freezing points, namely 180, and the convenient fact that no minus quantities are touched until the unusual cold of 32 degrees below freezing is reached. All registers above this depressed point are therefore noted by continuous ascending numbers, from 1 to 212, the 32 in this series then corresponding with the consolidation of water.

Close by these standard thermometers is one very remarkable instrument by Negretti and Zambra, which is probably the most sensitive thermometer that has ever been made. Its mercury reservoir has the form of a gridiron of eight bars, instead of the more ordinary one of a bulb, and takes up its change of temperature almost on the instant. The tube, with its gridiron reservoir, is a surprising specimen of the glass blower's skill; the construction of the instrument was, however, found to involve so much difficulty that this specimen is unique; it is the only thermometer of the form that has ever been made.

The thermometers, 2,827*a*, are, it will be observed, a pair, which are identical in all other points excepting that one has half of the inside of the glass tube converted into a white enamel, which shows the movement of a fine column of mercury in front of it with great clearness. This illustrates a very important improvement in the construction of thermometers, which was introduced by Negretti and Zambra.

The Board of Trade thermometers, 2,827*e*, also by Negretti and Zambra, show the extension of the same principle to the construction of the outer scale. In the one of these instruments the scale is formed of white metal, and rapidly deteriorates in legibility from use. In the other instrument the scale is of durable white porcelain, with indelible black lines, and remains untarnished under any amount of exposure. There is one excellent thermometer, of a bold and very legible form, by Elliott Brothers. The Pastorelli thermometer, on white metal scale, belongs properly to a series of instruments which this maker has planned for the use of colleges and schools. Negretti and Zambra's ordinary meteorological thermometer is shown in the set of instruments adopted for observatories of the second order by the Meteorological Society, which are placed in the observing frame in front of the first window. Analogous instruments by Casella are exhibited in the shipboard frame of the Meteorological-office, in the third case from the south end of the room, and in the wooden box in which a set of four instruments is displayed as furnished for sea use. In one of the cases which hold the contributions of the Meteorological-office, there is a very convenient small pocket thermometer, with boxwood mounting, which is supplied for navy surveying expeditions. The series contained in this department of the collection, and thus specified, very adequately demonstrates the best class of thermometers now used by meteorologists. It will be understood, however, that another large series of thermometers is contained in the gallery above, being there grouped with the instruments classed as measurers of heat, irrespective of their employment for meteorological purposes. Amongst these will be found a set of four, by Dring and Haye (No. 1,023), which conveniently illustrate the different thermometric scales most generally in use, those, namely, of Fahrenheit (already described), of Celsius (also called Centigrade), of Reaumur, and of De Lisle. The Celsius scale makes freezing water the zero, and boiling water 100 of the scale, and adopts 100 divisions between the two. In the Reaumur scale, which is employed in Sweden, Norway, and Denmark, the zero is fixed at the temperature of ice, and the temperature of boiling water is 80. In De Lisle's scale the zero is boiling water, and freezing water corresponds with 150 degrees. In this part of the collection there are some delicate foreign thermometers worthy of note, which are graduated to tenths of degrees.

Thermometers which will register the extreme degrees of heat and cold for a single day and night, are indispensable to exact meterological observation, in all circumstances where very frequent readings of the instruments cannot be made; a pair of such instruments are left duly adjusted for their work, and then in the early morning indications are found on them of the greatest heat of the preceding day, and the greatest cold of the preceding night. The large instrument (No. 2,827*f*) with the white porcelain scale, shows how this matter of registration is managed for the greatest heat, in the form of maximum thermometer, devised by Negretti and Zambra, and which is now in most general use. A short distance above the bulb, but below the horizontal bend, the tube is contracted to a very narrow aperture, by the introduction of a small fragment of enamel, so fashioned as to allow the mercury to pass freely outwards when it is expanded by heat, but which then offers sufficient impediment to prevent the column contained in the horizontal tube from returning to the bulb, until the instrument is raised into a vertical position, and rapped with the fingers, or shaken. When this instrument is looked at in the early morning, the column of mercury shows how far the liquid metal had been pushed out by expansion during the heat of the previous day, and there is a void space between the inner end of this column and the bulb. The instrument is set for the next observation by shaking the mercury back into this space. Pastorelli has two specimens of this form of maximum thermometer, one with a scale of white metal, and one with a black scale and white graduations. Negretti and Zambra's ordinary size of the registering instrument supplied to observatories, with the white porcelain scale, is shown in the observing frame of the Meteorological Society under the first window, and with the contribution from the Meteorological-office in the neighbouring large case. In Casella's maximum thermometer (No. 2,826*h*), a small bubble of air, introduced into the column of mercury, effects the same object as the scale of enamel; it divides the column when the part lying nearer to the bulb is withdrawn by contraction. The original instrument of this kind, which was first made by Professor Phillips, is shown in front of the end of the case. In Rutherford's maximum, a steel index rests at the end of the mercurial column, and is pressed forward when the mercury expands, but is left in the void space, to indicate the extent to which it had been driven, when it contracts, until the index is very carefully shaken back into contact with the contracted mercury, to prepare it for the next observation.

The thermometer for the registration of the greatest cold of the night is generally made with spirit of wine in the tube, instead of mercury. Spirit of wine has the same advantage with mercury, that it does not freeze at the low temperatures naturally experienced on the earth. Its most common form, the invention of which is also due to Rutherford, is shown by Pastorelli, on his peculiar black vulcanite scale, in No. 2,826*d*. A small glass float, about half an inch long, and with a knob at each end, is introduced into the tube. The knob which is furthest from the bulb of the thermometer is largest and flat. When the spirit expands under heat, it readily flows past this glass float without shifting its place. But when the spirit contracts with cold, its last film, as it retires, seizes upon the float, and draws it back with it by adhesive attraction. When the spirit again expands, it flows, as before, past the float without moving it, and so the float indicates the extreme point to which the spirit had been withdrawn by the cold. The thermometer is again set for the next observation, by simply holding it bulb upwards, and shaking it very gently and carefully, until the float falls to the extreme end of the expanded column of spirit. Other good specimens of this very useful and efficient instrument are shown by Negretti and Zambra, with their white porcelain scale, in the end case of the room, and also in the sets of the Meteorological Society and Meteorological-office stations. There is also a good instrument on a white metal scale, by Pastorelli, intended for his school and college selection; and one by Hicks, on a white porcelain scale.

Negretti and Zambra have, however, contrived a very excellent recording thermometer for minimum temperatures, in which mercury is successfully employed for the column instead of spirit. This mercurial minimum thermometer is shown in the end case (No. 2,827*b*), and will at once be recognised by having a small supplementary tube, or horn-like projection, curving over the end of the main tube near the bulb. A small plug of platinum is introduced into this short appendage, and the column of mercury in the main tube is, it will be observed, a very fine thread. The plug is so arranged that when the thread is influenced by the contraction of cold, it is withdrawn into the bulb. But when the mercury is afterwards expanded by heat, the liquid metal is pushed under the expansion past the plug into the short horn of the tube, instead of into the long central bore. The thread consequently remains in the position to which it had been withdrawn by the cold, and shows on the morning inspection how far it had been so withdrawn, or, in other words, how great the cold has been. The instrument is set for the next observation by shaking the mercury back out of the short horn-like appendage into the general column of the instrument.

Maximum and minimum thermometers are commonly mounted as pairs in the same case, or upon one common slab. Hicks shows a good pair connected together in this way. There is a very convenient and handsome pair, by Pastorelli, on white metal scales, which are fitted into a small pocket case, lined with purple velvet; and also another pair by the same maker, which can be attached to a brass frame, screwed into the lid of the mahogany case that contains them when in use. These last have a black vulcanite scale with white graduations. The observing frame of the Meteorological Society, and the college frame of Pastorelli, show how the maximum and minimum registering thermometers are ordinarily placed in observing stations.

The registering thermometer known as Sixe's, gives both the greatest heat and the greatest cold, with only one instrument. The principle employed in the construction of this piece of apparatus is very effectively illustrated in the large specimen (No. 2,826*a*), exhibited by Pastorelli, in which the thermometer is mounted upon a slab of transparent glass. with black figures and graduations. It will be observed that the glass tube of the thermometer bends twice upon itself, and in this way is distributed into three parallel limbs. The central portion of the tube is occupied by mercury: but there is spirit in the tube at each end. In one limb, however (the one towards the left-hand), this spirit presses at the outer end against a closed vacuous part, and in the other limb (the right-hand one), against a reservoir which contains a small portion of air. Immediately above the mercury, and in the spirit at each end, there is a float, or index, composed of a small piece of iron wire capped at each extremity with enamel. There are also fine springs of spreading bristles, attached to each float in such a way that they press with some firmness against the whole surface of the tube. Without these springs, the index would always fall by its own weight, until it rested on the top of the mercury. But, having these springs, the index is lifted by the column of mercury when it presses it up, but then remains fast in the tube, in the position in which it has been lifted, when the mercury afterwards drops away from it. With increase of temperature, the spirit in the closed side of the tube expands, and drives the mercury up at the opposite end, lifting the index before it to register the greatest expansion. The air at the top of the spirit is compressed, to allow this movement of the mercury to occur. With decrease of temperature the spirit in the closed part of the tube contracts, and the mercury is driven back against it by the elasticity of the air at the other end, lifting, however, the index at that end, to indicate how great the contraction has been. The two indices, therefore, act independently, and are left clinging in opposite ends of the tube, one indicating the greatest heat and one the greatest cold. The instrument is prepared for a renewed observation by drawing back the two iron wire indices into contact with tho mercury, by passing a magnet along the side of the tube. Pastorelli exhibits also a second instrument of this same construction, just above, in which the scales are of white porcelain, with black figures; and a third form, in which there are only two arms to the tube, instead of three. In this, however, the principle is identically the same; it is merely the proportions of the instrument which are changed, so as to allow the two end columns of spirit to be introduced within the dimensions of the instrument. The closed end of the tube is sometimes conveniently turned round upon itself, into the form of a convoluted spire, and the instrument then only has two branches, the additional length required for the spirit at one end, being in that way compactly and conveniently provided for. There is a good form of Sixe's thermometer, also exhibited by Dring. The Sixe's thermometer is somewhat of a favourite for ordinary domestic and quasi-scientific use, on account of comprising within itself the registration of extremes of both heat and cold, but it is liable to derangement in unskilful or careless hands; and is, practically superseded in observatories at the present time by Rutherford's spirit minimum and Negretti's mercurial maximum, which, with Negretti's equally excellent mercurial minimum, may now be said to be the accepted and standard instruments for thermometric registration.

Thermometers are especially provided for marking the results of radiation from grass, and for ascertaining the direct heating power of the rays of the sun. The first are termed terrestial radiation, and the second solar radiation thermometers. The form which is usually given to the terrestial radiation thermometer is shown in an instrument of Pastorelli's, in the end case, and of Casella's in the Meteorological Society's frame. The instrument is a minimum spirit registering thermometer with a forked tube taking the place of the bulb. It is graduated on its own tube, and inclosed in an outer glass jacket. When in use it is supported with one end in a fork, and the bulb is placed resting on the grass. The form of the solar radiation thermometers is exhibited in the end case, in No. 2,827*i*, which is an ordinary registering maximum thermometer, with its bulb blackened to facilitate the absorption of solar heat, and which is also inclosed in a large outer tube, from which all air has been removed. In this specimen, which is one of the best of its class, a small vacuum gauge is placed in the interior of the glass jacket, to indicate the perfection of the vacuum. All air is removed from the interior of this jacket, because if present there it would receive and communicate some heat on its own account, and so vitiate the result furnished by the thermometer. The group of instruments in front of the first window, belonging to the Meteorological Society, shows how this instrument is placed to receive the full influence of sunshine, but it will be observed there are two radiation thermometers here, of which one has a blackened, and one a bright bulb, in order that the difference of solar effect in the two circumstances may be compared. In the Meteorological-office contribution, contained in the third large case, there is a solar radiation thermometer, in which the perfection of the vacuum is tested in another way. Platinum wires are inserted through the glass jacket at each end, so that a voltaic current may be passed through the vacuous space within. The colour of the light when this is done indicates the state of the vacuum.

Amongst the special forms of thermometers, there is one in tho Meteorological-office contribution which is worthy of notice. It is marked the "thermometre fronde," and is a small thermometer attached to a silk cord, so that it may be swung rapidly round in the air. It is found that the thermometer at once takes up the true temperature of the air, when it is swung round in this way, just as it would if the air were blown upon it in a strong steady current. In the first large case there is a French thermometer, which looks precisely like an aneroid barometer, in which the expansion is secured from a metallic bar. There is also a Swiss metallic thermometer, by a maker of Berne, in which a sharp coiled spring of about six convolutions presses its point against a pin, and lifts an index on the right hand when it expands, and does the same thing on the left hand when it contracts. The extremities of both indices range along a graduated arc beneath, and retain their position of furthest extent by slight pressure and friction against the arc. The instruments marked as terrestrial thermometers, at the right-hand side of the case, are simply four thermometers, in outer protecting jackets, of identical construction, fixed upen blocks of wood of different lengths, so that they can be sunk in holes in the ground to different depths, for investigating the temperature of the soil.

It is of course a matter of some moment that the meteorologist should have the means of getting the temperature of any given hour of either day or night at will, by automatic registration. Negretti and Zambra provide for this need in a very ingenious way, which they term their "patent recording thermometer," No. 2,827*c*. The tube of the thermometer is bent at the middle so as to form two parallel vertical arms, and it is contracted at its union with the bulb, so that when it is turned over and upside down, all the mercury which is in the arm above the contraction runs round into the other branch of the tube, and there measures exactly the same length, and indicates the same number of degrees on the scale that it did in the first branch in the original position. The clock which carries the thermometer is set like an alarum. It turns the thermometer over, and so secures the register of the temperature at the hour at which its mechanism and hands are set. This very ingenious piece of apparatus has been adapted also as a deep-sea thermometer, to furnish the temperature of the water at any desired depth. The arrangement by which this is accomplished is shown in 2,827*h* in the same case. The thermometer is contained in a strong and heavy brass frame, finished at the bottom by a propeller-like spiral fan. When this heavy frame is dropped into the deep regions of the sea, the fan revolves as it passes through the water, and if at any depth the descent is suddenly stopped, and the frame drawn upwards for a brief space, the revolution of the fan is necessarily reversed. The mechanism, however, is so arranged that when the revolution is reversed the thermometer is turned over and the temperature registered. The reversal of the fan thus takes the place of the clock movement in the other instrument. With these deep-sea thermometers it has been found necessary to protect the instrument from the pressure to which it was exposed at great depths. The pressure acts even through the glass, and drives the mercury up from the bulb, so as to cause it to indicate a temperature higher than the one to which it has been exposed. A pressure of 21 tons upon the square inch, which is reached at a depth of a few hundred feet, causes an error in this way of nine-tenths of a degree. The deep-sea thermometers on this account are now inclosed in a very thick and strong outer jacket of glass, which shields them effectually from this source of derangement. A thermometer upon the shelf, just above the apparatus, has one half of this outer thick shield removed, to illustrate the contrivance by which Messrs. Negretti and Zambra have conquered this difficulty. Other forms of deep-sea thermometers, some of which have been in use, are also shown. One, constructed also by Negretti and Zambra (3,019) is simply a Sixe's registering thermometer with an outer protection for the tube. A similar instrument, by Casella, No. 3,021, is also shown, which was found to give erroneous results at great ocean depths. Both these instruments were used in the early deep sounding in the North Atlantic. A third Sixe's thermometer, by Casella (No. 3,021), of later construction, has an outer protection, and has been tested up to two tons to the square inch. This is the form of deep-sea thermometer which has been in use in the soundings of the *Challenger*, and which has been found to give readings correct within a very little more than a degree, at depths of three thousand fathoms. Two of these protected thermometers were, however, broken by the pressure at a depth of 3,875 fathoms. An old unprotected instrument, by Pastorelli, is shown, in which the error amounted to more than nine degrees with a pressure of two tons on the square inch.

There is a very notable instrument in this department of the collection (No. 2,826*m*), called a "Continuous Self-registering Thermometer," which is exhibited by Mr. W. Harrison Cripps, and which deserves something more than a passing glance on account of the great ingenuity and originality of its design. It consists essentially of a long tube of glass coiled into a flat whorle of six spires constituting a kind of wheel about five inches in diameter. This is delicately hung upon a transverse axis passing through its centre, which allows it to revolve to and fro. The five inner coils of the tube are filled with spirit of wine, and one-half of the large outer coil contains mercury. The consequence of this arrangement is that as the spirit in the inner coils, expands and contracts under varying influences of heat, the mercury is impelled by it in one or the other direction. But as mercury is a heavy material it acts as a weight, and always keeps itself in the lowest part of the spiral tube; in other words, as it moves to and fro, it revolves the wheel forwards and backwards. But the wheel carries a grooved circular plate of about two inches diameter upon its axis, and from the circumference of this plate a silk cord passes down to a pencil that slides upon a vertical rod. The point of this pencil rests upon the surface of a vertical drum, which is carried round by clock-work once every seven days. A trace is in this way inscribed upon the papered surface of the drum, which very accurately marks the oscillations of the temperature for the period of a week. This "Continuous Self-recording Thermometer" stands upon a pedestal of its own, very nearly opposite to the bust of Galileo.

The hygrometers, or instruments which are used to ascertain the amount of invisible moisture present in the air at any time, are contained in the large upright case at the south end of the room, and in a horizontal case immediately in front of it. The form which is now in most general use, on account of its convenience and of the good results which it may be made to give in skilful hands, is known as "Mason's Hydrometer," and consists essentially of two thermometers, of which one is exposed to the air in the usual way, whilst the other has its bulb kept constantly moist by a piece of thin muslin fed with water from a strand of cotton passing over to it from a small glass of water. The principle of the instrument is that as the moisture evaporates from the muslin, the thermometer is cooled, and that the more rapid the evaporation the greater the cooling. But the evaporation is more rapid in proportion as the air is dry, and less in proportion as the air is moist; dry air drinks up the moisture from the muslin more quickly than wet air. The difference of the reading between the dry bulb and the wet bulb thermometer, or in other words the extent to which the wet bulb is cooled down by evaporation below the dry bulb, consequently expresses the moisture or the dryness of the air. The exact amount of invisible moisture contained in the air, that is, the number of grams of water to the cubic foot, at the time of any observation, is at once ascertained by a reference to tables prepared for the purpose, in which the difference in degrees between the dry bulb and the wet bulb, for any given degree of the dry bulb, are shown in consecutive lines with the proper amounts of humidity present in each case. The thermometers that are used in this combination to give hydrometrical indications are, for the most part, those which are in general use for air temperatures; all that is requisite is that each instrument in the pair should be of identically the same make and give the same reading for changing temperatures in dry air. Specimens of the Mason's hygrometer are shown in the Loan Collection as it is mounted by Negretti and Zambra, Casella, Pastorelli, Denton, and Hicks. The most delicately finished and carefully mounted pair, is perhaps, that placed near the top of the case, (No. 2,857*b*) by Negretti and Zambra. In this instrument the thermometers have an elongated excellently proportioned bulb, and the tubes are graduated on the glass and enamelled within. It will be observed that there is no attached scale, and that the thermometers are projected out from the mahogany slab, quite clear of all large surface contacts, upon long arms. Casella and Pastorelli have both small neat forms, in which the therometer can be mounted on brass frames when in use, and can be packed away in the cases that support the frames at other times. The method of mounting the dry and wet bulb thermometers in observatories is illustrated in the frame of the Meteorological Society, and in the ship-board case of the Meteorological-office. By the side of the Meteorological Society's group a pair of wet and dry bulb thermometers, by Carl Bamberg, of Berlin, are shown in a somewhat peculiar louvred case swung freely under a white metal shade. In all these instances, in which the pair of identical thermometers are used side by side as hygrometers, it will be understood the dry bulb of the pair is turned to account to indicate the temperature of the air.

Another form of hygrometer, which is very scientific in principle, and which has obtained considerable favour amongst observers, is the one which is known as Daniell's, and the construction of which is shown in a specimen, No. 2,855. In this instrument there are two large glass balls, communicating with each other through a wide and bent glass tube. The longer arm of this tube contains a small, sensitive thermometer, with its bulb dipped into a reservoir of ether. The opposite ball is covered with muslin. When the instrument is to be used, the muslin is saturated with ether. The cold produced by its evaporation condenses the ether-vapour within, and more vapour then rises from the opposite reservoir containing the thermometer, chilling it down also as the process goes on. The instant a deposit of moisture, or dew, appears on the outside of this ether reservoir the temperature indicated upon the interior thermometer is read, and that temperature, considered in reference to the general air-temperature at the time, gives at once the proportion of moisture that is contained in the air. The dew appears sooner, and with a higher reading of the contained thermometer, when the air is moist, than it does when it is dry.

An ingenious instrument has recently been contrived by one of the Fellows of the Meteorological Society, Mr. Dines, in which a stream of cold water is used to produce the deposit of dew, and to give the hygrometric indication, instead of the evaporation of ether. The apparatus, as constructed by Casella, is shown at 2,871*f*. Cold or iced water is allowed to flow from a cup through a tube, which delivers it at the end, before it escapes, through a perforated diaphragm, into a chamber that contains the bulb of a thermometer, and that has over it a cover of black glass. The thermometer indicates the temperature at which dew begins to form on the outer surface of the black glass, as the chamber is cooled down by the flowing water, and in that way expresses the moisture of the air.

The second case from the south end of the room contains a considerable series of the more rude form of hygrometer, which was used before the invention of Daniells' and Mason's. In most of these the expansion and contraction of a human hair, as it became more and less moist, was made to move an index ranging along a graduated arc. The hair was first boiled in some alkaline solution, to free it from oily material, and afterwards washed and dried. One end was then attached to a fixed point, and the other end was weighted, and the weight turned over the axis of the index. In proportion as the hair was expanded and lengthened, the weight was dropped, and so the hand was moved round. No. 2,867 is an old form of the De Saussure instrument, contributed by the Geneva Association for Constructing Scientific Instruments. No. 2,871*c* is an interesting specimen of much later construction, contributed by Mr. G. J. Symons. 2,854 has the hair replaced by whalebone. No. 2,864 is an old De Saussure hygrometer, contributed by the Kew Committee of the Royal Society, in which eight hairs are used instead of one. 2,853, 2,865, and 2,867 are other old specimens of historical interest. These hair hygrometers are now very generally superseded by the more modern instruments in which thermometers, and cooling by evaporation, either of water, or ether, are employed, but it is worthy of note the Geneva Association maintains that if hair is properly prepared, and employed before it has been subjected to any injurious degree of extension, it is capable of being made to give hygrometric indications that compare favourably with any that can be procured by other means. In the most modern form of Geneva construction the weight is, however, replaced by a spiral convolution of gold, and the axle of the pulley is made of the light metal, aluminum. It is, perhaps, a practical objection to the improved form of this instrument that only hair which has never been combed can be satisfactorily used in its construction. No. 2,871 is a very curious early hygrometer, contributed from George the Third's Museum at King's-college; the instrument consists of a steel-yard balance, containing a thick pile of discs of porous paper at the short end, and a point ranging along a quadrant scale at the long end. The only attempt at a self-registering hygrometer which appears in the collection is a variety of Negretti and Zambra's recording thermometer, in which two thermometers are turned over by the clock instead of one, the second being furnished with the usual wet bulb covering and water jar. When these instruments are turned over by the release of a spring at the appointed time, the mercury which is transferred from the thermometer to the auxiliary, or recording tube, expresses the dry bulb reading of that instant in one instrument, and the wet-bulb reading in the other; and from these data the corresponding moisture of the air can be ascertained in the usual way.

The apparatus for measuring rainfall, an object which is of the very highest importance, alike for engineering and sanitary investigations, is very simple, and is very exhaustively illustrated in this exhibition, mainly through the care of Mr. G. J. Symons, who has made himself the leading authority in this branch of meteorological research. Mr. Symons exhibits a large series of gauges, on a long pedestal stand placed in front of the window, nearly opposite to the bust of Galileo. Of these the japanned-metal rain-gauge, by Negretti and Zambra, with a circular funnel eight inches in diameter (No. 2,852*c*), and the copper gauge, by Casella, with the smaller funnel of five inches diameter, are the forms which are most commonly used in observing stations at the present time. In both these instruments the receiving funnel ends below in a small semicircularly curved pipe, which always retains a few drops of water in its curvature, and so effectually prevents evaporation from the reservoir below. The upper rim of the funnel is made deep to enable it to retain a fair amount of snow on the occasion of snowfall. The quantity of water which is received in these gauges in 24 hours is measured out in a glass jar graduated to indicate hundredths of an inch for the area of 5, or 8 inches, as the case may be. That is to say, if five hundredths of an inch are measured off, it means that the 24 hours fall would have stood five hundredths of an inch deep if it remained where it fell without running away at all. No. 2,852*e*, in Mr. Symons' stand, is a 5-inch gauge by Negretti and Zambra, with sufficient capacity to contain an entire month's fall. 2,852*b*, is is an engineer's gauge, with a 12-inch funnel, and a receiver of sufficient size to accommodate a 12-inch fall. 2,852*a*, is a mountain rain gauge for wet mountain districts, capable of holding a 48-inch fall. Its receiver goes quite down to the floor. These two last guages are measured, as they are only intended for long intervals, by a wooden rod marked off into inches, which is plunged into the water in the reservoir to give its depth. In all these instruments the funnel is fitted upon the reservoir by a grooved rim, and has to be removed when the water has to be measured out. A small spouted can is supplied with the smaller gauges to facilitate the removal and measuring of the water. The rims of the funnels are of brass, and are rings carefully turned to the exact diameter that is required for the funnel. Other specimens of the rain gauge in the collection are Pastorelli's in green japanned metal, with a deep rim to prevent loss from splashing (No. 2,852). Cetti's 12-inch gauge, both in copper and green japan, and Negretti and Zambra's 8-inch in black japan, and 5-inch in green japan. The Meteorological-office often adopts Casella's 12-inch, and 5-inch, of copper with the deep snow rim; and the Meteorological Society Casella's copper 5-inch gauge of the same construction as 2,852*d*. These several forms of gauges are placed either on the stand by the window or in the large case which ranges immediately to the south. The rain gauge adopted by the Russian stations is shown in the case of the Meteorological-office. It is a 12-inch gauge in painted metal, with a narrow receiver below from which the water is drawn off for measuring through a tap. The Norwegians employ at their stations a square gauge with a rectangular funnel, 15 centimetres in diameter, and a reservoir 50 centimetres deep. The Scottish Meteorological Society exhibits an interesting gauge suggested by the Indian Rao Jagga, the peculiarity of which is that it has a circular funnel with a diameter of 4·697 inches, which allows the ordinary fluid ounce measure of the apothecary to be employed in estimating the quantity. With a gauge of these dimensions each fluid ounce of rain collected indicates a fall of a tenth of an inch.

There are several very ingenious and notable attempts to provide a self-recording rain gauge. In Yeate's registering guage (No. 2,852*g*), standing in a separato glass case of its own, a square funnel delivers its rain into a narrow central pipe, which discharges alternately into each side of a rocking shoot. This shoot makes an electrical contact, and registers the quantity each time the bucket tips and empties itself. The bucket, as it tips, lifts a lever and arm until this touches for an instant a binding screw, and moves a wheel, by an electrically formed magnet, one tooth. Each bucket-full, and each tooth of the recording wheel, indicates an hundredth of an inch fall, and a clock movement connected with the apparatus simultaneously registers the time at which each hundredth is measured off. In Elliott's recording gauge (2,852*h*), a similar result is secured by mechanical action, without any electrical current. A shoot, balanced on a pivot, tips opposite ways with each hundredth of an inch that is received in a ten-inch funnel. When the shoot tips it presses a stud attached to its side, upon a vertical lever-rod, which is connected with wheel work, and a series of recording dials marked to give the quantity up to one hundredth inches of fall. The lever, as it is moved from one side to the other, drives a toothed wheel of the recording train round one tooth. The time with this apparatus has to be taken independently from a watch each time the apparatus is examined. In Stutter's recording gauges the funnel delivers its charge into a pipe bent horizontally, and carried round, like a transverse arm by a clock. This clock is so arranged that the end of the discharging pipe stands over a separate reservoir with each succeeding hour, and each reservoir receives only the rain of that hour. The clock is contained in a square box, or cell, in the centre of the apparatus, and rain chambers are grouped in a circle around. The receiving funnel, which is of five inches diameter, is so formed that it constitutes a conical cover to the apparatus outside of its own rim; it is like the crater of a volcano, at the top of its cone. There are two specimens of tho gauge, the one with chambers for a twelve hour period, and the others with chambers for a twenty-four hour term. The Beckley recording rain gauge, constructed by Hicks, which stands at the end or the Symons series of rain gauges, on its own pedestal, is perhaps, on the whole, the simplest of the group of recording rain gauges. Its external form is that of a square iron tank. A 12-inch iron funnel delivers rain into this tank by a bent tube, which leads the water into a cylindrical copper vessel at one side of the tank. A float rises in the vessel as the water accumulates in it, and carries up with it a vertical rod that has a transverse pencil at the top, pressing against the paper surface of an upright drum. The drum is carried round at a regulated rate by a clockwork movement boxed at the other side of the tank. The trace of the pencil rises across four horizontal lines of the drum whilst one-fifth of an inch of rain is received in the cylinder; the water is then discharged, and the pencil falls to the lower line and begins to mount afresh, to record the next tenth of an inch.

The scientific meteorologist has frequent occasion to ascertain the rate at which vapour ascends from moist surfaces into the air. The instruments which he employs for this purpose are called "evaporimeters" and "atmometers." The Ronald's vapour-guage (No. 2,851), which was constructed for the Kew Observatory by Mr. Adie in 1843, consists of two cylinders, one large and one small, connected together by a transverse pipe. The large cylinder is open at the top, and the small one is closed, and carries a float, which turns a graduated circle above the cylinder, either towards the left or towards the right, accordingly as the water in the cylinder is increased by rain or diminished by evaporation. If the rainfall be observed at the same time by an ordinary rain-gauge, the difference between its reading and that of the Ronald instrument expresses the amount of evaporation. Osnaghi's evaporimeter (No. 2,897), a Viennese instrument, is simply a shallow, circular dish, five inches in diameter, mounted upon a vertical stem, which presses upon a spiral spring. As it is lightened by evaporation from water contained in the shallow dish, an index hand is moved round against a graduated quadrant to indicate the extent of lightening; or in other terms, the amount of the evaporation. In Lamont's atmometer (2,789*d*) exhibited by the Meteorological-office, the circular evaporating dish is connected with a smaller cylinder by a pipe. There is a float in this cylinder which sinks as the water is diminished by evaporation, and marks the amount of the sinking as it does so, upon a vertical graduated scale. In the Morgenstern's atmometer a circle of sand, having an area of one square decimeter is kept moist by water slowly distributed upon it from a tall glass tube. As the water evaporates from the sand the liquid column in the tube falls and marks the amount of the evaporation by the extent of its depression. A small glass globe near the bottom of the tube is provided to receive any excess of the water that is driven out when the air in the top of the tube expands by rapid increase of temperature, and is at the same time turned to further account by being used to renew the charge of water in the tube, when water is sucked into the globe for this purpose through small pipette at the top.

CORRESPONDENCE.

HOUSE DRAINS.

With reference to the most important question of efficient house-drains, I would beg briefly to say:—

1. Drain-smells in a house are the best proof of defective drains.

2. As some individuals are insensible to drain smells, the presence of rats in a house may be taken as an almost certain proof of defective drains. If rats can escape from the house drains, so can poisonous gases.

3. The drains being found defective, the tenant of the house should send to the Vestry, and request a visit from the inspector of nuisances.

Here I would advise that inspectors should thoroughly understand drain construction, and be fully able to advise as to the remedy for defective drains; and I think it might be well if the tenant could get a written and full report from the inspector, on payment of, say 5s.

4. It being proved that the drains are defective, the question arises how are they to be put to rights?

If the tenant has a lease, most likely, if he requires the drains made good, he must do so at his own expense; but if he is only a yearly tenant, and demands that the landlord shall make the drains good, most likely this landlord will send a bricklayer to block up the rat-holes with lime and broken glass. This is, of course, no efficient remedy, as the rats will probably, within a week of this job, undermine it by new holes and enter the house.

If the tenant proposes, at his own expense, to take up the old brick-drain, and lay a new pipe-drain, unless he knows how to proceed, he may get the job most imperfectly done, and have to pay an exorbitant bill.

Some years ago I laid down pipe-drains, having contracted to have it done for the moderate sum of £15; but if I had not watched the workmen from first to last, the job would have been scamped.

On two occasions, viz., when the sink-trap was being made good, and the soil-trap also, unless I had gone down on my knees and inserted my hand and arm exploringly into the traps, both these traps would have been scamped,

5. Would it not be well to have powers to compel landlords to lay down, in the first place, efficient pipe-drains, under inspection?

6. Would it not be advisable that the Vestries or Corporations, in circulating their half-yearly tax-papers, should print a brief and approved form of instruction regarding properly constructed and efficiently regulated house-drains.

7. Is there not an excellent opening for a young and enterprising firm of builders to devote themselves as a speciality to the making and righting of house-drains at the smallest remunerative cost, say from £5 to £20, according to the size of the house?

There cannot be fewer than 100,000 house drains in London requiring amendment.

Geo. Wyld, M.D.

12, Great Cumberland-place, Hyde-park.

Will you allow me to set out in detail some canon laws upon house-drainage, the want of which appears to me to be a defect in General Cotton's otherwise very valuable paper. I do not wish to intrude upon the domain of either engineer, surveyor, or architect, or to lay down details of work for their guidance, but the principles are fairly within the province of the professor of preventive medicine. I mentioned at the adjourned discussion upon the General's paper the defect in question, which time alone prevented me more fully explaining to the meeting in a proper manner.

There are four rules which should be canon laws in the construction of house-drainage.

1. The water service should not, on any pretence whatever, come into direct contact with the house-drain in any part of its course. This rule should apply to every kind of delivery pipe. A cistern placed over a water-closet, and which supplies water for dietetic purposes, is as unsafe as is the common screw-down tap, when the latter supplies the pan of the water-closet direct from the water main.

2. The water source must not be placed in juxtaposition with the house-drain, the sewer, or the gas-pipe, beneath the surface of the ground; unless they are placed in well-ventilated covered ways. Water-pipes and sewers must be kept as far apart as is possible. Too often in present house-construction, water-pipe, soil-pipe, and gas-pipe run side by side for long distances, an interchange of contents occasionally occurring.

3. The house-drain or sewer must not be allowed to pass through or beneath the foundation wall of the house on any pretence whatever, if it can be taken in any other direction. If from the circumstances of the case, the sewer must pass beneath the house, then the sewer should be laid in concrete with concrete or asphalte joints, covered up with concrete, and made absolutely impermeable, and no connexion should be allowed between the interior of the house and that sewer. There is a difficulty in complying with this law in the case of the soil-pipe of the water-closet, but if the soil-pipe is always kept outside the house-wall and freely ventilated, as it always should be in every case, at a point close to the trap, at the bend between the trap and the soil-pipe, all danger from that source would be averted.

4. Fresh sewage does not give off any element of danger, and it cannot become dangerous if it be kept in motion. Stagnation being at the root of all mischief, "move on" is the order which should be engraved on every foot of house-drain. This order should apply to air as well as to sewage, air upwards, sewage downwards, being the directions. No evil will then arise from sewer gas, for no gas will be developed. There should be free current of air through all sewers and every branch of a house-drain. No stagnation should be possible in any single foot of either.

Dilution of sewage by means of a constant water supply, dilution of air by its admission at the junction of every branch with another branch and at the junction with the main sewer, also by frequent man-holes in the course of the arch of the main sewage, and points for exit at the top of every soil-pipe, means that any change in the contents of the sewage into dangerous elements will be unlikely to arise. But if perchance, from some accidental circumstance, they should be produced, because stagnation has accidentally arisen, their dilution will be their destruction. Any departure from these first principles implies the recognised introduction of stagnation, and it will lay a foundation upon which mischief will certainly sooner or later arise.

I trust General Cotton will pardon my presuming to condense his observations, but the substance of most of my propositions is contained in his very instructive paper.

Alfred Carpenter, M.D., C.S.S. Camb.

Croydon, Dec. 11, 1876.

COFFEE-HUSK.

My attention has been drawn to a discussion on "Coffee-leaf Tea" contained in some of your recent numbers. I regret having apparently mislaid the one in which the original letter of "J. F. D." appeared. The following remarks on the subject may be of service.

I know nothing whatever about coffee-leaf tea, but it will probably surprise many to learn that the Arabs residing near the district from whence the so-called "Mocha" coffee is obtained, and in fact the Arabs generally of Southern and Eastern Arabia, never use coffee, meaning thereby the roasted bean, which they say is too heating for the system. Their beverage is made from *kishr*, that is, the husk of the berry, which they prepare much in the way that we do ordinary coffee or tea. To show that it is not frugality which prompts them to this, I may mention that a famous sayyid, at Aden, a great friend of mine, who occasionally presented me with a small bale of the best berry, never used it in his own establishment, but always drank *kishr*. In his case, as also in that of the more wealthy, the decoction is often seasoned with cardamums, in which shape they aver it to be an excellent stomachic, and it is certainly very appetising as well as soothing. The Arab cafés sell the *kishr* as the French sell coffee; and I have frequently seen squads of Arab labourers, at Aden, starting off early for a day's work, each carrying a small earthen pitcher, with a handle attached, filled with the beverage. An Arab can easily find materials, even in such a barren spot as Aden, wherewith to kindle sufficient fire to heat or boil his *kishr*, and to light his favourite hookah pipe. I have often tasted the beverage and have no hesitation in pronouncing it, when well made, far superior to much of the coffee drank by the lower classes in England.

George Percy Badger, D.C.L.

4th December, 1876.

The Centennial Exhibition was open 159 days. During that time the paid admissions were 8,004,325. The free admissions were 1,785,053. Total admissions, 9,789,392. The total receipts for admission were 3,813,740 dols. 75c.; average daily total admissions were 61,558. The average daily receipts were 23,935 dols. 85c. The Vienna Exhibition had a total attendance of 6,740,500, of which only 3,492,622 were cash admissions, amounting to 1,032,388 dols. The whole number of all kinds who attended the London Exhibition of 1851 was 6,039,195. The aggregate admission of all kinds attending the Paris Exhibition of 1855 were 5,162,330. The aggregate numbers of all kinds attending the London Exhibition of 1862 was 6,211,103. At the Paris Exhibition of 1867 the whole number of admissions of all kinds was 8,805,969.

OBITUARY.

Chandos Wren Hoskyns.—Mr. Chandos Wren Hoskyns died in London on the 28th ult. He was the second son of the late Sir Hungerford Hoskyns, Bart., and was born in 1812. He was educated at Shrewsbury and at Oxford, where he gained a second-class in classics in 1834. His marriage, in 1837, with the sole heiress of C. R. Wren, Esq., of Wroxall Abbey, Warwickshire, brought with it the care of a landed estate, and diverted his mind to agriculture, which thenceforth became the chief subject of his pen. His first published work was "A Short Enquiry into the History of Agriculture." This was followed by "Talpa: or, the Chronicles of a Clay Farm." He also contributed largely to the *Gardeners' Chronicle*, and other agricultural publications. In 1869 Mr. Hoskyns was elected M.P. for Hereford. He became a member of the Society of Arts as long ago as 1847, and in 1862 he came on the Council. In 1850 he read a paper before the Society, on "The Progress of English Agriculture during the Last Fifteen Years." He also was frequently in the chair at meetings of the Society, and on other occasions took part in the discussions. Till his death he continued to serve on the Society's Food Committee.

GENERAL NOTES.

Nitroglycerine.—Some of the physical characteristics of this body have recently been examined by C. Beckerhinn. He has determined the heat of fusion of the frozen body, and finds it to be 33·54 units of heat. The density of liquid nitroglycerine is 1·599; that of the solid 1·735. He refers to the opinion generally held, that the compound when frozen explodes more readily than when it is in the liquid state. Experience does not support this view, and it must be evident, on theoretical grounds, that it is highly improbable, since a considerable amount of heat must be consumed in causing a change in the state of aggregation before any explosion can ensue. To decide the question the author constructed an apparatus for the explosion, by percussion by the fall of a weight, of nitroglycerine, both solid and liquid, and he has found that while the liquid detonated when the weight fell from a height of 0·78 metre, solid nitroglycerine did not explode till the weight fell through a distance of 2·13 metres.

Chinese Opium.—Consul Robertson, in his report upon the trade of Canton, for the year 1875, gives some information upon the cultivation and uses of opium in different parts of China. From a native source he has learned that opium, which originally came from abroad, had, towards the close of the Ming dynasty (A.D. 1644) the name of "Ya Fu-jung," at which time it was not known that the drug could be used for smoking purposes, but its properties were cooling and astringent, and it was used for diarrhœa and fevers, but with what admixture is not known. Subsequently it was made into paste and smoked, hence the present taste for opium-smoking, which has also an astringent and antifebrile effect. It is relaxing, and reduces the system. At first the only sort was Patna, followed afterwards by Malwa, then Benares, and finally Persian, all imported from abroad. Tradition describes Persian as hot, acid, and liable to cause dysentery. It is all sent to the province of Kwangsi, as the chilly climate there is said to permit of its use. Kwangtung (Canton) only consumes Patna, and occasionally Malwa. Benares is used in the prefectures of Hui-chow, Chao-chow (Swatow), Kia-ying-chow, and is sent to other provinces of China. It is cheaper than the other kinds. Malwa is only used by one or two out of ten in Canton, and goes chiefly to the province. When China first began to cultivate the poppy, it was called the "Yung-su hwa," jar-shaped flower or capsule; and when the juice was extracted it was called white smoke, or white tobacco. It is grown chiefly in Yunnan, where it covers nearly the whole place; hence the name "Yunnan White." It is also grown on the hill tops of Kansah, but not to a tenth of the extent that is grown in Yunnan. It is exported from Yunnan to all the provinces, and is also smoked in Canton, being barely more than two-thirds the price of the foreign, but it is not so rich to the palate as Patna. Eight out of ten of the prefecture of Canton smoke Patna, and the other two Yunnan. Other provinces use a good deal of Yunnan. Nearly every one in Hunan, Hupeuh Yunnan, Kwachow, and Western Szechuen smoked Yunnan opium, and only the rich use Patna and Malwa, the reason being that, firstly, the price is cheaper, and, secondly, it is easier to purchase than the prepared.

NOTICES.

ORDINARY MEETINGS.

Wednesday evenings at eight o'clock. The following paper will be read at the remaining meeting before Christmas:—

DECEMBER 20.—"The Philadelphia Exhibition," by Professor ARCHER.

CANTOR LECTURES.

Monday evenings at eight o'clock. First Course, on "The History of the Art of Coach Building," by GEORGE A. THRUPP, Esq.

LECTURE V.—DECEMBER 18.

Rules of coach building and theories applicable to the carriages of the future.

MEETINGS FOR THE ENSUING WEEK.

MON. ...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. George A. Thrupp, "The History of the Art of Coach Building." (Lecture V.)

British Architects, 9, Conduit-street, W., 8 p.m. Mr. G. H. Birch, "Notes on 17th Century Domestic Architecture in London."

Medical, 11, Chandos-street, W., 8 p.m.

London Institution, Finsbury-circus, E.C., 5 p.m. Prof. J. Dewar, "Light and the Eye."

TUES....Women's Education Union (at the HOUSE OF THE SOCIETY OF ARTS), 6 p.m. M. Edmund Andrade, "The Galin-Paris-Chevé Method of Teaching Music." (Lecture VI.)

Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Annual General Meeting.

Statistical, Somerset House-terrace, W.C., 7¾ p.m. 1. Professor Leone Levi, "The Statistical Results of the Treaties of Commerce, and their Relation to the Balance of Trade." 2. Mr. Stephen Bourne, "The Growing Preponderance of Imports over Exports in the Trade of this Country."

Pathological, 53, Berners-street, Oxford-street, W., 8 p.m.

WED. ...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. Professor Archer, "The Centennial Exhibition, 1876."

Meteorological, 25, Great George-street, S.W., 7 p.m. 1. Dr. R. Rubenson, "Observations with the Psychrometer." 2. Mr. William Marriott, "Contributions to Hygrometry.—The Wet Bulb Thermometer." 3. Hon. Ralph Abercromby, "Visibility." 4. "Description of a Meteorographic Model," a letter from the late Commodore M. F. Maury.

Geological, Somerset-house, W.C., 8 p.m.

Royal Society of Literature, 4, St. Martin's-place, W.C., 8 p.m. Rev. Alex. J. D. D'Orsey, "The Curiosities of the English Language—Ancient, Mediæval, and Modern."

THUR. ...Royal, Burlington House, W., 8½ p.m.

Linnean, Burlington House, W., 8 p.m. 1. Mr. Marcus M. Hartog, "Morphological Notes on Species of Thunbergia." 2. Mr. A. G. Butler, "Butterflies of Malacca." 3. Mr. John R. Jackson, "The Commercial Cane termed Whangee." 4. Mr. A. H. G. Doran, "The Ear Bones of Mammalia."

Chemical, Burlington House, W., 8 p.m.

London Institution, Finsbury-circus, E.C., 7 p.m. Mr. C. R. Markham, "The Results of the Arctic Expedition."

Zoological, 11, Hanover-square, W., 4 p.m.

Numismatic, 13, Gate-street, W.C., 7 p.m.

Philosophical Club, Willis's Rooms, St. James's, S.W., 6 p.m.

Psychological, 11, Chandos-street, W., 8.30 p.m.

FRI.......Quekett Club, University College, W.C., 8 p.m.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,257. Vol. XXV.

FRIDAY, DECEMBER 22, 1876.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

PATENT LAW REFORM.

The petition to the Lord Chancellor on this subject, which was given in the *Journal* of the 1st inst., is still available for signature by members of the Society and others interested in the subject. It has already been signed by over 800 persons, and has received the adhesion of the principal patent agents, and of a large number of those whose names are best known in connection with the subject of Patent Law Reform. A great number of signatures from Working Men's and other Institutions throughout the country have already come in, and many more are expected.

Members can sign the petition at the Society's House on any day during office hours.

CANTOR LECTURES.

The fifth lecture of the course by G. A. THRUPP, Esq., on "The History of the Art of Coachbuilding," was delivered on Monday last, the 18th inst.

JUVENILE LECTURES.

Two lectures, suited for a juvenile audience, will be given on Wednesday, January 3, and Wednesday, Jan. 10, by R. A. PROCTOR, Esq., F.R.A.S.

LECTURE I.—JANUARY 3RD.

"The Sun and his Family."

LECTURE II.—JANUARY 10TH.

"Comets, Meteors, and the Stars."

The lectures will commence at 7 p.m., and will be fully illustrated. As the number of seats is limited, Members can only avail themselves of these lectures for their families by obtaining tickets from the Secretary. These will be issued strictly in order of application, and only to the extent of the accomodation available. When sufficient tickets to fill the room have been ordered the issue will be discontinued. Subject to these conditions, each Member is entitled to a ticket admitting one adult and two children. Tickets are now in course of issue.

PUBLIC MUSEUMS, &c.

The following is the scheme of Examinations in knowledge of contents of Public Museums and Collections of Works of Science and Art:—

I.—The Society of Arts, being desirous of promoting increased knowledge of Works of Art and Applications of Science illustrating productive industry, give notice that they will award Prizes and Certificates to persons who pass satisfactory examinations, the special object of these being to encourage the study and acquirement of a knowledge of the technical value of objects in any Public Museumsand Collections in any part of the United Kingdom.

II.—The Examinations will be conducted according to the general rules for the Society's Examinations of Institutions in Union, and will take place in the month of April, at the same time as the other Examinations. Papers of questions will be set, the answers to which may be illustrated by sketches from memory.

III.—Whilst these examinations will be open to Members of Institutions in Union and others, under the general regulations of the Society's Examinations, the artisan class is specially invited to compete.

IV.—The Prizes will consist of one Society's Silver Medal with Three Pounds; two Society's Bronze Medals with Two Pounds with each Medal; three Certificates with One Pound each, and four Certificates with Ten Shillings each, besides Certificates without money prizes.

V.—Secretaries of Institutions in Union with the Society must return the names of intending candidates and their occupation (if any), on the forms, and in the same manner as provided for candidates taking part in the Society's Commercial Examinations.

VI.—Curators and officers engaged in Museums may take Certificates, but not money prizes.

PROGRAMME.

1. The paper will contain questions for two classes of candidates.
2. The certificates of success will be of two grades.
3. Candidates for the first class must supplement their answers with sketches from memory.
4. The answers of candidates must have reference to objects, and the technical value of them, in one or more Public Museums in the United Kingdom or abroad, known to the candidate. The answers must be brief, and must not extend into treatises on abstract Art or Science.
5. Candidates will be asked to name the special features of certain Museums or Collections, and their uses to industry, the times when they visited the Museums, and for how long they have studied in them, also what Museums illustrate classes of scientific objects, and what artistic objects, and describe the general nature of them.
6. Candidates will be asked to state what catalogues and other works descriptive of the contents of Public Museums they have studied on this point.
7. Schoolmasters, pupil teachers, and others holding any certificate of the Science and Art Department of the second or third grade in Art or Science, or both, are eligible for examination. They should state what certificate they hold. There is no limit as to the age of the candidates.
8. Books recommended for perusal and consultation:—Owen Jones' "Grammar of Ornament," Digby Wyatt's "Industrial Art," W. B. Scott's "Fine Art," works relating to the Geological Museum (Jermyn-street), the Trade Collection at Kew, the collections of the South Kensington Museum, and Bethnal-green Museum, and the Patent Museum, the Technical Collections of the British Museum, as distinct from the Scientific Collections of Natural History there, also to the collections of the Louvre, Paris, the collections at Berlin, Vienna, &c.

INSTITUTIONS.

The following Institutions have been received into union since the last announcement:—

Coleraine Literary Club, Meeting-house-place, Coleraine, Co. Derry, Ireland.
Redruth Literary and Scientific Institution, Druid's-hall, Redruth.

SIXTH ORDINARY MEETING.

Wednesday, Dec. 20th, 1876, Lord Alfred S. Churchill, Chairman of Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Binyon, Charles, 44, Bedford-row, W.C.
Danks, John Ryan, Tettenhall, near Wolverhampton.
Fearon, Francis, 21, Great George-street, Westminster, S.W., and 8, Clydesdale-road, W.
Lester, Colonel John F., Sawunt Warree, Bombay Presidency, East Indies.
Walkey, Samuel, St. Stephen's-chambers, Telegraph-street, E.C.

The following candidates were ballotted for and duly elected members of the Society:—

Alleyne, Sir John Gay Newton, Bart., M.I.C.E., M.I.M.E., Butterley Car, Alfreton.
Baker, George (Mayor of Birmingham), Bellefield, Birmingham Heath, Birmingham.
Blackie, Robert, 17, Stanhope-street, Glasgow.
Blakeley, Mrs. Harriet, Forest-end, Sandhurst, Wokingham.
Duncombe, Hon. Cecil, Nawton-grange, York.
Heidemans, M., 11, Spring-gardens, Charing-cross, S.W.
Lucas, S. Bright, Tenby-villa, Stratford-road, Sparkbrook, Birmingham.
Martin, William Holt, A.I.C.E., 15, College-street, Nottingham
Mayer, Leonard, 32, Lawrence-lane, E.C.
Myers, W. Beswick, Bankfield, Burley, near Leeds.
Parker, John, Woodstock, Oxford.
Way, J. Thomas, 9, Russell-road, Kensington, W.
Webster, William, jun., Wyberton-house, Lee, S.E.
Williams, Charles S., 90, Cannon-street, E.C.
Wallerstein, Edward M., 3, York-villas, Walton Breck-road, Liverpool.

The Paper read was—

THE CENTENNIAL EXHIBITION, PHILADELPHIA, 1876.

By Professor Archer,
British Executive Commissioner.

Its Origin.

It was the most natural idea possible that the great American nation should determine to celebrate in some impressive and significant manner the centennial anniversary of that event which, by giving them liberty of action, gave them the means of attaining, in the comparatively short space of one century, a position in the foremost rank of nations. For several years before the time arrived active minds were at work to devise the best means of marking such an important event in history, and it is perhaps not too much to say that the Vienna International Exhibition led to the determination of holding one of a similar kind in the United States. Be that as it may, the idea of an International Exhibition was secondary to the idea of celebrating in the most impressive manner possible the birthday of American Independence, and when that had firmly taken root in the national mind, preparations were quickly made for giving effect to it.

The near approach of the Vienna Exhibition of 1873 led Americans to think of one in their own country; and there is a deep-seated love in the hearts of most Americans for the memory of our lamented Prince Consort, which had no small share in leading them to choose what he considered a festival of peace and industry, as the best means of securing the co-operation of all other nations in their national thanksgiving.

In a Federal combination like the United States, it was no easy matter to determine which State should have the honour of being foremost in the great celebration, but the fact that the crowning act of American Independence was consummated in Philadelphia, gave an almost unanswerable argument to the inhabitants of that city in favour of its being held there, added to which, the fact that, in respect of population, it is the second city in the Republic, gave it an overwhelming claim. No sooner had this thought seized the minds of the Philadelphians than they set themselves vigorously to work to carry it out, by in the first place addressing the following memorial to the Senate and House of Representatives of the United States:—

"To the Honourable the Senate and the House of Representatives of the United States:

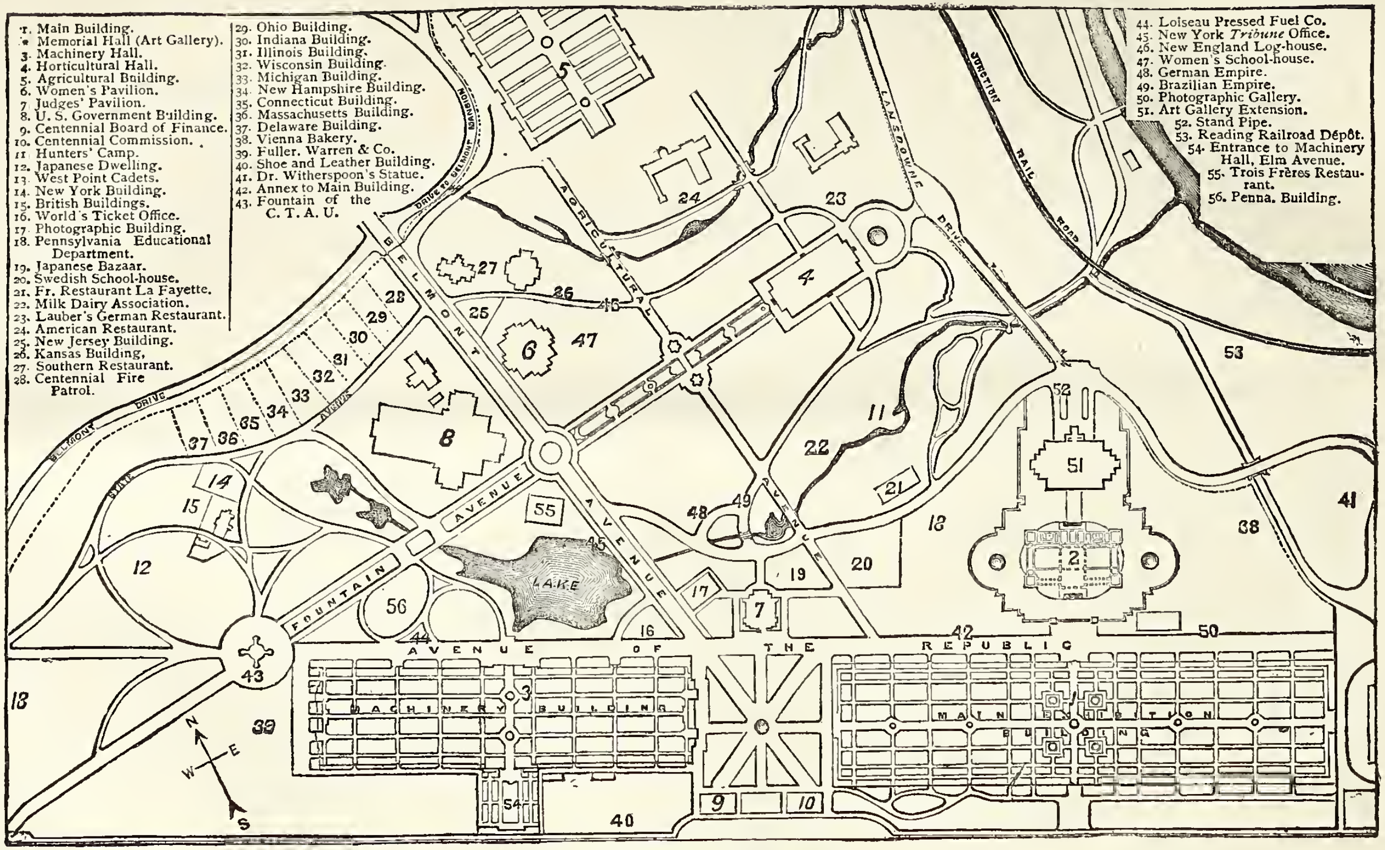
"The Declaration of Independence having been written and signed by its patriotic authors in Philadelphia, and its promulgation to the world first made in that city, and as the centennial anniversary of that memorable and decisive epoch in our country's history is nearly approaching, it behoves the people of the United States to prepare for its celebration by such demonstrations and appropriate ceremonies as may become a nation so rapidly risen from struggling infancy to a position of power and prosperity, as at once command the respect of all Governments and the admiration of the world.

"In order, therefore, to stimulate a pilgrimage to the Mecca of America, the home of American Independence, on an occasion so worthy of commemoration, it has been wisely suggested that prominent among the features for celebrating our One Hundredth Anniversary there should be an International Exhibition of Arts, Manufactures, and Products of the Soil and the Mine, as thereby we may illustrate the unparalleled advancement in Science and Art, and all the various appliances of human ingenuity for the refinement and comfort of man, in contrast with the meagre achievements of a century past.

"For the fulfilment of this, where so fitting a spot as the cradle of our country's liberty, and when the time as on the centennial anniversary of the year her freedom had its birth?

"In furtherance of an undertaking truly national in its character, and so commendable in spirit, the Council of the City of Philadelphia, the Board of Managers of the Franklin Institute, and the Legislature of the Commonwealth of Pennsylvania, have each appointed committees, who, clothed with authority to act from the bodies they represent, respectfully solicit Congress by its action to recognise the fact that the City of Philadelphia is, and of right should be, the place to hold, and that the year one thousand eight hundred and seventy-six would be the time to inaugurate an Exhibition of the Industry of All Nations.

"When such action as your wisdom may deem proper


1. Main Building.
2. Memorial Hall (Art Gallery).
3. Machinery Hall.
4. Horticultural Hall.
5. Agricultural Building.
6. Women's Pavilion.
7. Judges' Pavilion.
8. U. S. Government Building.
9. Centennial Board of Finance.
10. Centennial Commission.
11. Hunters' Camp.
12. Japanese Dwelling.
13. West Point Cadets.
14. New York Building.
15. British Buildings.
16. World's Ticket Office.
17. Photographic Building.
18. Pennsylvania Educational Department.
19. Japanese Bazaar.
20. Swedish School-house.
21. Fr. Restaurant La Fayette.
22. Milk Dairy Association.
23. Lauber's German Restaurant.
24. American Restaurant.
25. New Jersey Building.
26. Kansas Building,
27. Southern Restaurant.
28. Centennial Fire Patrol.
29. Ohio Building.
30. Indiana Building.
31. Illinois Building.
32. Wisconsin Building.
33. Michigan Building.
34. New Hampshire Building.
35. Connecticut Building.
36. Massachusetts Building.
37. Delaware Building.
38. Vienna Bakery.
39. Fuller. Warren & Co.
40. Shoe and Leather Building.
41. Dr. Witherspoon's Statue.
42. Annex to Main Building.
43. Fountain of the C. T. A. U.
44. Loiseau Pressed Fuel Co.
45. New York *Tribune* Office.
46. New England Log-house.
47. Women's School-house.
48. German Empire.
49. Brazilian Empire.
50. Photographic Gallery.
51. Art Gallery Extension.
52. Stand Pipe.
53. Reading Railroad Dépôt.
54. Entrance to Machinery Hall, Elm Avenue.
55. Trois Frères Restaurant.
56. Penna. Building.
BELMONT AVENUE
AGRICULTURAL AVENUE
LANSDOWNE DRIVE
JUNCTION RAIL ROAD
DRIVE TO BELMONT MANSION
BELMONT DRIVE
FOUNTAIN AVENUE
AVENUE OF THE REPUBLIC
MACHINERY BUILDING
MAIN EXHIBITION BUILDING
LAKE
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PLAN OF EXHIBITION GROUNDS.

shall have been taken, in order to place the grand design under your fostering care and control, it is hoped the President of the United States will be authorised in due time to invite the participation of all Governments.

"Respectfully submitted."

This remarkable document was signed by the members of the Committee of the Select and Common Councils of Philadelphia, the Committee of the Franklin Institute, and a Committee of the Legislature of the State of Pennsylvania.

There is a quaintness about the memorial almost old-fashioned, and certainly not unpleasing—at the same time it must be conceded that it places in very terse and expressive language the exact position of the question, and the most sensible mode of carrying it out.

The results of this memorial, and the energetic efforts made to impress its importance upon the august bodies to whom it was addressed, was that an Act was passed on the 3rd of March, 1871, under the following title:—

"An Act of Congress provides that an Exhibition of American and Foreign Arts, Products, and Manufactures shall be held in Philadelphia in 1876; also creates the United States Centennial Commission."

This Centennial Commission was so novel a point in the history of international exhibitions, that it requires a few words to explain its status. It must be remembered that the event to be celebrated by the exhibition was a national one, in which every State in the Union was equally interested, but that special circumstances rendered it proper and desirable that it should be held in the State of Pennsylvania, consequently every State had a right to see that it was done in such a way as would conduce to the credit of the United States. Therefore, Congress wisely formed a Commission, in which every State of the Union was represented. I say, wisely, because Congress could only do what seemed best at the time, and could not know beforehand how such a system would work. It was most desirable to have a control over the executive committees, because they did not know how those committees would be constituted, and how they would work; had they been able to foresee that they were to have a remarkable set of men in those committees, who required no supervision, and whose genius, and clearsightedness, and honesty, were all that could be desired, they would not have shackled them with the ponderous and all but unmanageable machinery of the Centennial Commission. Still they acted for the best, and did no great harm; possibly, if we could look deep enough into the whole of this complicated part of the affair, we should be led to say, no harm, but really good was done.

The following Governmental Acts followed:—

June 1st, 1872—An Act of Congress was passed creating a Centennial Board of Finance, and naming the Corporators. It provided the Board should consist of twenty-five directors, and limited the stock to be held by them to two millions sterling (10,000,000 dollars).

July 3rd, 1873—The President of the United States issued a proclamation, announcing that it was intended to hold an International Exhibition of Arts, Manufactures, and Products of the Soil and the Mine, and commended it to the notice of all nations.

July 5th, 1873—The Secretary of State transmitted a copy of the President's proclamation to the ministers of all foreign States for the information of their Governments.

January 23rd, 1874—The President issued an executive order appointing a Board to represent the Executive Departments, the Smithsonian Institution, and the Department of Agriculture.

June 5th, 1874—Congress passed an Act requesting the President of the United States to invite the Governments of all civilised countries to take part in the Exhibition.

June 16th—Another Act was passed, ordering appropriate medals to be struck at the Mint of Philadelphia.

June 18th—An Act was passed directing that all articles imported for exhibition should be duty free.

And February 16th, 1876—An Appropriation Act was passed, voting 1,500,000 dollars for the purposes of the exhibition. This gracious and necessary Act was, however, accompanied by a proviso, somewhat hard upon the holders of Centennial Stock, viz., that in the event of any surplus the Government should be recouped, as far as possible, before the shareholders received any benefit.

It will be remembered that the Vienna Exhibition was held in 1873, and it is no small an indication of the great hold which the Centennial Exhibition had by this time taken of the public mind in the United States, that the Commonwealth of the important State of Massachusetts, always foremost in intellectual activity, appointed an influential and competent Commission to go to the Austrian capital and collect all the information possible as to the working of the Vienna Exhibition, and a liberal sum of money was voted for the purpose.

The reports collected by this Commission on a great variety of subjects form a volume of over five hundred and sixty pages, and drew much attention in the States to the importance of exhibitions generally. This was of great value, for strange to say, previously the exhibition idea had never fairly entered the American mind.

The Act of Congress, previously mentioned as having been passed on the 1st of June, 1872, provided that a subscription stock should be raised over the whole territory of the United States of America, and that the scrip should be allocated in proportion to the respective populations of the States. The shares were only 10 dols. each, and as before mentioned, the capital sum was limited to 10,000,000 dols.

The table (next page) was compiled with great care; it represents the population of each State, and the *pro-rata* distribution of the shares.

How far this Centennial Stock was taken up is not yet publicly known; at one time it was not so satisfactory as was anticipated, hence the necessity for an appeal to Congress for the appropriation which was granted by the Act, February 10th, 1876, which removed all difficulties, and fairly launched the great exhibition.

So much for the origin and constitution of the Centennial Commission, and its ways and means. I will now endeavour to describe the organisation by which it was carried out. An Executive Committee was formed to act under the United States Centennial Commission, represented by its

Table showing the Population of the States and Territories, and the amount of Stock of the Centennial Board of Finance, to which they are severally entitled to Subscribe within the period of One Hundred Days, from the twenty-first day of November, 1872, *inclusive, to the first day of March*, 1873:—

No.	State or Territory.	Population.	Quota in Shares.	Quota in dollars.
1	New York	4,382,759	113,666	1,136,660
2	Pennsylvania......	3,521,951	91,341	913,410
3	Ohio	2,665,260	69,123	691,230
4	Illinois	2,539,891	65,871	658,710
5	Missouri..........	1,721,295	44,641	446,410
6	Indiana	1,680,637	43,587	435,870
7	Massachusetts	1,457,351	37,796	377,960
8	Kentucky	1,321,011	34,260	342,600
9	Tennessee	1,258,520	32,639	326,390
10	Virginia..........	1,225,163	31,774	317,740
11	Iowa	1,194,020	30,967	309,670
12	Georgia	1,184,109	30,710	307,100
13	Michigan	1,184,059	30,708	307,080
14	North Carolina	1,071,361	27,785	277,850
15	Wisconsin	1,054,670	27,353	273,530
16	Alabama..........	996,992	25,854	258,540
17	New Jersoy	906,096	23,499	234,990
18	Mississippi........	827,922	21,472	214,720
19	Texas	818,579	21,230	212,300
20	Maryland	780,894	20,252	202,520
21	Louisiana	726,915	18,852	188,520
22	South Carolina	705,606	18,300	183,000
23	Maine	626,915	16,258	162,580
24	California	560,247	14,530	145,300
25	Connecticut	537,454	13,939	139,390
26	Arkansas	484,471	12,565	125,650
27	West Virginia	442,014	11,464	114,640
28	Minnesota	439,706	11,404	114,040
29	Kansas	364,399	9,450	94,500
30	Vermont..........	330,551	8,573	85,730
31	New Hampshire ..	318,300	8,255	82,550
32	Rhode Island......	217,353	5,637	55,370
33	Florida	187,748	4,869	48,690
34	District of Columbia	131,700	3,417	34,170
35	Delaware	125,015	3,242	32,420
36	Nebraska	122,993	3,190	31,900
37	New Mexico	91,874	2,383	23,830
38	Oregon	90,923	2,359	23,590
39	Utah	86,786	2,251	22,510
40	Nevada	42,491	1,102	11,020
41	Colorado..........	39,864	1,034	10,340
42	Washington	23,955	621	6,210
43	Montana..........	20,595	534	5,340
44	Idaho	14,999	389	3,890
45	Dakota	14,181	368	3,680
46	Arizona	9,658	250	2,500
47	Wyoming	9,118	236	2,360
		38,558,371	1,000,000	10,000,000

President, General Hawley; Mr. Alfred T. Goshorn, was appointed Director-General; and Mr. Daniel T. Morrel, Chairman. Separate bureaus were established as follows, and presided over by competent gentlemen:—Foreign (chief), the Director-General; Installation, Mr. Henry Pettit, architect; Transportation, Captain D. Torrey; Fine Arts, Mr. John Sartain; Awards, Dr. Charles J. Stillé, Provost of the University, and afterwards General Walker; Machinery, Captain John S. Albert; Agriculture, Mr. Burnet Landreth; Horticulture, Mr. C. H. Miller; Police and Public Order, Colonel Henry de B. Clay. A central Board of Finance, consisting of twenty-six members, presided over by Mr. John Welsh, whose name was a tower of strength in what would have been otherwise a weak part of the administration. But if there ever was a man in whose honesty and ability a whole nation had faith, it is Mr. John Welsh. The engineers and architects, were Mr. Henry Pettit, Mr. Joseph Wilson, and Mr. H. J. Schwartzmann.

There was also another committee, which formed an entirely novel feature, namely, the Women's Centennial Executive Committee, consisting of a number of ladies, under the presidency of Mrs. E. D. Gillespie, who set themselves energetically and successfully to work to collect subscriptions for the general fund, and afterwards organised a special exhibition within the grounds for the proper display of woman's work, which formed an unique and interesting feature in the general plan.

I believe it will be admitted by every person who was brought into contact with the executive officers, from the Director-General downwards, that it would have been scarcely possible to have selected a set of gentlemen more thoroughly competent for the arduous duties they had to perform. It has never been my good fortune, certainly, to see the *fortiter et suaviter* more perfectly carried out than it was in the various bureaus of the Philadelphia Exhibition, and to this is doubtless owing the great success which has crowned the whole event.

The next point to which I shall direct your attention refers to the general arrangements for the accommodation of the different classes of exhibits, in various buildings and out-of-door groupings.

The locality assigned was a space comprising 236 acres of the great public park (Fairmount-park), which is the largest in the world, and I think it may fairly be said it is the most beautiful in natural scenery; some of the most charming bits of river scenery are found in those parts of the river Schuylkill and the Wissahickon Creek which run through it. Fairmount-park is variously stated at from 2,740 to 2,998 acres; but, at the smaller estimate, it exceeds the extent of any other public park, and it owes very little to artificial ornamentation. The ground is beautifully undulating and well-wooded; so even the part allotted to the exhibition, which was enclosed in a ring fence of three miles, was varied by beautiful dells and ravines, and so luxuriantly wooded that the new and not always beautiful structures with which it was thickly studded, and which would have looked garish and incongruous, were so mixed up with the foliage as to present an agreeable and novel effect. The height of George's-hill, outside the enclosure, commanded a beautiful view of the whole of the buildings and grounds, and afforded the spectator a spectacle of rare interest, especially in the late spring or early summer, when vegetation was in its greatest beauty; when the broad-leaved catalpas, with their masses of blossom rivalling our horse-chestnuts; the beautiful dogwood trees, with their white, butterfly-like flowers; the towering tulip trees, called there button-wood, or tulip-poplars; the variously-tinted maples, beautiful either in spring or fall; and, above all others, the purple-bloom, or American Judas tree, a mass of glorious purple coloured blossom before a leaf appears. A ramble under these trees, and in the ravines which they overshadowed, added much to the pleasure of the lover of nature. So rapidly had the exhibition been got up, that very much of the ground was in its original condition long after the opening, and in little bosky dells the botanist could find some of the most charming wild flowers; the beautiful little *Houstonia cœrulea*, the almost grotesque podophyllum, the huge, and not inviting skunk-weed, and a hundred others of great interest to the European botanist, were there as abundant as daisies in our own cultivated grounds. Of course it was necessary to lay out the principal part of the grounds, and make them subordinate to the various buildings of the exhibition. This was a most difficult matter, as there is no real spring in Philadelphia, and the transition from intense frost, when the ground is like iron for a depth of two feet or more, to one of almost tropical heat is so rapid, that it puts to flight all European notions of landscape gardening, and introduces new ideas which are as effective as they are necessary. The high keeping of the garden, such as we see it, is simply impossible, and gardening from our point of view cannot be attempted without a certainty of failure, nevertheless the park gardeners made the best of it, and their contest against temperature was not without success. One thing must be conceded to them, and that is the almost magical rapidity with which a large tract of land, made into a muddy swamp by the building operations which were so extensively carried out, was converted into a pleasure ground as beautiful as it was possible to make it.

I must now draw attention to the

Exhibition Buildings.

These were very numerous, reaching over two hundred in number by the middle of the exhibition period. We may divide them into the following classes:—

1st. The chief exhibition buildings, seven in number, viz.:—The Main Building; the Machinery Hall; the Memorial Hall for Fine Art; the Agricultural Hall; the Horticultural Hall; the United States Building; the Women's Pavilion.

2nd. Annexes to the above:—Main Building Annexe (Minerals); Main Building Annexe (Carriages); Machinery Hall Annexe; Fine Art Annexe and Photographic Annexe; Agricultural Hall Annexes.

3rd. Buildings for Special Exhibitions:—Glass making Works; Saw Mills; Organ Manufactory; Iron Works, Rolling Mills, &c.; New England Granite Company; Nevada Quartz Crushing Mills; Improved Friction Drum; Exhibition of Pneumatic Tubes; Hoisting Machines; Chilian Amalgamating Machinery; Printing Presses; First Locomotive and Car built in the United States; Averill Paint Company; Waterproof Roofing; Tombstones; Fireproof Ventilated Building; Swings; Ornamental Stonework; Tunisan Bazaar; Japanese Bazaar; Pressed Fuel Company; Newspaper Exhibition; Frank Leslie's Publications; Jerusalem Bazaar; Hungarian Times; Bethlehem Bazaar; Vienna Bakery; Kiltridge Cornice Company; The Dairy; Sewing Machines; French Exhibition of Stained Glass, &c.; Kinder-garten School-house; the Women's School-house; Burial Casket Building; Sheet Iron Building; Pennsylvania Educational Building; Rubber Roofing Company; New England Farmers Home (1771); American Dairymen and Farmers' Exhibition; House Apiary; Guano Company; Three Pavilions and large Plot of Land under cultivation with crops of cotton, tobacco, maize, &c.; Hay Preserving; Centennial Photographic Company, &c.

4th. Buildings for the separate States of the Union and for foreign countries. Those for the United States were erected by the following States: — Arkansas, California, Connecticut, Illinois, Iowa, Indiana, Kansas and Colorado, Maryland, Massachusetts, Michigan, Mississippi, Nevada, New Hampshire, New York, New Jersey, Ohio, Pennsylvania, Rhode Island, Tennesee, Vermont, West Virginia, Wisconsin, Philadelphia City. Those erected by foreign countries for official purposes were:—The three British houses, the two Spanish houses, the Japanese house, the German Government building, the Swedish Government building, the Brazilian Government building, the Canada log-house, the French Government buildings, the Portuguese Government buildings.

5th. Buildings connected with comfort of the visitors:—The House of Public Comfort, the two United States hospitals and tents, numerous restaurants, cafés, cigar pavilions, pop-corn shops, pavilions for aerated drinks, drinking fountains, Cook and Son's, and Jenkins' World's Ticket-office, Railroad Ticket-office, Empire Transportation Company.

6th. Buildings connected with the administration:—Offices of United States Centennial Commission, offices of Centenial Board of Finance, Centennial National Bank, Centennial Police-stations, the Judges'-hall, Telegraph-office, office of Water Department, Medical Department, &c.

The aggregate space occupied by all these, and numerous other roofed buildings, was nearly 75 acres. I will now refer to the principal ones in detail[*].

First.—*The Main Building*, in which the general exhibition of manufactures took place, was 1,876 feet in length; it covers 21½ acres, and cost £320,000. The architect, Mr. Henry Pettit, assured me that he had been mainly guided in its construction by the Crystal Palace of 1851, most especially in the uniform length of girders and pillars, the same dimensions, 24 feet, being taken; so that the whole structure is now available for railway stations, markets, &c. The impossibility of roof-lighting in a country where the sun has such great power rendered a special arrangement of the roof necessary, and this was cleverly managed by dividing the roof into three gables with flat sunken roofs between them, by which a large clerestory surface was obtained, and an abundance of light well diffused was the result. The general style of this building will now be familiar to all, through the numerous illustrations which have been published; the simplicity of the roof structure, and indeed of the whole fabric is seen at a glance, and has a pleasing effect. Notwithstanding its vast size, and the fact that so many specialities were provided for in other buildings, it was not found large enough, and two very considerable annexes had to be added to receive the great and interesting collections of economic minerals of the various States of the Union. The admirable manner in which these were displayed, and the care with which the huge specimens had been prepared, told very forcibly how deeply the value of the mining industries is appreciated in North America. I can use this general name here, for in the Canadian department also, the exhibition of the products of mines was on a grand scale, and under the very skilful arrangement of the Director of the Geological Survey of Canada, A. R. C. Selwyn, F.R.S., &c., was made a very striking feature, and was associated with admirably arranged collections of rocks, minerals, and ores, by Dr. Honeyman, Professor Howe, and Mr. H. S. Poole, from Nova Scotia.

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[*] Illustrations of some of these buildings were given in the *Journal* for July 9th, 1875, and September 1st and 15th, 1876.

The only other annexe belonging properly to the Main Building was the one for carriages, which covered two acres; it was intended at first only for horse carriages, but was found too large for the purpose, and became of great use in relieving the pressure on several other sections, especially railway passenger carriages, velocipedes, and also stoves.

Second.—*The Machinery-hall* was intended from the first to be a permanent building, and I believe the original idea was to retain it as a great hall, in which in bad weather the numerous excursionists to the Park might find shelter and amusement, and in which such local exhibitions as those of the Franklin Institute might be held. Hence it has been much more solidly built than the Main Building, and it is really a beautiful piece of construction. The details of this and the various other structures on the grounds would form an excellent subject for a special paper from some competent authority on architecture of the civil engineering class, and I believe I am correct in saying that there was more original skill and cleverness shown in the construction of the various edifices in the exhibition grounds, than in any other department of this great exhibition.

Third.—*Machinery-hall* covered fourteen acres, and had in addition several annexes. The Hydraulic Annexe, for hydraulic machinery; the American boiler Annexe; the Machine shop; the Corliss boiler house; the British boiler house, and although very indirectly connected with it, except as regards leather belting, the Shoe and Leather Annexe, a very large building, covering at least an acre of space, admirably constructed, and arranged for the display of all manufactures of leather, and for leather itself in every condition. In the centre of the Machinery-hall itself stood the great Corliss engine, provided to move, if necessary, all the shafting in this vast building. Great Britain alone chose to be independent, because it was desirable to show our own boilers in action, and our own machinery moved by them, hence we had a special boiler-house for three of Galloways' boilers, which were much admired by all practical engineers.

Here I may be allowed, I trust, to say the little that needs saying about British machinery, because I am nowhere going to enter into special details—we should have done better nearer home —we did as well as we could be expected to do with machinery at so great a distance—we were equal to, and perhaps I may say, superior to any other European nation in our exhibits of the mechanical arts and machinery generally, and both the British Commission and the British exhibitors were greatly indebted to Mr. J. H. Cimdall, Assistant-General Superintendent and Engineer, whose indefatigable exertions enabled us, under the most disadvantageous circumstances, to make a most respectable appearance. I hope I shall be excused this digression, but the object of it deserves all and more than all I can say in his favour. His exertions for the honour of the British Section can never be too highly rated.

The great Corliss engine, previously mentioned, was in itself a remarkable object, giving the spectator an extraordinary idea of power, for its energy, equal to 1,400 horses, kept the miles of shafting, and the innumerable machines dependent thereupon in constant motion during the time when they were shown in action.

The Hydraulic Annexe, for the display of pumps and other hydraulic works, was an excellent feature in the exhibition; it was nearly 200 feet long by about 100 feet wide, and contained a sunken tank, 144 feet long by 60 feet wide, with a depth of eight feet of water; around this the various pumps, &c., made an almost continuous cataract when in action, which had a delightful effect in cooling the air during the hot season.

The Exhibition of Fine Arts was in the *Memorial Hall* and its annexes, two in number. The chief building is of a beautiful fine grained granite, almost white in colour, and of a pleasing pearly lustre, and is well designed for an exhibition building, which it is intended it shall continue to be; indeed, it is to be the home of the great Industrial Art Museum, which it is hoped will be the outcome of the Centennial Exhibition. The proportions of the structure are good, but cannot well be seen until the overpowering mass of the Main Building is removed, when the general effect will be good, though somewhat injured by the huge eagles, which with widespread wings surmount each of the four corner pavilions; good taste, in time, will insist on their removal. This permanent building stands on an elevated plateau 120 feet above the level of the river, of which beautiful views may be obtained from several points; it has a frontage of 365 feet, and a depth of 210 feet. Large as it is, it was found far too small for the enormous demands for exhibiting space made from all parts of the world where art is practised, hence it was found necessary to erect a building four times as large; this annexe was built of brick, and was admirably designed for the purpose; it contained twenty-eight spacious halls, well lighted by double sky-lights. The doorways leading from room to room were cleverly placed in a diagonal way, so that no room was lost, and good vistas were obtained. Large as was the extent of these two art-buildings, they were so filled with paintings and sculpture, &c., that photography had to be accommodated in another building on the east side of the Memorial hall; it was about 100 feet long by 50 feet wide, and was divided into bays by screens, which gave ample hanging space for a vast collection of remarkable photographs from Europe and America. It was certainly the best arranged photographic exhibition I have ever seen. In portraiture our American friends had the lead, but no landscapes came up to the marvellous ones of our own Vernon Heath.

With respect to the general art collections I shall not attempt any critical remarks, further than to say that it was a matter of surprise and pleasure to note the rapid progress which American artists are making, and how little of really bad art there was to be found in the very large collection of paintings which they exhibited, certainly worse ones could be found amongst those of some countries in which art has for ages had a home.

Fourth.—*The Agricultural Hall*, an immense wooden structure, was distant about half a mile from the Main Building, but easily reached by the small gauge circular railroad which made all parts of the enclosure easily and pleasantly accessible. The dimensions of the Agricultural Hall are 826 feet by 540 feet, and in addition there are the Pomological Annexe for fruit shows, the Brewers' Annexe for storing and exhibiting beer, with an immense ice-house capable of storing 1,600 tons of ice to keep the beer cool during the tropical summer heat. No part of the Centennial Exhibition was better managed than the department of agriculture under Mr. Burnet Landreth; every part of the vast space gave evidence of thoughtful care in its arrangement, and it was a marvel to see such heterogeneous materials disposed of in such a manner as to prove extremely interesting to the multitude which was always to be found in its broad avenues. Great Britain did not shine there, but the Dominion of Canada did, and so also did Portugal, Brazil, and Spain. The United States of course furnished the most of this vast display, and certainly no such agricultural exhibition has ever been seen before. Its completeness was remarkable, beginning with various States, the depths and characters of the soils of which were shown in hugh glass cylinders, the products were also displayed with a skill and tact which surpassed all that we have seen in our European exhibitions. Connected with the department of agriculture was also the exhibition of live stock, and the trials of implements; for these purposes arrangements were made outside the inclosure. For the exhibition of stock, 22 acres of ground were allotted very near the main entrance, and near the Pennsylvania Railway Station Depôt, so that the animals could be delivered directly into the sheds; whilst lands for trial ploughing, reaping, &c., were set apart at greater distances, but on railway lines and within half an hour's ride. Great Britain was from the first out of the competition for implements, our manufacturers having, for probably good reasons, determined not to go. Our live stock exhibitors, however, went in greater strength than could have been expected in the face of such distance and difficulties.

Fifth.—*The Horticultural Hall and Grounds.*—This section of the exhibition comprised 40 acres of ground, tastefully laid out, and a handsome conservatory, flanked on each side with curved, lean-to hothouses and greenhouses. This structure is intended to be permanent, and to form the nucleus of a botanical garden; it is 383 feet in length, by a width of 193 feet, with exterior galleries, from which most beautiful views of the scenery on the Schuykill and Delaware can be seen. Within the outer allotment, and near to the hall, is a wooden-framed erection, provided with canvas covering, similar to those in which our great flower shows are held, and in this Mr. Waterer, of Knaphill Nurseries, made a splendid display of rhododendrons, which were to most of the visitors a great treat, and as great a surprise. It was a very spirited thing on the part of the exhibitor, which only those who know the difficulties with which he had to contend can possibly appreciate. A very choice out-of-door display was made also by Mr. Veitch, of rhododendrons, azaleas, and ornamented evergreens, all of which he generously gave to the Park Commissioners, by whom they were highly prized.

It was usual both in the official documents and also in conversation to call the above the five chief buildings, and generally in the order in which I have placed them. There were, however, two others which deserve to be placed in the same class, and one of them very especially so, viz.:—

Sixth.—*The United States Government Building and its Annexes.*—This group consisted of a very large edifice in the form of a cross, erected by the United States Government at a cost of 60,000 dollars, or £12,000, and, in addition, a laboratory, for illustrations of arsenal work, and a model military hospital, which was of great practical utility during the exhibition. Within the chief building was displayed most interesting and instructive collections, illustrative of the work of the Smithsonian Institution, and their general and geological surveys of the States, the mineral, zoological, and botanical collections connected with those surveys, and also most important ethnological and pre-historic collections. The great collection of food fishes of America, made for the Fishery Commission by Professor Baird, with the appliances for catching and preserving fish; also series illustrating the various naval and military weapons, and engines, and machinery for arsenal work; and lastly a complete display of all the appliances in the postal department of the States. The general arrangement of the contents of this large building, covering about two acres, was most satisfactory, and had been carried out under the most competent scientific supervision; hence it was felt to be the most instructive portion of the Centennial Exhibition. It brought into full view a great mass of the intellectual work of some of the greatest of American workers in the fields of science. The veteran Henry, Baird, Hayden, Leidy, Powell, Blake, Leslie, Le Conte, Barker, Donaldson, and many others who have worked with a will to make the science gathering of America worthy the occasion.

Seventh.—*The Women's Pavilion.*—In this building, covering an acre, and built by voluntary contributions from American women at a cost of £6,000, and managed by a committee of ladies under the presidency of Mrs. Gillespie, of Philadelphia, was collected together a very large and interesting assortment of products of female skill and industry drawn from most parts of the civilised world. Some contributions by our own gracious Queen and Royal Princesses were especially prized, and gave great satisfaction to the management.

I will now refer to another and a larger group of buildings.

THE UNITED STATES' STATE BUILDINGS.

They amounted in number to between twenty and thirty, and were built by the respective States whose names they bore, for the especial comfort and convenience of visitors coming from the different States. In each a register of visitors and addresses was kept so that friends could learn the whereabouts of each other. A reading-room with the special papers of the State was provided, and the house answered to a large extent the purpose of a club. In some cases, a collection of the special products of the State formed also a part of the attractions. They were generally built of timber, framed and filled in with boarding and plaster, but in other cases the material was a special product of the State represented, thus New Jersey is famous for its roof tiles; the roof of its State-house was therefore so arranged as to exhibit the tiles of different makers, and its quaint pointed roofs had a very picturesque effect. Ohio is famous for its stone quarries, hence its State-house was built of stone, each course of which was from a special quarry. Western Virginia is famous for its ornamental hard-woods, and it was prettily panelled with choice kinds of furniture woods. The idea of these State-houses was quite new, and out of them sprang an equally unique idea, that of each State having a special day set aside for a celebration of the centennial year within the grounds of the exhibition, with a particular reception in the respective State-houses. It was a happy idea, and conduced much to the success of the vast concern, for it gave each individual State a strong feeling of interest in the Centennial Exhibition, no matter how distant it was from their homes. Another point connected with these State-houses was that in many instances they were built after the characteriste styles of the various States; the older ones showing remains of the tastes imported by the Dutch, English, German, and French colonists, surrounded by pretty gardens, and being mostly arranged along a fine avenue, their general effect was good.

The smaller buildings of the large group which, in my previous enumeration is placed No. 3, are chiefly erections by individuals or companies for special exhibits. It is questionable if this great multiplication of separate structures scattered over so large a space was desirable; the only good result it appeared to me to have was to spread the multitudes over a greater space and add to the liveliness of the park. Their names in most instances denote their uses, and render any particular description unnecessary.

Amongst the structures in Group 5, is one deserving of notice, as, if the idea was not absolutely new, it was carried out on a scale of such magnitude, and with so much good management, as to far exceed anything of the kind ever attempted before. It was well named the House of Public Comfort. There visitors arriving by the trains from far distant places could immediately get rest and refreshment, could deposit in safety superfluous wraps, get their boots cleaned, or their chins shaven, and their hair cut, could see a newspaper, write a letter, or send a telegram. Ladies had their handsomely furnished parlour and dressing-rooms. There were excellent lavatories, and a staff of messengers who would take messages or parcels for a small fee; indeed every want that a visitor could have, seemed to have been anticipated and provided for. At the door of this useful establishment was one of the stations of the Circular Narrow Gauge Railway, which went round and across the grounds, and enabled the visitors, without toil or exposure to the sun's rays, to reach all the outlying buildings of the exhibition. This railway was a happy idea; it was well managed, and was an immense public convenience. The railway and steamer ticket offices, and the parcels express arrangement, also added much to the comfort of visitors. The hospitals were well appointed and admirably tended by medical men and nurses, whose untiring zeal and kindly manners showed that they had been most carefully and judiciously selected for a very harrassing and onerous duty. They were in great request, and during the latter half of the exhibition period received an average of about forty cases per diem.

The General Character of the Exhibition.

Of course it would be impossible in the course of an evening to go into particulars respecting the objects exhibited in-doors and out of doors, and it would be invidious to select a few exhibitors for special notice. I will, therefore, with your permission, confine myself to a few general remarks. First, then, as to the arrangement of the Main Building, the installation in every section was carried out with great ease, owing to the extraordinary fact that as early as the beginning of February the flooring was complete and swept ready for the exhibitors' goods as they arrived, and consequently confusion and delay were avoided, and things fell into their places as if by magic. There was reason to fear that European States, and the further distant countries and colonies, would object to trust their most valuable articles so far, and with the risk of the ocean before them. This fear was groundless, and the result was that there was as good a proportion of beautiful with the useful in this as in any previous exhibition. The foreign countries exhibiting were:—Argentine Republic, Austria, Belgium, Bolivia, Brazil, Chili, China, Denmark, Ecuador, Egypt, France and Colonies, German Empire, Great Britain and Colonies, Bermuda, Mexico, Netherlands, Norway, Orange Free State, Peru, Portugal, Russia, Canada, Cape of Good Hope, New South Wales, New Zealand, Queensland, South Australia, Tasmania, Victoria, Jamaica, Mauritius, Ceylon, Singapore, Gold Coast, Greece, Guatemala and Salvador, Haiwaian Islands, Honduras, Italy, Japan, Siam, Spain, Sweden, Switzerland, Tunis, Turkey, Venezuela.

In the Main Building, the largest claims for space were 100,000 square feet by Great Britain and her Colonies, a space which was rather exceeded.

Square feet.	
43,314	France and her Colonies.
27,705	The German Empire.
24,070	Austria.
24,650	Sweden and Norway.
17,080	Japan.
15,509	Netherlands.
15,358	Belgium.
11,802	Russia.
11,253	Spain and her Colonies.

In every instance, whether the space was large or small, it was well filled, and the chief outcry was for more space.

The United States of North America occupied

189,231 square feet, or not quite double the British space, and as a general rule their exhibits were of such excellent quality, and so carefully displayed, that the exhibitors were evidently alive to the vast importance of the competition. No one who had only seen their weak efforts in the European exhibitions could have expected such superior manufactures in metalwork, textiles, and especially in chemicals, which were shown by them. They have much to do before their artistic decorations are entitled to praise, but it is very evident that they are not asleep in that now very important accompaniment of many manufactures.

In the machinery department there was an immense display from various parts of the world, but less of novelty than usual; and there was a smaller amount of iron machinery and more wood-work shown than we have been accustomed to see, but there were a few notable examples, and of both there was an abundance to make up a great and interesting exhibition, which to the New World people, unfamiliar with European shows, would be surpassingly interesting and instructive.

As to the general success of the exhibition, I am sure you will all be glad to know that it is assured it was begun under somewhat adverse circumstances, not the least of which was the difficulty of bringing the whole of the States into one harmonious feeling in favour of it, for there were jealousies which could not be suppressed, and which nothing but the marvellous tact of Director-General Goshorn, and the chiefs and staffs of the executive bureaux smoothed down. There was also the great pecuniary difficulty, which was a mountain in itself, and this could not have been removed had not the Board of Finance been composed of a president and members of such unimpeachable integrity and acknowledged business abilities, that their names wherever known were guarantees against any mal-administration.

The result has been that the attendance has far surpassed that at any previous World's Fair. Thus, the official returns of the admissions through the stiles, published on the 17th November, show the following remarkable results :—From May 10th to Nov. 10th, inclusive cash admissions, 8,004,274; free, 1,906,692; total, 9,910,966; and the receipts were 3,813,724 dols., or in round numbers £762,700, which with money paid for concessions, sales of buildings, materials, &c., will bring the whole receipts up to very nearly a million pounds sterling.

The number of visitors at previous exhibitions in Europe was as follows :—

1851—London	6,170,000
1855—Paris	4,533,464
1862—London	6,211,103
1867—Paris	9,300,000
1873—Vienna............	7,254,287

These results must prove that International Exhibitions are not played out, as many people suppose, but have still a very important part to perform in advancing commercial prosperity and the general interests of civilisation.

I have purposely avoided all reference to the system of awards, because from the first I disapproved of it; and also because now it is on its trial, and all interested in it can form their own opinions upon the greatest innovation upon previous exhibition rules which occurred at the Centennial.

It would ill become me to close this very imperfect review of the general features of the great Centennial Exhibition just closed, if I were to omit reference to one feature, which, to visitors from distant parts, was of great value and importance, and that is, the widespread kindliness of feeling and unbounded hospitality with which they were received by the inhabitants of Philadelphia. For my own part, I never can feel sufficiently grateful, and I know my feelings are shared by most of my countrymen who were there.

Closing Remarks.

It is impossible to foretell what will be the actual effect of the exhibition upon the people of the United States, but judging from what such displays have done for our own and other countries, it is only fair to infer that it will certainly be beneficial. The quick appreciative nature of the inhabitants of the great Republic is certain to have gathered a wealth of useful facts, and they will not be slow in applying them. Those from the remote inland districts will have had their eyes opened to the activity of other people, and the charms, which improved tastes bring into social life. The great cities themselves have received a wholesome and powerful stimulus to strive in the race for higher culture and more æsthetical feeling, and with the general public from all parts the effect will have been to dispel innumerable errors, prejudices, and false estimates. Let us hope that our American brethren may realise these and every other possible good from so well conceived and splendidly managed an undertaking as that which they have just so successfully completed.

DISCUSSION.

The Chairman said there was no doubt the Philadelphia Exhibition was the greatest which had ever taken place in the world, and really constituted the most happy means of celebrating the anniversary of American independence. It was interesting to remember that the parent of all these exhibitions, that of 1851, originated in the hall in which they were then assembled. This Philadelphia Exhibition, therefore, formed a very appropriate subject to be brought forward in this Society, and they would all agree it had been most ably treated. Some years ago he visited Philadelphia, but did not stay long enough to see much of it, but he did see that wonderful park, 12 or 13 miles round, which possessed the beautiful natural advantages which had been mentioned. There could not have been a more appropriate place for the exhibition; and the wonderful way in which the Americans threw themselves into this, as into every subject they took up, was most remarkable. They always liked to do things on a gigantic scale, and generally succeeded in doing so. Their hospitality had been referred to, and that was certainly most remarkable. They would give you a pass from one end of the Union to the other, entertained you free of all charge, and were never better pleased than when they were showing hospitality to a Britisher. Indeed, notwithstanding a little tall talk now and then, there was a strong under-current feeling of affection for the mother country, and especially, he believed, for the Queen and the Royal family.

Mr. Hyde Clarke said:—When this year of centenary celebration arrived it seemed to me very desirable that it should be commemorated by this Society, which dates its origin beyond the hundred years of the United States. It would have been found how, in times preceding 1776, this Society of Arts had taken an interest in advancing what was then a chief object with Englishmen—our North American colonies. It would have been seen how many of the men connected with the Society were devoted to the cause of the colonists, and were themselves promoters of that independence which this year has been made the subject of such a noble celebration, and in which Arts, Manufactures, and Commerce have been made to take a prominent part. The Council accepted my ideas, but failed in finding some man of distinction who would take charge of the address, for which they were willing to devote a handsome remuneration. This evening presents an opportunity for referring to the subject under the aspect to which reference has been made. In the last century those philosophers who set a-foot revolutions which still remain incomplete, looked with the deepest attention on the grand experiment of the establishment of a new nation and a new race in America under the most favourable circumstances. In America the situation was accepted readily; they set aside all reference to England and Englishmen, they were Americans; they almost persuaded themselves they were the heirs of the perishing Indians, and that the soil of America, traversed by gigantic rivers, was capable of giving birth to peculiar and gigantic men, certainly to gigantic ideas. They talked of establishing an American language. It is in the present day that we have to ascertain how, after the passage of a century, a special nationality has been formed, and has manifested itself in literature, art, and mechanics. The answer is open to us all, that no such wide change has been. The reason is not to be sought far off, and that in natural causes. As the people of the thirteen colonies of the United States spring from the people of England, so did their revolution, historically descended from English precedents. At the utmost the new Americans had to start from an English basis. There was, however, this circumstance; as the American Revolution had its roots in England, so it left its branches there. The people in England were not, as is vulgarly conceived, opposed to the people of America. Just as in America, there were people on both sides, and it is most likely there were more men in favour of the cause of independence in England than there were in America. Among such were many of the founders of this Society, and the forefathers of many of those now present. The same ideas that conduced to the independence of the United States continued to operate here, and thus, as well as by the reaction of the United States on the mother country, notwithstanding all adverse influences, the people have become more and more English, by the recognition of English ideas in America, by the introduction of those of America here. America has contributed some bright names to the common literature and art, and she now puts in a special claim to the conservation of the common inheritance in the works of Shakespeare. America has, indeed, heen represented by Frenchmen as possessing no literature and no art. We know she has given her share. Now comes the special question—what special American nationality is there in the mechanical department? If we take our thought back a little we shall find that this result was regarded as a certainty. While the forests of America furnished timber in abundance, to the exclusion of iron and copper, and for bridges in substitution of stone and brick, so they were to supply fuel, rendering coal unnecessary. The water power, looked upon as a vast and special resource, was considered certain to make the steam-engine impossible. The absence of paupers in America, and the impossibility of their existence there, would, it was esteemed, naturally favour the production of labour-saving machines. Much of this expectation was realised, but notwithstanding the fact, and the present peculiarities, America is using the same machinery as the old world, and is actively competing in its production. Yet it seemed at one time as if the old dream was to be realised. Extraordinary timber bridges and viaducts were constructed, and water power was extensively employed for manufacturing purposes. Had no other causes operated, the reckless invitation to American privileges to the untrained populations of the old world was sufficient to supply American cities with rookeries, drunkards, and distracted needlewomen. The circumstances are not exactly the same on each side of the Atlantic, but an equilibrium is near, and the peculiarities are less salient than the striking points of resemblance. Then again we have to consider the reaction of Americans on the old country. The development of the sewing-machine for instance has brought a direct influence to bear on this country. On all grounds, therefore, the study and the knowledge of the mechanical productions of America exhibited this year, and so ably illustrated this evening, are well deserving of our serious and earnest attention.

Mr. Botly said, as a member of the committee for the first exhibition, and also as a supporter and guarantor of succeeding exhibitions, he felt very proud of the success which had attended this youngest and best of them all. It was somewhat remarkable to find that in the Philadelphia Exhibition no intoxicating liquors were allowed to be sold, and to remember that the same rule was made in connection with the Exhibition of 1851. He thought that had a great deal to do with its success, not because he was a teetotaller, but because he believed that many persons sent their families there who would not have done so but for the way in which it was carried out, and for the sobriety and good conduct of those who visited it. In conclusion, he referred to the admirable reports written by the artisans who visited the Paris Exhibition under the auspices of the Society of Arts.

Mr. Christopher Cooke called attention to an article in the *Times*, on the 1st of December, and to another in the *British Almanac*, in which the Philadelphia Exhibition was alluded to in very flattering terms. He had been in America some four years ago, and could quite endorse what had been said by the Chairman with reference to the kindly feelings of Americans.

Mr. J. B. Brown, as an exhibitor and also a medallist at Philadelphia, desired to thank Prof. Archer for the admirable account he had given of some of the most prominent features of the exhibition. He was proud to be in the hall where the first exhibition was set on foot, and could not but refer to what was said at that time about the reign of peace and concord, which it was hoped would then be inaugurated. They all knew, unfortunately, how far the results had fallen short of their expectations, but he did not despair, since great ideas were never fully realised immediately. It was most touching to see the warmth with which English, Scotch, and Irish visitors were welcomed at Philadelphia, and he believed that if half-a-million Frenchmen and Germans had been sent by their respective Governments to travel in each other's countries there would have been very much less chance of the Franco-German war taking place. Having visited America, for the first time, twenty-six years ago, he was able to judge of the immense progress which had been made in a quarter of a century. He quite concurred in what had heen said about the hospitality of Americans and their appreciation of Englishmen, for whenever Col. Sandford, the chief of the British Commission, was announced, he was always received with hearty cheers.

The Chairman then moved a vote of thanks to Professor Archer, which was carried unanimously.

Professor Archer, in responding, said his paper had in fact only been a preface to the subject, for it was impossible to do more in the short space of one evening.

He had hoped that some gentleman would have addressed some questions to him relative to special objects in the exhibition in which they and he felt an interest, but the discussion had taken a different direction, and run rather into the social question started by Mr. Hyde Clarke. However, nothing better could arise out of the exhibition than a feeling of good fellowship between the two nations, and he should certainly no longer call the Americans cousins, but rather brothers and sisters. In fact, it was impossible for any one who had spent six months in the United States, as he had, to convey to anyone else how grateful he must feel for the kindness, and more than kindness, he had received. He believed the Americans were even more loyal to the idea of old England than Englishmen themselves. Whenever he and his colleagues entered a hall in which music was being played, no matter what piece, it was immediately stopped, and "God save the Queen" was commenced, and there was a very general feeling of astonishment that the Queen did not go to the exhibition. They thought nothing of travelling themselves, and could not understand why the Queen did not come across. There was no doubt that the Americans themselves would be greatly benefitted by the exhibition, as they could not fail to learn a great deal from the European productions which had been sent there. In fact, it would take not one but a hundred evenings, to give a fair idea of the spread of knowledge which that exhibition had carried over to the other side of the Atlantic, and a great many specialists to properly develop the different branches, and do justice to them.

MISCELLANEOUS.

A MODE OF GENERATING SULPHUROUS ACID GAS FOR USE AS A DISINFECTANT, &c.

By Thomas W. Keats,

Consulting Chemist to the Metropolitan Board of Works, &c.

The effect of sulphurous acid gas as a disinfecting and antiseptic agent is too well known to require to be dwelt upon. All persons know its value who are acquainted with sanitary questions, but the difficulty has been to obtain it conveniently and readily, and under such conditions that it could be applied with facility when it happened to be wanted.

Sulphur burned in the air will produce double its weight of sulphurous acid; but the burning of sulphur is not convenient, and, indeed, not easy without a proper arrangement for carrying on the combustion. Sulphurous acid is soluble in water, and is afterwards again slowly evolved from the water in the gaseous state; but the solution requires to be made beforehand, does not keep well, and, again, is not always easy of application where the disinfectant action is required.

Sulphurous acid in the gaseous form can, however, be obtained with the greatest facility, and under circumstances which render it applicable, I believe I may say to all conditions in which such an agent can be used, by the simple expedient of burning the liquid called bisulphide of carbon.

Bisulphide of carbon is a colourless, heavy liquid, sinking in water, excessively volatile and inflammable, burning with the greatest avidity, with a livid blue flame, and giving off abundance of sulphurous acid gas, and, what is of importance, it can be burned in a lamp like spirit of wine; it is this quality which renders it so remarkably suitable to the object in question when considered in connection with its chemical constitution.

Bisulphide of carbon, as its name indicates, consists of an atom of carbon united to two atoms of sulphur ($C S_2$); 100 parts by weight contain 84 parts of sulphur, and 16 parts of carbon. This quantity of bisulphide yields, in burning, 268 parts of sulphurous acid, and 58 parts of carbonic acid calculated in grains, the 168 parts of sulphurous acid measuring rather less than 250 cubic inches, or about one-seventh part of a cubic foot.

Many experiments have been made with the view of ascertaining the effect which the burning of a given quantity of the bisulphide will produce upon the atmosphere in which the burning takes place. The result of these experiments is, that about half an ounce by weight will impregnate a thousand cubic feet of air with sulphurous acid, to such an extent that it is rendered irrespirable for more than a few moments; and it may be assumed that in such an atmosphere disease germs and the products of putrefaction would be entirely destroyed, and the air effectually purified and disinfected. The time required for burning half an ounce of the bisulphide in a lamp of the size of a common spirit lamp is about 20 minutes, and in that time the quantity of air mentioned will be completely charged with sulphurous acid throughout its volume.

The application of this method of generating sulphurous acid is so simple and convenient, that it can be used in almost any locality, and obviously not only for the disinfection of the place, but likewise of the materials which it might contain; so the bedding and linen of fever patients, or the interior of a vehicle in which they have been carried, can be completely purified with very little trouble and at the cost of very few pence.

Sulphurous acid is considered by most skilled persons to be the most effective of disinfectants where it can be used, but the ordinary method of obtaining it by burning sulphur precludes its employment in most cases. The burning of the bisulphide of carbon, on the contrary, is as easy as the burning of a little spirit of wine in a lamp under the coffee-urn, and it can be carried on in the most inconvenient places and in a very limited space. On board ship it can be used with advantage, not only for disinfection in cases of contagious disease, but also for ordinary fumigation, and I think it would be found of value in tropical countries in connection with the treatment of the virulent fevers of those regions.

There is another application of the employment of bisulphide of carbon to which it might be useful to advert. I mean in destroying the fungoid growths which occur in casks that have contained beer and similar liquids. Burning sulphur is the specific in those cases, but the burning bisulphide is more convenient.

In using this agent, it must be borne in mind that it is extremely volatile, intensely inflammable, so that in filling the lamp no light should be near at hand, and that the odour of the bisulphide itself is rather disagreeable, and therefore the bottle in which it is kept should be well stopped, and the lamp fitted with a good screw cap to keep in the odour, and at the same time to prevent the evaporation of the liquid.*

An official return shows that there were 324 blast furnaces in Germany in 1874. These furnaces worked on an average eight months and twenty days in 1874. The quantity of iron ore used amounted to 4,342,184 tons, of which 4,130,000 tons were produced in Germany itself. The total quantity of pig and cast iron of the first quality produced was 1,660,208 tons. The average number of workpeople employed in the trade was 22,765, of whom 853 were women. Prussia ranked first with 244 blast furnaces. The Rhenish provinces ranked second.

The drawings for the prizes, offered by the Goldsmiths' Company, for designs for plate, will be exhibited in the Royal Architectural Museum on and after December 26. The admission is free (daily) from 10 till 4, and Saturdays till 6, and every evening (except Saturday) from 6 till 9. Art workmen are specially invited.

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*A convenient arrangement of lamp and case is made by J. How and Co., of St. Bride's-street, Ludgate-circus.

THE SUGAR-CANE DISEASE IN QUEENSLAND.

The sugar-cane plantations in Queensland have, of late years, been visited by a devastating disease, known as "rust," the origin of which has formed the subject of inquiry in the different plantations; microscopical examination of diseased plants, and chemical analysis of the soils in which they were grown, have been made, and a report drawn up thereupon. Like most plants cultivated on a large scale, and attacked by a common disease, it was naturally expected that the disease in Queensland would prove to be due to the effects of microscopic fungi; this supposition was strengthened from the fact that the disease was much more marked and general after unusually wet and cold seasons. While most of the varieties cultivated have been more or less affected, the Bourbon variety seems on all sides to have suffered much more than any of the others. The plants for the most part, whether healthy or diseased, were attacked by fungoid growths, the leaves being covered with red spots, which were much more abundant on the diseased plants than on the healthy ones. These red spots appear to be developed gradually. The leaves of the affected canes are, in the first instance, covered with numerous small, light-coloured, transparent spots; in addition to these, reddish-brown spots make their appearance, gradually increasing in numbers, until the colour of the leaf is completely changed; they soon wither, and finally fall off, the growth of the cane itself is naturally impaired, and the plant, sooner or later, dies. Further examination showed, at the bases of the leaves and near the bud, patches of dark red, brown, or purple, which proved to be a number of minute bodies, more or less cup-shaped, often with an irregular rim or opening, sometimes partially closed by flaps. These cup-like bodies are connected by dark red and purple filaments, which spread over the surface and penetrate into the substance of the leaf. Near the dark-coloured, cup-like growths are others of a lighter colour, and others again quite colourless, and spherical in shape, filled with fluid. These appear to be the young state of the cup-like bodies alluded to, which became darker in colour as they approach maturity, and, when fully ripe, burst at the top with an irregular rent.

The rust spots on the leaves are described as being often seen "split open, and to have extruded a minute quantity of a white, powdery substance; a similar white powder is also scattered over the surface of the diseased leaf, and the same thing is seen on the healthy leaf, but in much smaller proportion; this powder is probably of the same nature as the white deposit generally seen at the joints of the cane. As might be expected, the leaf cells under the rust patches are seen to be more or less destroyed, and to contain a brown-coloured decomposed matter, and through it fungoid filaments (*mycelium*) are seen to permeate."

It will be seen from the foregoing, that the fungoid enemies of the sugar-cane in Queensland are by no means scarce; nevertheless, the disease that has prevailed is certainly not attributable to fungoid organisms; their presence is rather more the consequence than the cause of disease, which is probably to be found in the method, or rather want of method, in cultivation, which is most primitive and simple. Most of the ground is prepared by the hoe, the presence of numerous stumps preventing the use of the plough, where it can be used, however, it is preferred. The usual plan of preparing the ground for planting the canes is to dig holes or troughs some twelve inches by eighteen long, and nine inches deep, and from two to five feet apart; into these holes the canes are planted. Of the common sorts usually only the tops of fully grown canes are used; of the rarer varieties the entire cane is planted. With some of the sugar growers the middle joints are considered not the most suitable, being liable to turn sour, and not to grow so well. The top and bottom joints are considered the best. Plants taken from the lower and harder portions of the cane are slower in shooting, and more often fail than those near the top. The great fault, however, and one of the principal causes that have probably brought about the disease, is the want of proper drainage, and a system of manuring. It is scarcely conceivable that, in a colony like Queensland, no attention should be paid to these all-important points. The fact of simply making holes in unturned ground for the reception of the plants, gives them little chance for extending their roots, which are unable to penetrate the walls of these holes. The drainage from around each hole runs into it, and by stagnation becomes sour, and consequently injurious to plants, "neither can the cane in such holes be properly manured, for if the manure be placed at the bottom of the hole, it will be too strong and contentrated to be good for the young cane; and when the cane is older, and its roots have spread, should the cane not become root-bound, most of the root fibres will have overshot the manure, and will no longer derive nourishment from it." The importance of the proper preparation of the soil, the drainage and manuring is strongly impressed upon planters in the report on the subject from which the above extract has been taken, and it is further pointed out that even loose, porous soil and lands, which are liable to be burnt up, are wonderfully improved by proper drainage, which, in addition to removing sour water and unwholesome substances from the land, causes and maintains a regular circulation of food, air, and warmth through the soil, and the roots which are prevented descending a sufficient depth by the presence of stagnant and impure moisture, immediately begin to penetrate to below the influence of the surface heat when the unwholesome water is drawn off.

In most of the Queensland plantations no manure whatever is used; only in very few cases the megass, or the ashes of the megass are applied to the land. Even the refuse from the distillation of rum, generally known as "dunder," which is acknowledged to be rich in various salts, and to form a most valuable manure, is allowed to run away into the river or creek nearest the plantation; many thousand gallons of a valuable manure are thus wasted annually. It is strongly recommended that the megass should be returned to the land in the green state, and on no account used as fuel, the scum, the dunder, and the refuse washing waters ought all to be so used, and even the molasses, unless they can be disposed of at a remunerative profit. All these substances contain the actual salts and organic matter in the proportions required by the cane, and they are accordingly of the utmost value to its proper growth. The organic matter will, for the most part, have to decay before it can be assimilated, but then the products of decomposition will exist in proper proportions. The megass, with the trash, should be ploughed into the land in a green state, in order that the whole of it may be utilised; and as it decays it will tend to leave the soil open and porous. The water which enters into its composition will not only hasten its decay, but will also serve as a reservoir of moisture, which is slowly given out, and will, in dry weather, become of great benefit to the growing crop. It seems that some of the planters in Queensland attach but little importance to megass as a manure, because much of the woody fibre has been found to remain undecomposed, often lying in the ground a year or so; but this megass had been stacked for some time, and had, consequently, lost much of its soluble as well as fermentable matter. Such megass consists mainly of matter which has resisted decomposition; the matter forming the stack owes its very existence at that period to its power of resisting decomposition, all the readily decomposable and, therefore, most valuable parts either having drained away or become volatilised. The rich, dark-coloured stream of liquid draining from every fresh megass heap is proof that green or new megass does contain a large quantity of organic and inorganic matter which cannot possibly be present in the old megass. The opinion of the author of the report is, that but little benefit would be derived from old megass until after it had been in the ground for a year, or even perhaps for two or three years; but he further thinks that, by using the megass in its fresh state, an improvement would be apparent; and as the less readily decomposable portions underwent general decomposition, they would slowly become available as plant food. Three or four years, however, would probably elapse before the megass was completely used up. The plan of stacking the megass in heaps is shown to be a very destructive one, in consequence of the richest and most valuable part draining away, the unexpressed sugar remaining in the megass is thus lost, besides which there is a great loss from the evaporation of the volatile constituents, the greater proportion of the ammoniacal salts are thus volatilised, and too often the manure oxidises by such exposure, and becomes rank and unwholesome to the plant.

With regard to the molasses, nearly all the soluble salts which exist in the cane-juice are contained in them, and when they are fermented and distilled these salts remain in the dunder, which contains also a large proportion of organic matter.

The conclusions arrived at in the report, and the recommendations of the reporter, with the view of arresting or stamping out the disease, are summed up as follows:—A free use, to the extent of from four to five hundredweight per acre, of a manure composed of

Bone meal	35 parts	All in fine powder.
Superphosphate of lime	25 "	
Sulphate of lime	25 "	
Nitrate of ammonium	15 "	

Should nitrate of ammonium not be readidly obtainable, nitrate of potassium may be substituted. Those manures which contain potash, soda, and magnesia are recommended to be avoided, as a rule, for sugar plantations. In default of the above mixture, lime and superphosphate may be employed, but not with such good effect. The cane-plants might also, as a further precaution, be dipped in milk of lime a short time before planting, or with a solution of carbolic acid, composed of one part acid to 100 parts of water. New plants should also be obtained from time to time from other countries. Finally, the organic matter, humus, and other similar compounds, should, by a liberal use of megass, stable manure, and other available vegetable organic matter, be restored to the soil. This might, to some extent, be effected by ploughing in green crops, such as lupins, indigo, or other leguminous plants.

LIBERIAN COFFEE.

From the great interest which has attached to Liberian coffee, as much in a commercial as in a scientific point of view, owing to its reputation as to quality and prolific bearing—and, not least, its reputed power of being disease-proof—the replies to a series of questions regarding the cultivation and production of coffee in Liberia will be of especial interest to many readers of the *Journal*. The plant producing Liberian coffee is distinguished from the ordinary coffee (*Coffea arabica*) by its more robust habit, its larger leaves, and much larger berries and seeds. It is now considered to be a distinct species, and has been described as *Coffea liberica*. The questions referred to above were drawn up by Dr. Thwaites, the Director of the Royal Botanic Gardens, Peradeniya, Ceylon, and the replies have been obtained by Messrs. Irvine and Co., of Liverpool. From these replies it seems that the Liberian coffee grows equally well in the immediate neighbourhood of the sea and at considerable distances from it. Under like conditions of soil and cultivation, trees near the sea-shore in Mourovia are about the same as those at Careysburg and other places thirty miles distant. The wild coffee, from which the cultivated comes, is found at even still greater distances in the interior. At Bassa and Sinon the coffee-trees are said to grow within a hundred yards of the sea. The general temperature at which coffee thrives best ranges from 72° to 87° Fahr. in the shade. In the country, at the furthest point at which coffee is cultivated by the settlers, there is a difference of one or two degrees lower, owing principally to the rise in the land. The lowest temperature observed at Mourovia near the sea was 62°, at seven o'clock, a.m., in the month of January, during the prevalence of the Harmattan winds, the highest temperature being 91°; but these are exceptional cases. Along the coast the coffee-tree thrives at only a few feet (about ten) above sea-level. At Careysburg, and at Mount Coffee, it succeeds as well at an elevation of 550 feet. It grows equally well on level ground as on slopes. In the former situation, however, care should be taken not to allow water to stand; and in the latter the rich mould, or surface-soil, should not be washed away. "While the leaves of the coffee-tree delight in frequent refreshing showers, the roots are averse to standing water." With regard to soil, that of virgin forest is recommended as best for coffee culture, simply because it contains sufficient plant-food, and saves the expense of manuring for several years; ordinary soil, however, will answer, provided it contains sufficient plant-food, or otherwise can get a sufficiency of manure. A loose soil is most suitable. The tree will not thrive in stiff clay. Distinct varieties of the plant are known, one of which produces fruit at an earlier age than the other; the berry, also, is smaller. The large variety, however, is preferred, as yielding a superior quality of coffee and a larger crop. This larger variety, again, varies in itself under changed conditions of soil. In the moist lowlands the berry is very large, while in the dry rocky hills, or uplands, it becomes somewhat smaller, but of a finer flavour. The trees on a single plantation produce berries varying in size to some extent. It does not appear to what extent high cultivation would produce a crop of more equable size. It has been proved that planting a nursery with seeds of a uniform size does not produce uniform plants.

Under shade, both the quality and quantity of the coffee crop is much diminished. "When the trees are not large enough to shade the ground with their branches and fallen leaves, they should be mulched in the dry season; that is, their roots should be covered with dried grass, straw, shavings, or anything capable of shading them. But the leaves and branches should have the influence of the sun, to elaborate a due proportion of sap into fruit-buds." The species being indigenous to Liberia, it does not, of course, when once established, suffer from the tropical suns of the country. Mulching in the dry season is generally required for very young trees on dry, hilly slopes.

The distance at which trees are planted from each other varies; sometimes they are placed at a distance of 6 to 8 feet, and others 10 to 12 feet. If planted sufficiently close that their branches meet, provided that these leaves and branches have the influence of the sun, they thrive and bear well. The shade they cast upon the ground also prevents the growth of grass and weeds, and so the expense of weeding is saved. When planted so close, however, some inconvenience is felt in passing among the trees for manuring, pruning, or gathering the crop. When planted even at the distance of 12 feet, if the trees are topped and kept down, they will eventually meet. The small variety before referred to begins to bear at 18 months, the larger form in the third year; this variety has, however, been known to bear sooner. The first crop is usually only a few berries, but the tree goes on increasing until it becomes capable of yielding twenty pounds, and some very old trees have been known to give twenty-four pounds each, but more generally depends upon cultivation than upon age. The tree, if left alone, grows to a height of 20 feet or more. In some plantations they are allowed to grow up without being touched, while in others they are topped, perhaps at a height of five feet. By topping, the crops are more conveniently gathered, and, others things being equal, give a larger crop. When the trees grow up tall, moreover, they are frequently injured by climbing with ladders, and pulling down the limbs, &c., and as the tree ripens its crop and blossoms for the next year at the same time, much of the blossom and young fruit is rubbed off the true, whereas the low trees are picked by standing on the ground.

Owing chiefly to the fact that most of the Liberian plantations are young, manuring is not practised to any extent, but when needed the coffee pulp is used mixed with cattle manure, also decomposed vegetable matter, wood ashes, the "compost heap," the earth from the hills made by white ants, &c. The coffee-tree delights in nitrogenous manures; surface manuring is considered best on account of the fibrous roots, or feeders, always keeping near the surface.

Though there are no very old plantations in Liberia, it is believed that they can be kept up permanently, or at least, for a great number of years. It is pointed out that the coffee plant is not a shrub but a forest tree. There are trees in the country forty years old, flourishing in all the vigour and verdure of youth, and bending down under the weight of berries. Some of these old trees, when cut down, shoot up more rapidly and more vigorously than when first planted from seed.

A most important point is touched upon in the matter of the liability of the Liberian coffee to disease. On this subject, the writer says:—"Last year some of the trees on different plantations were affected with what was said to be the disease *Hemileia vastatrix*. The leaves of the trees turned yellow (although want of cultivation will cause the same phenomenon); there was a tendency in some of the upper branches to decay and dry up the berries before they could ripen. This may have happened before; but it was observed only last year. Occasionally, the bark of a tree will decay, partially or wholly; when wholly it causes the death of the tree. Occasionally, a borer will attack a tree. Nothing as yet has been observed that would cause serious losses in coffee growing in Liberia." The author of the replies thinks "that the yellow appearance in some trees was owing to the want of cultivation. Some of the trees supposed to be diseased were as full of berries as the other trees."

It is further pointed out, in the circular from which the foregoing are abstracts, that it is very desirable that small branches of the tree on which are leaves affected with the disease should be rapidly and carefully dried for transmission to Kew, and to Peradeniya, for comparison with specimens of Ceylon coffee affected with *Hemileia vastatrix*.

VIENNA BREAD.

Professor Horsford, of Cambridge, Massachusetts, says the *Academy*, has recently published (Washington: Government Printing Office) an elaborate report on the methods employed in the manufacture of bread in Vienna, as illustrated at the Austrian Exhibition in 1873. He describes the characteristics of the grain, the art of milling, the making of yeast-bread, and the processes in use in the Vienna bakeries. Some of the woodcuts which illustrate his memoir, such as those representing sections of miller's bran (page 49), and others of barley, oats, rye, and Indian corn (page 70), have evidently been executed with exceptional care. The unusual excellence of the Vienna bread, arising for the most part from the marked superiority of the Hungarian wheat and flour, is considered to be due, not so much to the constant care of the farmer in changing the varieties grown when the slightest deterioration of the quality of the product is detected, as to the dryness and clearness of the atmosphere of the district where the wheat is grown, at the time when the contents of the berry are in the condition technically known as "milk." So dry is the air in the Hungarian lowlands that there is no dew during the summer night; soon after sunrise the temperature rises 74°–77° F., and in the course of the day attains 95°–100° F., remaining at that temperature till nearly sunset. The driest months are July and August, the Hungarian summer being uniformly very dry. For testing the qualities of the flour, the author states that the whole of the nitrogenous substances can be separated from the starch by treatment with dilute acetic acid, and their amount estimated, after the settling out of the starch, by determining the specific gravity of the solution; this appears, however, to be a facile but insufficiently accurate means of arriving at the result aimed at. In speaking of the press-yeast employed in the manufacture of the "Kaiser-Semmel," he quotes the following interesting statistics, which give some idea of the development of this branch of industry during the last thirty years. One firm alsone (Mauntner und Sohn, of St. Mark's) sold in

1846	72,400	Zollver. lbs.
1852	380,600	"
1862	1,144,500	"
1872	3,170,000	"

The problem why bread becomes stale was attacked many years ago by Boussingault, who found that it did not necessarily lose weight by the evaporation of water, but he could arrive at no satisfactory explanation for the change. The author believes that the gluten of the crumb-walls of stale bread, which are stiff and brittle, is dehydrated by the heat in freshening (re-baking), and the water of hydration driven out softens the glucoid, horny starch which coats and penetrates the gluten. Thus softened, the crumb is more palatable, because it is in a condition to be dissolved by the saliva, and tasted. On cooling, the water is withdrawn from the starch, which is thereby rendered stiff, and restored to the gluten, and the bread becomes stale. The author is of opinion that by adopting the methods which he describes in his report, bread of as good quality as that baked in Vienna may be produced in America.

CORRESPONDENCE.

THE TRADE OF TRIESTE.

In your *Journal* of 8th December I find a letter from Capt. R. H. Burton, giving some important corrections of his paper on the trade of Trieste, in answer to my observations of 19th Sept. I notice that he invites my criticism on the second part of the same paper, published in your *Journal* of 22nd Sept.

I shall be glad if you will allow me to say that my intention went no further than to point out certain obvious errors, and to elicit information on one or two other matters, as to which I was apprehensive that there might also be some mistake. The essay is too voluminous for me to find time to test all its statements, nor can I easily command the materials necessary for doing so.

The principle, that statistical data are only valuable as furnishing materials for comparison, whether as regards the same place at different times, or the same time in different places, is one which I think needs only to be enunciated. I may then disregard as of no weight the observation, that "for each inhabitant of the civilised lands there are two-tenths of a league of distance" of electric telegraph; nor need I regard seriously the remark that in 1870 the goods (17½ millions of centners) conveyed by ships and steamers were double the amount of the total railway freightage, described as 16 thousand millions of centners. There must be some error here. But no argument is founded on these allegations.

I cannot but regard the paragraph as to the "credit of Europe and North America in 1871" as of exceedingly small value, having particular reference to the explanation now furnished, viz., that by credit we are to understand "the medium of circulation in general." I fail to see how the "deposits" can be regarded as a medium of circulation; and I entirely disbelieve that the bills of exchange in circulation at any given moment in Europe and North America come to so little as £292,300,000. But it is somewhat difficult to understand from what source the alleged fact has been derived, as even in this country the task of ascertaining the amount of bills in circulation is no light one. Mr. Dun (*Statistical Journal*, vol. xxxix., page 120) estimates the bills under discount in Great Britain in 1874 at 260 millions sterling. Mr. Dun's painstaking paper would well repay a little attention from Capt. Burton. Then the item "clearings," seen in the light of a medium of circulation, ought to be restricted, one would suppose, to a single day: does Capt. Burton imagine cheques and bills for eleven milliards of pounds sterling are ever simultaneously afloat? These comments, all relating to the first portion of Capt. Burton's paper, will convince him that I did not exhaust all the remarks I could make upon it.

The heading of the last column of Table 1 is evidently wrong, Trieste being printed instead of "South Germany." And the second column of Table 6 should, I suppose, be headed "Austria imported through Germany," and not the reverse. I suppose that on page 947 "all the merchants in Bohemia import coffee from the South as they did twenty years ago" is the exact opposite of what is intended to be conveyed. On the same page, near the end, article 9 should seem to be intended to read "The colonial imports into Austria, *viâ* Germany, increased in greater ratio than the mileage of German railways; and the like imports *viâ* Trieste increased in a lesser ratio than the growth of the Austrian lines." Whilst I must sympathise with the merchants of Trieste, if through unwisdom and the effect of private interests the trade of their port is crippled, I think it right to suggest that trade routes are used or abandoned in obedience to many considerations, of which the convenience of railway transport is doubtless one of the most vital, yet not always, perhaps, that which decides the merchant. A ship from the tropics calling at Falmouth for orders has the choice of France, England, Germany, and the Baltic for its place of discharge, and the desire of such a large choice of markets may control a merchant's action.

Thomas A. Welton.

9th December, 1876.

OBITUARY.

Seymour Teulon.—It is with deep regret that the death of Mr. Seymour Teulon is announced, for amongst those connected with the Society of Arts there were few who took a deeper or kindlier interest in its welfare. Mr. Teulon died on the 9th instant, at his residence, Tenchley-park, Surrey. He was 73 years old at the time of his death. He was descended from an old Huguenot family, one branch of which, at least, still exists in France. For a long time he was a Director of the South-Eastern Railway, and took great interest in its working. He was also an active Justice of the Peace for more than one county, and a Deputy-Lieutenant. His connection with the Society commenced in 1861, and a few years afterwards, in 1865, he became Treasurer. On the expiration of his two years' service as treasurer, he was elected on the Council, and afterwards he became a Vice-President of the Society. During the chairmanship of Lord Henry Lennox, he acted with Mr. S. Redgrave, as deputy-chairman. He retired by rotation from the Council of last year, but continued his active service on committees down to the time of his death.

GENERAL NOTES.

Cochineal from the Canaries.—Mr. Vice-Consul Wetberell says that the prosperity of the Island of Grand Canary has undergone a serious decline, principally in consequence of the depreciation of cochineal, now the principal product of the country. Between July 1, 1874, and June 30, 1875, the quantity exported was nearly 3,000,000 pounds. valued at nearly £300,000 sterling. The large profits realised from cochineal in former years led to the exclusive cultivation of the cactus wherever it would grow. The profits were, as a rule, squandered before even they were realised, Soon the value of cochineal declined; but although at last yielding little or no profit, the growers cannot realise the necessity for cutting down the cactuses, which to them represent so much capital, and replacing them with other crops. The production therefore continues to increase in the face of falling prices. In the palmy days of cochineal, it was an object of competition amongst shippers as furnishing almost the only return cargo available in the island. Sometimes therefore they were induced to bid a higher price for it than it was actually worth. But some of them were equal to the occasion; by paying for their cochineal in coin made of platinum coated with gold, which was purchased in Barcelona for 28 per cent. of its nominal value, they got their cochineal at a low price, and added largely to the ruin of the island.—*Pharmaceutical Journal.*

Lighting by Electricity.—Professor William A. Anthony, of the Physical Department, Cornell University, sends the following account of a recent experiment to the *Scientific American*:—"The following is a brief description of my experiments:—To my electro-magnetic machine, which was driven by a Brayton petroleum oil engine of 5-horse power, wires were connected for conveying the electricity produced to a room some 300ft. distant, from which daylight could be excluded, for photometric experiments. In this room, the wires were connected with a Foucault regulator for the electric light, the light being produced by the passage of the electric curve between two carbon points. The electric light being too brilliant for direct comparison with the standard candle, I took from my house a common coal oil lamp, having a flat wick 1 in. wide. The electric light was found to be equal to what would been produced by 234 such lamps. But 234 such lamps would have consumed nearly 16 lb. of oil per hour, while the engine, whose power developed the electric current, which in turn produced the electric light, consumed but 6¾ lb. of oil in the same time. This fact was stated in the paper giving the results of my experiments, merely as showing, in a striking manner, how very small a proportion of the energy of combustion of the oil in the common lamp is utilised as light."

NOTICES.

THE LIBRARY.

The following works have been presented to the Library:—

The Church Builder, 1876. Presented by the publishers, Messrs. Rivingtons.

Saving Life and Preventing Suffering in Cases of Disaster at Sea. By William Smith, C.E. Presented by the author.

Transactions of the Institution of Engineers and Shipbuilders in Scotland. Vol. 19. Presented by the Institution.

A Statistical Account of Bengal. 5 vols. By W. W. Hunter, B.A., LL.D.

The Peasant's Home, 1760-1875 (The Howard Prize Essay, 1875). By Edward Smith, F.S.S. Presented by the publisher, Edward Stanford.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,258. Vol. XXV.

FRIDAY, DECEMBER 29, 1876.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

THE HISTORY OF THE ART OF COACH-BUILDING.

By G. A. Thrupp, Esq.

Lecture I.[*]

The progress of the art of coach-building, like the progress of most inventions and discoveries, has been slow. It certain ages it has seemed to make a sudden start, then again to remain almost stationary for a long time.

It is only during the last two centuries that coach-making has been in a satisfactory condition as an art, and it has arrived at comparative perfection only during the present century. The same, however, may be said of other inventions:—Pendulum clocks were invented about 1260; paper was made from old rags about 1250; gunpowder dates from the year 1330; printing, that valuable aid to the arts, 1430; watches are said to have been first made in England about the year 1500; and the first coach was seen in England in the year 1555, three hundred and twenty years ago.

The history of coaches and carriages is not as extensive as the human race, nor can it be traced among all those nations that have arrived at an advanced stage of civilisation. Ancient America, especially the civilised Mexico, tells us nothing, from China and Japan we gain next to nothing; and only a strip of North Africa contributes to the history of wheels. But Europe, Asia Minor, Hindostan, and Tartary furnish nearly all the information we can glean.

The history of art of coach-making must be divided into several marked epochs. The first terminates with the change of government at Rome from the rule by Consuls to the rule by Emperors, about 2,000 years ago; during this period there was little variation in the vehicles chiefly used. The second epoch terminates with the overturning of the Roman empire, about 1,500 years ago; during that epoch, which was one marked by the display of great wealth, and the indulgence of most luxurious living, several new and larger vehicles were introduced, and many were decorated in a costly manner. The third epoch commences with the introduction of vehicles slung upon leather straps, and may be considered to end about the year 1700, when the use of steel springs began to be understood. The fourth epoch will end in 1790, when coaches began to assume their present form, size, and style. And the last epoch must commence with the introduction of carriages hung wholly on elliptic springs, about 1805, by Mr. Obadiah Elliott. This last and surprising change has been productive of very important results to all interested in the use of carriages or in coach-building. By the introduction of elliptic springs the construction of wheeled vehicles has been rendered less costly, their weight has been materially reduced, and many complicated parts have been abandoned. Simultaneously, the number of vehicles has been multiplied, and their comfort and accommodation has been increased.

We may fairly suppose the first means of locomotion entitled to the name of a carriage to have been a sledge. It would be so natural to place a burden, too heavy for the shoulders, on some slight framework and drag it over the ground. A very little experience would enable a man to judge of the best form for a sledge; and in point of fact, the first sledge of which we find any record, on a sculpture of the Temple of Luxor, at Thebes, in Egypt, is precisely similar to that used by brewers' draymen in London. It has two long runners slightly turned upwards in front, and half-a-dozen cross pieces to unite the runners and bear the burden. Sledges of many shapes and fashions are in use during the winter in most countries where snow lies for any length of time upon the ground, as sledges glide more easily over its surface than do wheels. The Esquimaux and the Laplanders habitually use sledges, all more raised from the ground than the sledge that carries the casks of the brewers. The Swiss and other inhabitants of mountain districts use sledges to bring down hewn timber and faggots to the valleys; and a hundred years ago, when carts were not so numerous, it was common in England to load the new-made hay or sheaves of wheat on light high sledges for transport to the farm yard. In North America and Northern Europe, sledges of elegant shape are every year in use; and in Holland and Belgium, during some winters, not only do the gentry ride in sledges two or three months, but the meat, bread, and vegetables are run through the streets daily on hand sledges.

Egypt is the chief of the countries of which we have any record of the arts and manufactures introduced by the progress of civilisation. Egypt had, at an early period, buildings composed of very large stones; in moving these the sledge and the roller were used; and it is natural that these should be combined to form a low truck, or platform moving on rollers. Later on, wheels and axles were substituted for rollers; at first wheels were slices of the trunk of a tree, all solid pieces of wood, and firmly wedged to the axles. Thus the wheels and axle revolved together below the cart or truck, and were retained in their position by strong wooden pins like the thole-pins or rowlocks of a boat. The wheels and axle revolve together in tramway cars and in railway carriages. Carts are made in this way now in Portugal, Spain, and in South America. All the earlier carts seem to have been fitted only with a pole, and at least two animals seem always to have been yoked together to the vehicle. The objection to the wheels and axle in one piece is, that it is difficult to turn a vehicle thus fitted, in a small space. Any one using a garden-roller round a corner may easily convince himself of this, for whilst the outer edge of the roller is going over the necessary sweep, the inner edge is sliding on, and crushing the gravel walk; it should be moving independently. It was soon discovered in Egypt that it was better to have a fixed axle-tree, and allow the wheels to revolve independently of one another.

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[*] Delivered November 20th, 1876.

A wheeled carriage appears to have been in very general use in Egypt at an early period, called a car or chariot; in the Bible it is usually translated "chariot." There are paintings and sculptures upon the walls of the temples and tombs of Egypt which have lasted 4,000 years, and from those we learn precisely the appearance of these chariots. They are of great interest to us, as they formed the chief means of conveying man for 2,000 years before Christ, and were more or less the type of all other vehicles of the ancient world. We find certain words used in describing them, both by Homer, who lived 1,000 years before Christ, and by Moses, who lived at least 500 years earlier, and that the words are technical terms, such as axles, wheels, naves, felloes, tyres, spokes, &c. Now technical terms imply that the art that had such terms must have existed prior to the writer who speaks of the art, so that, if we hesitated as to the date of the chariots sculptured and painted on the walls of the Egyptian temples, we are reassured by the terms used by the authors we name. Moses, in the description of the wheels upon which moved the great cauldron used by the priest, and Homer, in describing the car of the goddess Juno, used the same terms. We read in the fifth book of the Iliad, "The awful Juno led out the golden bitted horses, whilst Hebe fitted the whirling wheels on the iron axles of the swift chariot. The wheels had each eight brazen spokes, the felloes were of gold secured with brazen tyres all round, admirable to the sight. The seat was of gold, hung by silver cords; the beam or pole was of silver, at the end of which was hung the golden yoke and the golden reins." These cars were occasionally square, but more generally semi-circular or horse-shoe shaped; the rounded front towards the horses was high, the sides lower, the back was open, and the bottom was near the ground, so that it was easy to step in and out. The wheels, especially in Egypt, are very low, from 2 ft. 6 in. to 3 ft. 3 in. in height. The framework of the body was often open, but sometimes closed up with leather skins or basket work, and occasionally with carved wood or embossed metal. The pole by which it was supported curved up from the bottom of the bar to the backs of the necks of the horses or oxen, where it was joined to a wooden yoke, this was again strapped round the bodies and necks of the horses, or tied to the horns of the oxen. The addition of bridles and reins would complete the simple harness. Some horses were attached to the pole by an iron bar with knobs at each end, which passed through a ring at the end of the pole, and through a similar ring upon each of the pads or saddles of the horses. This would be very similar to the curricle bars used in modern time and would allow of more freedom in motion than a fixed yoke would give. The bodies of these chariots, in Egypt at least, were small, usually containing but two persons standing upright. It may be remarked that, as they were so small, they could not have been of much use, and from the small size of the wheels, too, they would be jolted by every little obstacle on the road; and as they were so near the ground, those using them would be exposed to mud and dirt: yet, in spite of these objections, they were used in vast numbers. They were very light, and could be driven at a great speed—nearly as fast as the horses could gallop. They were narrow, and, therefore, suitable to cities in which the streets are still very narrow, and to mountain roads which were often only 4ft. wide. They suited the period and the people, or their usefulness would not have lasted 2,000 years. According to Homer, a strong man could lift a chariot on his shoulders and carry it away. Possibly this would be without the wheels, but even then it could not have been heavier than one of our wheel-barrows. From Egypt the use of chariots spread into other countries, and they were used in war in large numbers upon the extensive plains of Asia. We read of the 900 chariots of Jabin, king of Canaan; that David took 700 chariots from the kings of Syria, and 1,000 from the king of Zobah. Solomon had 1,400 chariots, and his merchants supplied northern Syria and the surrounding countries with chariots fetched up out of Egypt at 600 shekels (about £50) apiece. They were not the first nor the last merchants who have preferred their pockets to their patriotism, and supplied nations who might become their country's enemies with the weapons of warfare. Solomon, we find in the Song of Solomon, built a state or wedding chariot of cedar with pillars of gold, probably supporting a canopy. We may also notice the poetic description by the prophet Nahum of the future state of Nineveh, no longer to echo "to the noise of the chariots raging up and down the paved streets, jostling against one another in the broad ways, with the crack of the whip, the rattle of the wheels, the prancing horses and the jumping chariots;" and the remark in another place of "the stamping of strong horses, the rushing of the chariots, and the rumbling of the wheels," all pointing to the great impression which was made upon the prophet of the wilderness by the carriages and noise of the crowded city. In a museum of New York is a wheel of an Egyptian chariot, found in a mummy pit at Dashour, by Dr. Henry Abbott. It is 3 ft. 3 in. high, the nave is $14\frac{1}{2}$ in. long, and 5 in. in diameter, and worked upon an axle of wood which tapered, and was from 3 in. to $2\frac{3}{4}$ in. in diameter. The unusual size and length of this axle-arm would be very apparent in so small a vehicle as the Egyptian chariot; the spokes, six in number, are 2 in. by $1\frac{5}{8}$ in. at the nave, and taper towards the felloe to $1\frac{5}{8}$ in. round; it has a double rim all round. The six inner felloes do not meet as in modern wheels, but are spliced one over the other, with an overlap of 3 in.; the felloes are $1\frac{1}{2}$ in. square. The outer rim is formed also of six felloes, but they are tenoned together, and are pierced all round the lower edge with small holes, through which, we may well conjecture, leather thongs passed, binding the outer to the inner rim. The total depth of the double rim is $3\frac{1}{4}$ in. by $1\frac{1}{4}$ in. to $1\frac{1}{2}$ in. in width. From the ancient sculptures preserved from Nineveh and Babylon, some of which are in the British Museum, we observe the use of chariots was continued in the great plains, for the purposes of hunting as well as for war. The chariots of Assyria were larger than those of Egypt, and would carry three or more persons; they seem, too, much heavier in the build. The Greeks used chariots, and at the siege of Troy, which Homer has immortalised in his poem, all the chief warriors on both sides are described as going into battle and fighting from their chariots. As years passed on, however, the Greeks no longer used chariots for war, but only for processions in public on state occasions, or in their great races, or for the amusement of their leisure hours. Erectheus, king of Athens, is reported to have been the first to drive four horses in a car; afterwards it became common to use, in the races, four horses attached to each car. The Grecian chariots were all curved in front, and were rather larger and on higher wheels than those used in Egypt.

The Roman nation, as it increased in power, adopted the car, which had also been for many years in use by the Etrurians, a neighbouring country to their own in the Italian peninsula. The Etrurians were traditionally the first to place a hood or awning over the open two-wheeled car; they decorated both the car and the awning with that beautiful tracery and ornamental bordering which is familiar to us from the copies of their pottery. The Roman car was chiefly used in the cities, and for purposes of show and state rather than for daily use. A beautiful marble model of one of these still exists at the Vatican of Rome; a copy of it and the horses drawing it is in the Museum at South Kensington.

Besides the chariots, the Romans had other two-wheeled cars, and four-wheeled wagons of different shapes, and giving different accommodation; but first they were kept for conveying agricultural produce, and for moving goods and baggage, and the better sorts were reserved for the conveyance of the images of their gods and vestal virgins in religious processions. Then came the triumphal processions of successful military commanders, and a variety of vehicles conveyed the conqueror, the captives, and the arms and valuables taken from the enemy. Plutarch tells us that Emilius, the Roman Consul, had 750 wagons in his triumph in the year 170 B.C., bearing the spoils of Perseus, last king of Macedonia. On the column of Trajan at Rome is modelled one of these wagons. It is a large square basket on four wheels, the back a little higher, and the hind wheels also are a very little higher than the front.

Roman history, of the time of Camillus, 350 B.C., mentions a carriage termed a *Pilentum*, as as a splendid four-wheeled carriage with a covering to it, and with seats suspended by straps. The use of these *Pilenta* was allowed as a special favour to a few great Roman ladies. The Empress Agrippina also had a *Carpentum*, an elegantly carved carriage on two wheels, the arched covering of which was supported by four female statues; it was drawn by two mules. The Romans also used *Basternæ*, which were litters or couches with low coverings, carried on poles by horses or mules; and *Lecticæ*, or litters carried by men only. The Roman chariot was called a *Currus*.

Herodotus (450 B.C.), and other writers tell us of the vehicles of the ancient Scythians. These were a race of people who inhabited the country near the Caspian Sea, and wandered about with large herds of cattle and horses. They used a rough two-wheeled cart which consisted of a platform, on which they placed a covering shaped like a bee-hive, and composed of basket work of hazel wood covered with skins of beasts or thatched with reeds. When they were stationary in any part, these bee-hive huts were taken off the carts and placed upon the ground to serve as their dwellings, like gipsy tents.

The war chariots used by the Persians were larger and more unwieldy than those previously built. The idea seems to have been to form a sort of turret upon the car, from which several warriors might shoot, or throw their spears. These chariots were provided with curved blades or scythes projecting from the axle-trees. The Persians had also cars that were used for state processions, in which the king or noble was raised above the crowd among which he passed on a sort of throne of many steps.

The Dacians, who inhabited Wallachia on the Danube and part of Hungary, were conquered by the Romans about the year 300. Their cars are sculptured upon Roman monuments, and resemble the Persian cars. They are on two wheels and drawn by two horses; the shape is that of a large square box or chest, with a smaller box upon it, which formed a seat for the passengers. The spokes of the wheels are six in number, and are widest at the ends supporting the rims of the wheels. A Dacian car of this sort is represented upon a fragment of terra cotta in the British Museum.

Alexander the Great, King of Macedon, invaded Asia and advanced to India; he was met upon the banks of the river Indus by king Porus, in whose army were a number of elephants of large size, and also several thousand chariots; each chariot carried six persons; but the historian notes that in a soft soil or in rainy weather it was difficult for these vehicles to move quickly. On Alexander's return from India towards Persia, he travelled in a chariot drawn by eight horses, on which a square stage or platform was erected and covered in by a tent. His car was followed by an innumerable number of others, covered with rich carpets and purple coverlets; some shaped like shells or cradles were shaded with the branches of trees. I have seen a drawing of a Persian car in which the body is raised above the wheels and seems to swing from pivots like a large cradle, or such a cot as is used on board ship. After Alexander's death a funeral car was prepared to convey his body from Babylon to Alexandria, in Egypt, a distance of several hundred miles, which car perhaps has never been excelled in the annals of coachbuilding. It was prepared during two years, and was designed by the celebrated architect and engineer, Hieronymus. It was 8 ft. long and 12 ft. wide, on four massive wheels and drawn by 64 mules, eight abreast. The car was composed of a platform with a lofty roof supported by 18 columns, and was profusely adorned with drapery and gold and jewels; round the edge of the roof was a row of golden bells; in the centre was a throne, and before it the coffin; around were placed the weapons of war and the armour that Alexander had used. This car was thought so much of that several historians have described it, and there are various plans of its appearance, one of which may be seen in Ginzrot's work on ancient carriages in the British Museum library.

The second epoch of the history of carriages I take to commence at the invasion of Belgium and Britain by the Romans. The ancient Britons had used a car for warlike purposes which was evidently new to the Romans. It was on higher wheels than their cars, it was open in front, and was ascended in the front, instead of, as in their cars, at the back; the pole, instead of sloping up to the horses' necks, went straight out between the horses' bodies, and was broad, so that the driver of the car could stand on it, and if necessary, drive from the end of the pole, or leap out and stand before his horses. It was larger than a Roman car, and above all it possessed a seat, and was called *essedum* from this peculiarity. At times this car was furnished with scythes, which projected from the axle-tree ends. No doubt the same or a similar car was used by the Gauls and Belgians; but the British *essedum* was the best; and Cicero, writing to a friend in Britain, remarks "that there appeared to be very little worth bringing away from Britain except the chariots, of which he wished his friend to bring him one as a pattern."

When Cassibelaunus was taken prisoner by the Romans, they also captured 600 cars and 4,000 *essedarii*, or car drivers and warriors. I think we may look upon this vehicle as the origin of the curricle of later years. It is certain that it attracted great notice among the Romans, and under its own name, *essedum*, and with another of a smaller size and with still higher wheels called *cisium* became the chief and most rapid vehicles upon the public roads, whether in Italy itself, or along the military roads already made into France, Spain, or Germany. Despatches and letters were conveyed with speed and punctuality to the more distant parts of the Roman Empire. The historian Suetonius mentions that the Emperor Augustus established on the military roads active young men at first, and afterwards carriages, to convey his despatches to the governors of the provinces. Besides these rapid conveyances along the public roads, there was the *rheda*, a slow sort of wagon drawn by six or eight mules. Buildings were erected along the main road where these different carriages could be hired. Cicero declares that a message was sent 56 miles in a *cisium* in 10 hours. On a monumental column at Ingel, near Treves, is the representation of two persons riding in a *cisium* with one horse. The vehicle is very much like a gig.

Under the Emperors of Rome, the number of kinds and shapes of vehicles increased; but from the vague manner in which the writers of the period speak of them, it is difficult to enter into minute descriptions. The height of the wheels increased. At the capital of Rome, the Emperor, Marcus Aurelius, is represented in a car of triumph, the wheels of which are as high as the backs of the horses. Sir William Gell, in his work on the ancient city of Pompeii, which was destroyed in the year A.D. 79, mentions that three wheels had been dug out of the ruins in his day—very much like our modern wheels—a little dished, and 4 ft. 3 in. high, with 10 spokes, rather thicker at each end than in the middle. Sir W. Gell also gives a well-known picture of a cart used for conveyance of wine in a huge skin or leathern bag; it is a four-wheeled cart, with an arch in the centre for the front wheel to turn under. The pole in this painting appears to end in a fork, and to be attached to the axle-bed. As the wealth of the Romans increased, so did their desire to use comfortable and highly decorated carriages. For many years what are called "sumptuary laws" existed, which regulated each citizen's dress, furniture, and ornaments, according to his rank and consequence, and these laws restrained the decorations upon private carriages.

The Emperor Alexander Severus, however, issued a decree, "that anyone might decorate his car as he pleased;" and the number of vehicles in use rapidly increased. We find upon monuments many different shaped cars of the time of the Emperors, chiefly processional cars, lofty and highly ornamented, evidently adorned with embossed and chased work in metal, rich carvings, drapery and cushions. On the columns of Theodosius, at Constantinople, are some specially handsome cars on two and on four wheels, with door-like openings in the sides of a square shape. On the arch of Constantine, at Rome, are several cars. Sufficient evidence, however, exists, that for nearly 500 years, during the reign of the different Emperors of Rome, the art of coach-building must have been a good and important business. Besides the ordinary artisans, the woodmen, the wheelwrights, and the smiths, there must have been plenty of employment for the carvers, painters, chasers, embossers, embroiderers, and trimmers.

Homer, as I have mentioned, tells us that the seat of Juno's car was slung upon cords, to lessen the vibration and jolting attendant upon a car without spring or braces; and it is certain that the Roman Emperors were not better off for comfort or ease than Juno was, unless we except one sort of carriage which is described as borne on long poles, fixed to the axles. Now, a certain amount of spring can be obtained from the centre of a long light pole. The Neapolitan Calesso, the Norwegian Carriole, and the Yarmouth Cart, were all made with a view to obtaining ease by suspension on poles between bearings placed far apart. In these the seat is placed midway between the two wheels and the horse, on very long shafts, which are thus made into wooden springs. In the old Roman carriages the weight was carried between the front and hind axles, on long poles or wooden springs. The under-carriage of the latter four-wheeled vehicles used by the Romans, was, in all probability, the same as is in use in the present day, both in this country and on the Continent, and in America, for the under-carriages of agricultural wagons. There is a work on this subject of ancient carriages which was published at Munich, in 1817; it was prepared by John Christian von Ginzrot, who was an inspector in the office of the Master of the Horse of the King of Bavaria. A few copies of this work exist still, but only in the German language, and not easily accessible to the public. This author gives the Greek and Latin names for the pole, perch, wheel-plate, and other technical terms of carriages so fully as to leave no doubt that coach-building was well understood by the Romans. He also gives a plan of a four-wheeled dray, used by the Romans for conveying casks of wine, which is identical with the drays used now in Vienna and Munich. If his authorities are sound, we may be satisfied that the art of coach-building, as far as the under-carriage works, and the making of agricultural wagons, was as forward in the days of the Cæsars of Rome as it is to this day in central Germany.

We will, however, quit ancient carriages for those now used in Asia. In Hindostan are a great number of vehicles of native build. It has been frequently remarked that there is little change in the Eastern fashions, that tools and workmen are precisely as they were a thousand years ago, and the work they produce is precisely the same. In examining, therefore, what is done now by Indian coach-builders, we are probably noticing carriages of a similar, if not identical, sort with those in use 3,000 years ago. The commonest cart in Hindostan is called "hackery" by Europeans; it is on two wheels with a high axletree-bed, and a long platform, frequently made of two bamboos, which join in front and form the pole, to which two oxen are yoked; the whole length is united by smaller pieces of bamboo tied together, not nailed. In France, two hundred years ago, there was a similar cart, but the main beams terminated in front in shafts; in neither the cart of India nor of France were there any sides or ends; the French cart is called "Haquet;" it is probable that the French, who were in India as well as ourselves, may have given the term "hackery" to the native cart, which was so like their own. The native name, however, is "Gharry." Other carts have sides made by stakes driven into the side-beams; the wheels are sometimes of solid wood, or even of stone. Wheels are also made by a plank with rounded ends, and two felloes fitted on to complete the circle. Again, wheels are made like ours, and also with six or eight spokes, which are placed in pairs, each pair close to and parallel with one another. If a carriage for the rich is required, the under-work are like those of a cart, but the pole is carefully padded and ornamented with handsome cloths or velvet; the sides of the body are railed or carved, and the top is of a very ornamental character, similar to the howdah of state that is placed on an elephant. It has a domed roof, supported upon four pillars, with curtains to the back and sides. The passengers ride cross-legged under the dome, on pillows. The driver sits on the pole, which is broad at the butt-end, and he is screened from the heat by a cloth which is fastened to the dome roof and supported upon two stakes which point outwards from the body. A variety of different shaped native vehicles may be seen in elaborate models in the India Museum, at South Kensington; although they do not show much originality in design or beauty of execution, and are said to be really creaking and lumbering affairs. When the Hindoos wished for a four-wheeled vehicle, the plan appears to have been to hook on one two-wheel behind another, connecting them with a perch-bolt, and upon the hindermost they placed the body. There is a singular addition to their vehicles outside the wheels; a piece of wood curved to the shape of the wheel is placed above it, frequently supported by two straight uprights from the end of the axle-tree outside the wheel; this acts as a wing or guard to keep anyone from falling out of the vehicle, and also the dress of the passengers from becoming entangled in the wheel. In addition, a long bar of wood, rather longer than the diameter of the wheel, curved in the shape called "cupid's bow," is fastened to the axle-tree, the linchpin being outside of it, and the ends of the bar tied to the ends of the wing by cords. I imagine it to be placed in order to be a safeguard for the people in crowded streets, who might be pushed by the throng against the wheel. It will be seen in many of the models, and I have seen it also in ancient drawings of India and Persian vehicles. Many of the carts, which are designed to carry heavy loads, have a curved rest from 20 in. to 30 in. long attached to the lower-side of the front-end of the pole; this serves not only as a prop whilst the vehicle is being loaded, but, should the oxen trip and fall, it supports the cart, and prevents the load, yoke, and harness from weighing down the poor animals as they struggle to recover themselves. In England we have very few of these humane contrivances; we have, however, short rests to prop up a hansom-cab when not at work. In India there are several huge unwieldly structures on wheels called "idol cars;" the name of the car of Juggernaut must be familiar to many. The wheels of some of these are enormous blocks of stone shaped and drilled for the work. In the Indian Museum there is a photograph of an idol car from South India, in the district of Chamoondee and the province of Mysore, which deserves examination. The car appears well proportioned, and the ornamental carvings are beautiful in design, and would bear comparison with most European work.

The *Hecca* or *Heka* is a one-horse native car, resembling an Irish car; it consists of a tray for the body, fixed above the wheels on the shafts, and has a canopy roof; the driver sits on the front edge of the tray, and the passenger cross-legged behind him. The *Shampony* is the usual vehicle for women, which resembles the former, but it is larger; the wheels are outside the body, and it is drawn by two bullocks; the canopy roof is furnished with curtains that are drawn all round, and the driver sits on the pole in front of the body. All these native vehicles have wooden axles, which, until recently, I am told, were used without grease, from the prejudices of the people forbidding them to use animal fat. Some used olive oil or soap, but in most large towns there are now regulations obliging the natives to use some substance to avoid the noise and creaking of the dry axles. The commonest carriages in Central India are called "Tongas," but the universal native word for a vehicle is "Gharry." In Calcutta are several coachbuilders of repute, who employ large numbers of native workmen; Messrs. Dyke employ 600, Messrs. Stewart and Co., 400, and Messrs. Eastman, 300. The men are chiefly Hindoos, and are clever and industrious, but have a singular habit of sitting down at their work. The labourers, who have to use grease, are all Mahommedans. The wages vary from sixpence to two shillings per day.

A representation of a primitive vehicle, which was in the use of Hungary not very long ago, is given by Von Ginzrot as representing the Roman *rhedum*. It is very curious, and just such a primitive affair as might be made in any country. The body is a disguised wagon; the tilt top has two leather flaps, to fall over the doorways; the panels are of wicker work, such as was in common use for carriages both in Greece and Italy; and of such a character we may suppose the wagons were which were used by the many wandering tribes that, in the times of the Roman empire, poured out of Asia and Russia, and invaded Germany, Gaul, and Italy. In the history of Julius Cæsar's wars in Gaul, we are told of the large number of wagons which the savage wandering tribes possessed.

Another primitive vehicle is the Turkish "Araba," used for the conveyance of women. The lattice work admits air without too much light. The singular wing-guards over the wheels identify this "Araba" as being derived from the same source as the carriages of Persia and Hindostan. These vehicles have been superseded in many parts of Turkey, Asia, and Egypt by carriages sent from the West of Europe.

In 1860 a carriage was made for one of the ladies of the Sultan's harem, which consisted of silver as far as possible. It cost, it is said, 2,000,000 Turkish piastres, about £15,000; a very expensive present for the ruler of Turkey to make to one out of many wives.

To speak of one more primitive carriage. Dr. Edgeworth describes some cars which were in use in his time (that is in 1800) in Ireland, as the common vehicles of the country. They were composed of shafts with cross bars; two low wheels of solid wood were wedged on to the axle-tree, so as to form one piece, like a railway axle and wheels; they were nearer together than the shafts, and ran inside the shafts; the axle projected beyond the wheels, and moved in sockets beneath the shafts. These cars, Dr. Edgeworth says, "cost only four guineas, including painting; they would follow a horse anywhere, they could scarcely be overturned even with bulky loads, they were light and easily moved by hand, their repair was easy, and they lay so near the ground that they could be easily loaded and unloaded; the whole would turn in a very small compass." It is probable that these were the primitive cars of Ireland. The nearest approach to them in the present day are the costermongers' barrows. We have noticed how light and simple are these vehicles, and that a wretched pony or donkey will canter along with three or even four persons sitting upon them. They also resemble the Yarmouth cart, in which the wheels are inside the shafts; but then the difference is that the shafts of the Yarmouth carts are of great length, and the load is carried between the horse and the wheels instead of over the wheels, as is usual in a cart. In some parts of Wales cars are used of this construction, and are also supposed to be the primitive cars of that country; their wheels are solid. In Yarmouth this shape was adopted to suit the very narrow streets or alleys, which a cart made with the wheels outside the shafts could not traverse. The great length of the shafts is occasioned by the necessity of carrying a quantity of goods, such as barrels or sacks, which would tend to make the vehicle top-heavy if piled up above the wheels.

The Irish jaunting car, as now built, is superior to the vehicle of 40 years ago. It was then on lower wheels, and being hung lower, the shafts pitched up in front, and the unfortunate passengers were huddled upon one another at every jolt in the road. This car was very light, a great benefit for the horse; it is easily turned and moved in a crowded thoroughfare, and is capable of conveying more luggage than might at first be supposed. The car is no doubt very cheap, and perhaps more Irish drivers are able to own their own cars than are the drivers of London cabs. Irishmen, perhaps, like the vehicle to which they are accustomed, but it will never become popular in this country.

The car, however, used in Cork, is still more uncomfortable; it is an inside-car, that is, instead of sitting back to back, you sit face to face, and to most there is a hood or tilt; a very good vehicle no doubt for two persons at a slow pace, but with four persons at a trot it is the worst vehicle I had ever the misfortune to enter. If the Cork car was hung on higher wheels, and the shafts kept parallel to the ground, it would be a better vehicle; if, however, it cannot be balanced properly, it should be placed upon four wheels, like the inside-cars of the North of England.

I will mention one more primitive vehicle,—the cart with a tilt, with side windows, and a door behind, which is called a Coburg, and is used in the south-west of England; when on good springs, it is a very cheap and comfortable vehicle. In Belgium and Holland it is much used, and is usually built of a larger size than in England. It is, however, after all, rather like a bathing-machine on wheels. It is to be found pictured in our earliest illustrations of vehicles in old English illuminated manuscripts, differing from the modern Coburg only in the want of a door and springs.

In reviewing what I have laid before you as to ancient carriages, I would say, that any one who desires to learn more about them can do so in the pages of the *London Carriage Builders' Art Journal* for 1859 and 1860, which appears to contain much of the information given by the German work of Von Ginzrot. It is interesting to observe the character of the different people illustrated in their carriages. The Egyptians, with all their learning and skill, appear to have made no change during centuries of experience; as at the beginning, so at the end, the kings stand by the side of their charioteers, or hold the reins themselves. The Persians and Hindoos introduced luxurious improvements, and in lofty vehicles elevated the nobles above the heads of the people, and secluded their women in curtained carriages. The Greeks introduced no new vehicles, but perfected so successfully the useful wagon, that their model is still seen throughout Europe, without change of principle or structure. The Romans, on the other hand, in their career of conquest, gathered from every nation what was good, and, wherever possible, improved upon it:—From Greece, the wagons; from Persia, the *harmamaxa* and elevated triumphal cars; and from Hungary, the *rheda*. We may well add that the genius of the Roman nation speaks through Cicero, when he wrote, "I hear that in Britain are most excellent chariots; bring me one of them for a pattern."

MISCELLANEOUS.

ADULT INSTRUCTION THROUGH PUBLIC MUSEUMS.

(Subsidised by Parliament.)

The following results, giving important information bearing on public education, are obtained as correctly as possible, from inquiry and Parliamentary returns, in the hope that they may hereafter be officially collected and published periodically, like the Registrar-General's returns. The number of visitors for the month of November, 1876, are stated. When they are counted by sight the letter "S" is used, when by turnstile the letter "M":—

Institutions.	Amounts voted in 1876.	Number of Visitors in November.	How counted.	Observations.
1. British Museum	£ 108,947	32,793 (1)	S	Return refused. Open Mondays, Wednesdays, Fridays, and Saturdays. Closed, except to students, on Tuesdays and Thursdays. (1)
2. National Gallery, Charing-cross	6,898	126,191	S	Open Mondays, Tuesdays, Wednesdays, and Saturdays. Closed on Thursdays, and Fridays. Open from 10 to 4.30. (2)
3. Kew Gardens and Museum ..	22,622	..	S	Open on Sundays and week days. (3)
4. South Kensington Museum ..	39,058	57,308	M	Open Morning and evening till 10, on Mondays, Tuesdays, and Saturdays. Students' days—Wednesday, Thursday, and Friday, 6d. entrance. (4)
5. Bethnal-green Museum	7,200	266,820	M	Ditto. (5)
6. National Portrait Gallery, South Kensington	2,000	..	M	Return refused. Open daily except Sundays. (6)
7. School of Mines and Mining Record Office, Geological Museum, Jermyn-street..	8,947	2,850	M	Open daily, except Sundays and Fridays, and in the evenings till 10 of Monday, Tuesday, and Saturday. (7)
8. Patent Office Museum, South Kensington	..	13,676	M	Open daily, except Sundays. (8)
9. Edinburgh National Gallery..	2,100	..	M	(9) Closed for the month.
10. Edinburgh Museum of Antiquities	..	..	M	(10) Ditto.
11. Edinburgh Museum of Science and Art	10,320	25,424	M	Open daily (10 a.m. to 4 p.m.) except Sundays, and Friday and Saturday evenings (6 to 9). Students' days—Monday, Tuesday, and Thursday; admission 6d.; other days, admission free. (11)
12. Edinburgh Botanic Gardens ..	1,750	2,156	M	(12)
13. Dublin Museum of Natural History	1,742	8,157	M	Open daily, and in the evening. (13)
14. Glasnevin Botanical Gardens and Museum	2,224	4,103	M	Open daily, including Sundays. (14)
15. National Gallery of Ireland ..	2,339	5,411	M	(15)
16. Museum of Royal Irish Academy, Dublin	300	..	M	(16)
17. Zoological Gardens, Dublin ..	500	2,317	M	Open daily, including Sundays. Number of visitors in July, 15,281. (17)
18. Tower of London	1,590	15,075	S	Open daily, except Sundays. (18)
19. Royal Naval College, including Greenwich Painted Hall	38,051	15,543	S	Open daily, including Sundays. (19)
20. Royal Naval Museum, Greenwich	1,055	2,247	S	Open daily, except Fridays & Saturdays. (20)
21. India Museum, South Kensington	..	1,290	M	Paid for by Indian Government. Open on Mondays, Tuesdays, Fridays, and Saturdays, 1d. admission; on Wednesday and Thursday, 6d. admission. (21)
22. Hampton Court Palace	7,475	..	..	Open on Sundays, and on week days except Fridays. (22)

NOTES.

(1) The numbers are those for the corresponding months of last year, as given in the Parliamentary return.

(2) 17 public days, from 10 to 4 o'clock.

(9) (10) (12) (16) No information as to opening.

(22) As far back as 1855 returns of the number of visitors were made to Parliament and printed, but this practice, for the present t least, has been suspended. The statistics published by the Board of Trade every three years give returns.

LOCAL MUSEUMS.

These institutions are being gradually established throughout the country in different forms. In some places they are connected with Schools of Art, and to some degree indirectly subsidised from the public funds. In other places they are supported by a rate obtained under Ewart's Act. In other places, again, they are partially endowed, as at Liverpool. Rules for admission vary. Birmingham is, perhaps, distinguished above other places by opening both its Public Library and its Museum on Sunday afternoons, after three o'clock. For two years past returns relating to Local Public Libraries, ordered by the House of Commons, have been in preparation, and it may be hoped that in the next session of Parliament they will be printed and circulated. In the meantime the Council of the Society of Arts request that any information about local museums, especially as regards the number of visitors, may be furnished, in order that it may appear monthly in the *Journal.*

NOTES ON SOME OF THE PHENOMENA OF PLANT LIFE.

By **W. B. Hemsley.**

In a former article (*ante* page 15) some of the phenomena of vegetable nutrition, or the sources of some of the principal elements of the food of plants, were considered; here it is proposed to treat of the growth of plants. By growth, lengthening and enlargement are to be understood. Of course in the small space that can here be allotted to the subject, an exhaustive treatise is out of the question, but without entering into technicalities, it is possible to give, in a few sentences, a tolerably clear idea of the laws of growth in the vegetable kingdom. In the first place it is necessary to explain the nature of the substance of plants, and some of their physiological peculiarities. All parts of all plants are built up of a number of minute cells or hollow sacs, various modifications in the size and shape of which constitute the different tissues, as the collective masses of cells of the same kind and different kinds are termed. Different kinds of tissue are present in certain parts of plants, each kind exercising its special function, but an intimate connexion exists between all the modifications of the cell. Although in plants (flowering plants, at least) there are different, usually easily distinguishable parts, which we term root, stem, leaf, flower, and so on, there are no special morphological adaptations or separate organs in the sense that we understand them in the animal kingdom. Thus there are no special respiratory, digestive, excretory, and other organs; nor are the veins and nerves, as they are called, of leaves, analogous, either in their structure or function, to the veins and arteries of animals. Indeed, the same parts of plants perform different functions simultaneously, or at different stages of their existence. It has already been pointed out that one of the fundamental distinctions between plants and animals lies in the form of nutrition. Plants take up no solid food, and, therefore, the morphological adaptations are limited to provisions for the chemical changes of the liquid and gaseous elements absorbed, and their diffusion through the living and growing parts of the plant. But since the growth alone of plants is to be the subject of this article, the mode in which the food is transferred to the parts of the plant where it is required, and the actual process of fixing it in the growing parts, must be dismissed in a few words. By a process of diffusion, the food assimilated in the leaves or other green parts is conveyed to the points where growth is actually going on, or where, under certain conditions, growth will take place; for example, to the buds which will next year grow out into shoots, or to the seeds in the seed-vessel which will in their turn become separate individuals. The vegetable cell in all its modifications is always very small, and usually exceedingly minute, and to the microscope we owe our knowledge of its innumerable forms, and the mode of its origin and growth. The active living cell consists of wall and contents. The wall is composed of carbon, oxygen, and hydrogen, forming a ternary compound termed cellulose, enclosing, besides other substances, a quaternary compound, in which nitrogen is the fourth element. This is the protoplasm, or vital substance mentioned in the previous article, and the proximate cause of growth. Disregarding a few exceptional cases, one of which will be mentioned further on, growth takes place by the division of existing cells. The contents separate into two agglomerations between which a double cell-wall is formed of cellulose, thus forming two distinct cells, each with its own wall, though closely united to each other. The cells thus formed increase in size until they reach their normal dimensions, when they in their turn again divide, and thus growth goes on. Here it may be well to point out that, broadly speaking, the differently shaped cells form only two fundamental kinds of tissue—cellular and vascular. The cells of the former are of various shapes, but not much longer than broad, and constitute the soft parts of plants, whilst those of the latter are commonly long and narrow, forming the woody or hard parts of plants, including the veins of the leaves. We may now endeavour to trace the growth of a plant, from its earliest inception in the ovary (future seed-vessel) of the parent individual. Take the common pea, for example. In a very early stage of the formation of the pod, a number of cellular projections appear on the inside. These are the ovules or eggs (incipient seed) of the plant. In course of time one of the central cells of the ovule becomes differentiated, and within this cell one or more separate free cells are formed. These are termed the embryonic vesicles. But the contents of one of these embryonic vesicles must be impregnated by the male element before the ovule will develop into a perfect seed, containing an embryo (plantlet). After impregnation has been effected, the embryo (plantlet) is formed by cell division, according to some definite plan. Simultaneously, a flow of nutrient subtances to the ovary takes place, and these are stored up in the seed for the use of the future plant in the earliest stages of its growth. Sometimes, as in the pea, the whole cavity of the seed is filled by the plantlet, which consists, in this case, of two thick bodies, called the seed-leaves, or cotyledons, and rudiments of the future root and stem. But there are many plants in which the embryo is very small, and embedded in a solid substance which occupies the remainder of the cavity within the shell ovuline of the seed. The only real difference in the condition of things is that in the one case the seed-leaves have absorbed all the nutrient substance in the seed in the embryo stage, whilst, in the other, very little is absorbed, the remainder being used by the plantlet as soon as it begins to germinate (grow). Now, every perfectly matured seed contains a passive vital principle, or germ of life, which, like the vitellus of a bird's egg, becomes active under certain conditions. Usually, however, in plants, the embryo retains its germinating power much longer than in animals, and in this state it will bear a much wider range of temperature than the actively growing plant. Of this fact we have recently received a most remarkable confirmation by Dr. Belgrave Ninnis, one of the members of the Arctic Expedition, who succeeded in growing wheat from seeds left exposed in the Arctic regions, four years previously, by the *Polaris* party. Another instance may be given. The mature or flowering bulbs of the beautiful Cape *gladioli* are killed by little frost, whereas the tiny bulblets formed around them will withstand our winters unharmed on the surface of the ground, and eventually develop into flowering bulbs. Here then we have a wonderful provision for the perpetuation of a plant. It is also worthy of note that the seeds of most of our native plants lie dormant in the ground until the warmer temperature of spring stimulates them inte growth. Sometimes, on the other hand, unusually warm weather in the autumn or early winter will cause some of the seeds to germinate, but not to make sufficient growth to withstand the cold of winter. The conditions subject to which seed will germinate are heat and moisture, varying in degree and quantity according to the species. Different species present widely diverse constitutions. De Candolle, the celebrated French botanist, has recently made a number of experiments to determine the temperatures most favourable to the germination and development of the seeds of various plants, as well as the sum totals of heat required by different species to attain maturity. The common mustard, *Sinapis alba*, will germinate at, or a little above, 32° Fahr. in seventeen days, and in a shorter period as the temperature is increased up to 70°, at which temperature it will germinate in less than twenty-four hours. Above this temperature, each increment was more and more unfavourable, until at 104° not a single seed germinated. Taking tho melon as an example of a tropical type, he found the lowest temperature at which it would germinate to be about 61·5; but from 66° to 75° was the most favourable heat, and above 82° the temperature appeared to act detrimentally. *Sesamum orientale* germinated in ten-and-a-half hours, at a heat of 104° to 105°. Number 3,935 in the Loan Collection is an apparatus employed for various purposes, in which a constantly uniform temperature is required, among others, for determining the germinating power of agricultural seeds. When seed is committed to the ground under suitable conditions of heat and moisture, the contents of the cells undergo certain chemical changes, cell-division takes place, and roots and leaves are formed which absorb and keep up the supply of nutrient substances required. The main point to remember is that every growth is the result of previously stored up materials. This may be proved by causing seeds to germinate in a medium, from which they can derive no nourishment beyond that stored up in themselves. Large trees, too, will sometimes continue to grow for some time after being felled, that is until the supply of food is exhausted. So far, only the mode in which the substance or frame of a plant is built up and increases has been considered; it now remains to point out where growth takes place, and the manner in which our trees increase in height and size of trunk. There is an essential difference between the growth of plants and animals, taking oak or any other of our common trees as a type; and a knowledge of this difference would have prevented an enthusiastic American telling us that, on returning to his native place after many years absence, he espied high up on the trunk of a tree the initials he had cut when a boy some few feet from the ground. In animals the limbs grow throughout their entire length, and not merely at the extremities, until the individual has attained its full size; consequently, in the human species the knees may be as far from the feet at the age of eighteen years as the head was at the age of as many months. Without asserting that the trunks of trees do not grow at all throughout their entire length, it may be safely stated that it is so slight as to be inappreciable, and any person returning to a tree known to him only in his childhood would be more struck with the apparent lowness of the branches, which in his boyish days required some climbing to reach. It is true that a given spot on the trunk of a tree may be a little higher ten years hence than it is to-day, though this may be due to some other cause than lengthening out. Indeed, this has been observed of trees growing in crevices of hard rocks, in consequence of the increase in the diameter of the principal roots. If we plant an acorn, and occasionally examino the tree springing from it, we shall, as early as the second year, become aware of two kinds of growth, an apical and a lateral. During the growing season of the first year a single stem will make its appearance, with the leaves at first very close together, the spaces between them increase gradually in length, until growth ceases and the leaves fall off. The following spring another period of growth commences, with the result, under favourable circumstances, that the stem increases in height by a second shoot (or continuation of the first), which lengthens, telescope-like, just as the first year's shoot did. With regard to the first year's growth, there will be an increase in its diameter but not in its height, and this holds good for each successive growth to the ultimate branchlets of the largest oak or beech. This fact is so easily confirmed that further comment would be superfluous. Briefly, the trees of our woods exhibit two apparently different but essentially tho same kinds of growth—new shoots elongating throughout their whole length, and new layers of wood on previous years' shoots, branches, and trunks, which merely add to their diameter. These additional growths appear as successive slender cones, each one adding to the length and size of the axis formed by them collectively. In most of our trees they appear as rings in a cross-section, the number of which indicates the age of the tree at the height or part where the section is made. Hence, if the real age of a tree be required the section must be taken from near the ground. In palms the mode of growth is quite different; the trunk scarcely increases in size, but merely grows taller. Here the hardest wood is near the circumference of the trunk, just the contrary to what obtains in the oak. A few words now respecting the rate of growth, and the force exerted by the growing tissues of plants. Two or three ingenious contrivances for registering the velocity of the growth of the plants are exhibited at South Kensington. In principle they are esentially the same. A thread is attached to the tip of the growing stem, and passed over a pulley and kept stretched by a small weight at the other end. As the shoot lengthens the weight descends, and a long index on the revolving wheel of the pulley decribes an arc of sufficiently large dimensions for purposes of observation. How far growth (mere extension) and the formation of cells coincide it is difficult to say; and perhaps cell-division is least active during the actual period that extension takes place. But even if there are alterations of cell-formation and cell-distension, the formation of cells is incredibly rapid in some plants at certain seasons. Some trees, such as the yew, grow very slowly; whilst others, some of the poplars, for example, attain the dimensions of large trees in thirty or forty years. Among sub-tropical and tropical plants we have many instances of much more rapid growth; thus some of the bamboo will attain a height of sixty or seventy feet in a less number of days, and the lofty flower-shafts, *Agave americana*, spring up no less rapidly.

The expansive force of growing vegetable tissue is something marvellous. Even the apparently soft cellular fungi will lift enormous weights; and almost every reader must be familiar with some records of their displacing huge flagstones or bursting the arches of cellars. About two years ago, Mr. W. S. Clarke, president of the State Agricultural College of Massachusetts, assisted by a number of the officers and students of the college, conducted a series of experiments to ascertain the expansive force of vegetable tissue. It would occupy too much space to describe the experiments in detail, and the apparatus employed; but the results may be summarised in a few words. The plant employed for the purpose was the mammoth pumpkin, *Cucurbita maxima*. The fruit was the part confined to test the force. The seed was planted on July 1st, and the plant grew with such extraordinary rapidity, that by August 1st, the first female flower was artificially impregnated. The young pumpkin immediately began to enlarge, and on the 17th it measured 27 inches in circumference. It was then confined, and connected with an apparatus for measuring its lifting power. The weight lifted increased from 60 lbs. on August 21st, to 500 lbs. on August 31st. By the end of September it raised 2,015 lbs., and on October 24th, the weight was increased to 4,120 lbs. The last weight was 5,000 lbs., but this was not clearly raised, though it was carried ten days, on account of the breaking of the apparatus. The root system of this pumpkin plant was something extraordinary. After carefully washing away the earth from it was measured in all its ramifications; the entire length being calculated at 15 miles. It was also estimated that 50,000 feet of roots must have been produced at the rate of 1,000 feet or more per day. A second plant of the pumpkin in the same bed was cut off close to the ground, when eight weeks old, and attached to a mercurial gauge to measure the pressure of the sap. The maximum force attained was equal to a column of water 48·51 feet high. Numerous other experiments in the same branch of inquiry might be quoted, but they reveal only the same phenomena in different plants.

CORRESPONDENCE.

COFFEE HUSK.

I think Dr. Badger must have made a mistake with regard to a beverage from "Coffee husk." The coffee-tree bears a fruit resembling the cherry, and when ripe is of a deep red colour. We have first the pulp, then the parchment surrounding the two beans, then the silver skin, and then the two berries; but on nearly every tree there are a few of the fruit which contain but a single berry, generally small and deformed, called pea-berries, which realises here about 10s. to 12s. per cwt. more than the best quality of the usual sort.

The plantations in Ceylon run into hundreds of acres, the coffee is cultivated on hill sides, and all dropped berries are viewed in the same light as a hat which blows overboard—costs more to recover than it is worth. When ripe, the berries are gathered from the trees, are put into heaps, where they ferment and decompose, and after 24 hours the pulp is removed by washing. The beans enclosed in parchment are dried for about three days, and are then sent to Colombo, where, by means of special machinery, the parchment and the silver skin are removed from the berries, which are of a bluish colour, when they are ready for shipment.

Mocha coffee, on the other hand, is cultivated in very small fields of a few acres in extent, and on level ground; the fruit is allowed to remain on the trees until they drop, and is gathered from the ground. As the climate is very hot, the pulp of the fruit shrinks and becomes rather hard, and then, by the primitive method of pounding by hand, the berries, of a light grayish colour, are separated from the silver skin, the parchment, and the dried pulp, at one operation.

Putting aside mere arrangements, the four constituents are in almost the same proportion as the white of an egg, the hard shell, the thin inner skin, and the yolk. It would require a very large quantity of fruit to yield a small quantity of parchment and silver skin, the amount being about 1 per cent., and, consequently, the infusion spoken of by Dr. Badger could not have been from these, for it was freely used; though a German gentleman, about two months ago, offered for sale in the Hamburg market a preparation from the parchment, which he stated considerably improved the flavour of coffee when added to it. As for the pulp, the opinions of planters in Ceylon and South India are all in one direction; some say it is of a "sickly, saccharine flavour;" others call it "nasty;" and others term it "muck." If, therefore, by the word "husk" Dr. Badger means the dried pulp (for the parchment adhering to it is of infinitesimal amount), then he asserts it to be pleasant, while in Ceylon and India it is held to be the very reverse.

Perhaps his mistake has arisen from the fact that, to distinguish between the Ceylon and Arabian methods of obtaining the berry, the former is commercially known as "washed coffee," and the latter "husked coffee." Many persons, and notably the French, affirm that the Arabian method of obtaining the bean is the best, and makes the most superior coffee, as it ought reasonably to be expected to do; for, if the berry derives its growth and peculiar properties from the outer portions of the fruit, the more time is allowed to the berry, the more it would extract and absorb to itself the prized flavour of the fruit, leaving all the other constituents of less worth so far as the peculiar flavour of coffee is concerned. This of itself shows that, if the Mocha coffee bean is superior in flavour, the residue ef the fruit must be correspondingly inferior to the pulp of the fresh gathered fruit as in Ceylon, where, at its best, and from a superior kind of coffee tree, it is very lightly esteemed. Be this as it may, if "husked coffee" is superior to "washed coffee," it does not necessarily imply that the Arabs make a pleasant beverage from "coffee husk." Perhaps, like many of the natives in the East with whom the Arabs do much trade, they prefer the beverage from "coffee leaf," as to which there is much evidence, and notably that of Mr. Alexander, of Brisbane, who exhibited some at the exhibition there, as quoted in my first letter "far preferable to that from the berry." Unless Dr. Badger, therefore, has the evidence of his own eyesight, and at the stages antecedent to its appearance as a beverage, it appears to me that he must have made some mistake; but if sure of his fact, it ought to be of some value to Ceylon planters, who at present deem it of so little value that they scarcely take the trouble to use it as manure. Any additional source of profit would be gladly received by them, the more especially that during the past few years the plantations have been ravaged by the "coffee-leaf disease," brought about chiefly, I believe, by the method practised in plantations of severely dwarfing and pruning the trees, which correspondingly prevents the roots from extending far and wide, and surface manuring, which causes the side roots to tend upwards and towards the enriched portion of the soil, so long as there is no drought, on the exhaustion of which the trees, with enfeebled constitutions, "mysteriously" fall a prey to every passing epidemic, to the great grief of all dependent thereon. A lamentable illustration of the proverb, "the more haste (to obtain plentiful crops of berries in Ceylon and other things in England) the worse speed."—I am, &c.,

J. F. D.

December 20th, 1876.

NOTICES.

JUVENILE LECTURES.

Two lectures, suited for a juvenile audience, will be given on Wednesday, January 3, and Wednesday, Jan. 10, by R. A. Proctor, Esq., F.R.A.S.

Lecture I.—January 3rd.

"The Sun and his Family."

Lecture II.—January 10th.

"Comets, Meteors, and the Stars."

The lectures will commence at 7 p.m., and will be fully illustrated. As the number of seats is limited, Members can only avail themselves of these lectures for their families by obtaining tickets from the Secretary. These will be issued strictly in order of application, and only to the extent of the accomodation available. When sufficient tickets to fill the room have been ordered the issue will be discontinued. Subject to these conditions, each Member is entitled to a ticket admitting one adult and two children. Tickets are now in course of issue.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,259. Vol. XXV.

FRIDAY, JANUARY 5, 1877.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

JUVENILE LECTURES.

Mr. R. A. Proctor gave his first lecture "On the Sun and his Family," on Wednesday evening, the 3rd January. The room was crowded, and the lecture, which extended over an hour and a quarter, was received with hearty demonstrations of applause. A large number of interesting illustrations, prepared by Mr. Proctor, thrown on a sheet by means of the oxyhydrogen light, under the management of Messrs. Darker, were thoroughly appreciated by the audience. The next lecture, which will treat specially of "Comets, Meteors, and the Stars," will take place on Wednesday evening next, the 10th instant.

CANTOR LECTURES.

THE HISTORY OF THE ART OF COACH-BUILDING.

By G. A. Thrupp, Esq.

Lecture II.*

With the decadence of the Romans we may well suppose many of the arts of civilisation fell into disuse. The skilled artisans died out, and left no successors, for their work was not required, and for some centuries we find little or no mention of carriages.

Ordinary carts were used, it is true, but the great and wealthy moved about the cities or travelled on horseback, and if ill they had litters, carried by men or horses. But another cause tended to the disuse of wheeled carriages—the state of the roads.

The Romans had been celebrated for the perfection of their roads; some of these roads have lasted nearly 2,000 years. There is one, called the Appian way, which leads from Rome to near Naples, made B.C. 500 by the Consul Appius Claudius, which is paved with blocks of stone, and can still be travelled upon after such a lapse of time. Roads like these could easily be traversed by carriages, but in the course of time they fell into disorder, whilst barbarian tribes had over-run Italy and driven the Romans from Germany, France, and Britain.

The increase of population caused a gradual increase of traffic, and the formation of new roads, which, from the absence of method in making them, soon became mere horse-tracks, and very unsuitable for travelling on wheels for pleasure. We ascertain, however, from old manuscripts and books that, by degrees, the use of two and four-wheeled carts was revived by the wealthy, in addition to riding on horseback as a means of travelling. The only distinction, however, from common carriers' carts was in the use of carving on the woodwork, and gaily coloured curtains and cushions.

In the reign of Richard II., we find mention of a vehicle termed a whirlicote, viz., a cot or bed upon wheels. The king and his mother rode a whirlicote in 1380, when she was sick, and history tells us that they were much used for the conveyance of ladies, but still more for their luggage. We are told by Stowe, that in the following year King Richard took to wife Anne, the daughter of the King of Bohemia, and she first brought hither the riding upon side-saddles, and so was the riding in those chariots and whirlicotes forsaken except at coronations and such like spectacles. We have here evidence that the chariot and whirlicote of that time were identical. In 1294, Philip, King of France, issued an ordinance prohibiting the citizens' wives the use of cars or chars. In 1267, Charles of Anjou entered Naples, and his queen, Beatrice, rode in a *caretta*, the outside and inside covered with sky-blue velvet powdered with golden lilies, and in 1273 Pope Gregory X. entered Milan in a caretta. In an early English poem, the father of a princess of Hungary promises—

> "To-morrow ye shall on hunting fare,
> And ride my daughter in a char;
> It shall be covered with velvet red,
> And cloths of velvet about your head."

Froissart speaks of the return of the English from Scotland in the time of Edward III. in their charettes—about 1360. We can therefore trace the word chariot from the original Roman currus, car, char, charette, charet, chariot, as a vehicle used in the middle ages, and gradually becoming that chiefly used in state processions.

When King Henry VIII.'s queen, Anne Boleyn, went to her coronation, she passed through the streets of London; gravel had been strewed all over the pavement that the horses should not slide, and wooden railings were placed along the route; this was on May 31st, 1533. Anne herself was in a litter of white cloth of gold; not covered or bailled, which was carried by two palfreys, clad in white damask to the ground, led by two footmen; following her were two chariots covered with red cloth of gold, a third chariot in white, with six ladies in it in crimson velvet; and a fourth chariot was red, with eight ladies in it.

Twenty years later, on September 30th, 1553, Queen Mary Tudor rode through the city from the Tower to Westminster to her coronation, in a chariot of cloth of tissue, drawn by six horses trapped with the like cloth, and a canopy was borne over her chariot. A second chariot had a covering of cloth of silver all white, and six horses trapped with the like, wherein sat Lady Elizabeth and the Lady Anne of Cleves. Then two other chariots covered with red satin, and the horses betrapped with the same. Also 46 gentlewomen rode on horseback in the procession.

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* Delivered November 27th, 1876.

Now what was the shape of these chariots? We are able to judge from a painting of the triumph of the Emperor Maximillian I, on the walls of the Town-hall at Nuremburg, a copy of which is in the Museum at South Kensington, also from a sculpture at Orleans Cathedral, and from an old print of Queen Elizabth in a chariot. It was an open vehicle on four wheels, rather higher at the back than at the sides, open in front, and containing two or three seats, what the French once called a *char-à-banc*.

M. Roubo has preserved a design of a charette in his work written for the French Academy of Arts, but we cannot have a safer and more reliable model than in a Flemish car or *char-à-banc* now in the Museum at South Kensington; this is a very small vehicle with but two seats, only four people could just sit in it, and it is suspended on leather braces, which we do not know had been introduced into England in Queen Mary's time, but that even is not impossible or improbable. We may, therefore, fairly conclude that in this Flemish car we see an improved representation of what our ancestors used during many hundred years under the name of whirlicote car, and of different sizes, to carry from four to twelve persons.

About the commencement of the sixteenth century we find that there was a remarkable revival of coach-building in Italy, France, Spain, and Germany; and it has been warmly debated in which of these countries it commenced, which originated the word coach, and which first suspended a coach upon braces.

I may premise that we find also a vast increase in the size of the wheels used. Up to this period wheels of 4 ft. to 4 ft. 6 in. seem to have been the limit; but the first coaches, and all their successors for nearly 250 years, had wheels 5 ft. and upwards in height. I can only suppose that, as soon as any large body had to be conveyed, the model of the vehicle was taken from a timber-carriage, such as must have been in use in all parts of Europe. Secondly, although at first all the wheels of a coach were similar in height, it was soon found necessary, for use in cities, that the coach must turn in a shorter space than a lofty front wheel would allow. Consequently, the front wheel was made lower, and an imperfection was caused, the effects of which have been felt by horse and vehicle to the present day.

In all the claims to the origin of the coach, we must understand that by that word we mean a conveyance in which the roof forms part of the framing of the body—as distinguished from cars and biroches, above which a canopy was often placed by means of iron rods or wooden pillars.

We have further to notice that the vehicles called coaches are distinguished from chariots, by the name of Hungarian coaches, by the Italian writers, and that we must consider a coach to have been not merely a covered, but a suspended vehicle, after the fashion introduced first in Hungary.

Mr. Bridges Adams, in his work on carriages, mentions that Ladislaus, King of Hungary, sent an ambassador to King Charles VII., to Paris, and as a present a beautiful carriage, the body of which "trembled;" it is considered that this coach was suspended upon leather braces, and was a specimen of the coaches already in use in Hungary.

The word coach in all European languages has the same sound, and is derived from the town of Kotze in Hungary, where coaches were first built, just as Landaus and Berlins were so named from the cities that first produced them. The coach from Hungary was given to Charles VII., at Paris, in the year 1457. In 1474, the Emperor Frederick III. rode to Frankfort in a coach covered and suspended. In 1509, the Pope Paul III. visited Ferrara, and was met by the duke with a train of 60 coaches, whilst to make it clear that these were not the cars, the historian mentions that the Duchess of Ferrara rode in a litter, and her ladies followed her in 22 cars. At this period, 1550, there were only three coaches in Paris, one belonging to the Queen of Francis I., another to Diana of Poitiers, and a third to a corpulent nobleman who could not mount a horse. There must have been many other vehicles in France, but it seems only three covered and suspended coaches. In 1594, the Margrave of Brandenburg, father of the first Duke of Prussia, had 36 coaches, each with six horses.

We will now consider what was the origin and the shape of these coaches. It is in the German waggon that we find the origin of the coach. Throughout Germany, Russia, France, and other parts of Europe, the chief agricultural vehicle is the waggon. It is of the same form now that it was hundred years ago. The under part is similar in its construction to our timber-waggons, and, like them, it is capable of being lengthened or shortened at pleasure. The wheels vary in height, according to the requirements of the owner and the country, and the chief purpose for which it is used. As in our timber-waggons, the wheels are sometimes 4 ft. and 5 ft. high, and sometimes they are as low as 2 ft. 8 in. in front and 3 ft. 6 in. behind, but the usual size is 3 ft. 6 in. in front and 4 ft. behind, the track on the road between the tyres is but 4 ft., and the centres of the axletrees are about 7 ft. apart. The carriage is composed of a transom in front, with a perch (as we name the long piece of timber that unites the front and hind wheels) fastened to it. There is a hind axletree bed formed of two pieces of timber, clipped together, between which the wings are notched in; these wings meet together above the perch to which they are united by a strong iron pin. The under works consist of a front axletree bed, also made of two pieces clipped together with two futchels notched in between, and meeting in a point in front, and spreading outwards behind the axletree bed; a long sway bar, generally quite straight, rests on the futchels and bears against the under part of the perch. Our word futchels is derived through the French word *fourchils*, from the Latin *furca* or fork. The pole of these waggons has at the hind end two wings fixed by iron hoops; the wings are fitted outside the front end of the futchels and are secured by two moveable iron pins. This method of attaching the pole is very ancient; it was in use in the time of the Romans, and may be traced in old pictures. The horses are harnessed to splinter or drawing bars; the longest of these is attached to the pole by a bolt or pin. When the load is light, it is common to harness one horse only to the left or near side of the pole. The under works being thus complete, a body is formed by two long fir poles laid from the top of the transom to the top of the hind axletree bed, about 18 inches apart, with two planks between. Outside the poles are four standard posts, about 30 inches long, which rise upright from the transom and axle-beds, but which, viewed from behind, spread outwards from four to six inches each towards the wheels. The sides are formed by planks resting against these standard posts, and the ends of the waggon are also moveable. The body is thus much narrower at the bottom than at the top. We shall find that this shape pervades all the early vehicles used by the wealthy classes, showing very plainly the original type of the coach. When the waggon is thus fitted up with plank sides, it can carry earth, manure, or roots. When the farmer wishes to transport a load of hay, the planks are removed, the carriage is lengthened two or more feet, and the sides are formed by long and high hurdles. If a large cask of wine has to be transported, the sides are removed and the cask placed upon the centre of the poles, and, as the waggon moves along, the poles may be seen to sway slightly up and down under the weight of the cask, as the poles of a sedan-chair or palankeen sway, suggesting, as I hope to show hereafter, a means of forming a species of spring for the ease of anyone riding in the waggon.

We find, then, at a very early date, that waggons were chiefly employed for the conveyance of agricultural produce or the transport of merchandise and the goods of the upper classes. It was also easy, by placing planks across the sides, or suspending seats by straps from the sides, to use the waggons for the conveyance of men and women. But we have evidence that they were made still more free from jolting. In an ancient Saxon manuscript treating on the Book of Genesis and the history of Joseph in Egypt, there is an illustration of the meeting of Joseph and Jacob. The father is seated in a two-wheeled cart drawn by a pair of oxen, but Joseph is seated in a hammock, suspended by iron hooks from the standard posts of one of these waggons which I have been describing. This manuscript is supposed to be of the 11th century, and the artist would be likely to represent only what was in use in his own time for the easy conveyance of great people.

The next step, however, in the advance of coach-building, would be the use of a better body than that of a mere cart. Such was the case with the horse-litter. These were long and narrow —long enough for a person to recline in—and no wider than could be carried between the poles which are placed on either side of the horses. They were about 4 ft. to 5 ft. long, and 2 ft. 6 in. wide, with low sides and higher ends. The entrance was in the middle, on both sides, the doors being formed sometimes by a sliding panel and sometimes simply by a cross-bar. The steps were of leather, or iron hoops, the latter being hinged to turn up when the litter was placed on the ground. The upper part was formed by a few broad wooden hoops, united along the top by four or five slats, and over the whole a canopy was placed, which opened in the middle, at the sides and ends, for air and light. The first pleasure-waggon bodies were made in a similar fashion to the horse-litters, but rather longer and wider, with similar doors. By degrees, these bodies were ornamented with carving, and the slats of the tilt-top were exchanged for poles, whose ends were ornamented with metal rosettes, or animals' heads, and gilt. I have not found any certain date at which these bodies were first suspended upon straps or braces. The suspension of a hammock from the standard posts of a waggon, and of the litter from the harness of the horses, would, however, suggest the suspension of these improved waggon bodies from the same standard posts. I have seen in a very early picture in oil, at Nuremberg, two waggons such as I have described, with carved and gilt standard posts both in front of and behind the body, the tilt-tops have the middle of the sides cut out square, and made to turn over the top, and the driver sits outside the waggon body, between the standards.

We have, however, at Coburg, the capital of Saxe-Coburg, several ancient vehicles preserved, which are among the oldest in Europe. One of these was built for the occasion of the marriage of the Elector of Saxony, Duke John Casimir, in 1584, to Anne of Saxony. It has leather braces and high wheels, which measure 4 ft. 8 ft. and 5 ft. in height; the distance from centre to centre of the axletrees is 10 ft. 6 ft. The carved standard posts, from which the body hangs by the leather braces, are evidently developed from the standards of the common waggon. The body is 6 ft. 4 in. long, but only 3 ft. wide. The steps have now disappeared. The wheels have wooden rims, but over the joints of the felloes are small plates of iron about 10 in. long.

This coach is not the only one. There is another, rather longer and larger, built for the Duke's second marriage, in 1599, with the Lady Margaret. There is also a smaller coach-body, built for the Duke John Frederick, as early as 1527, for his marriage with Sybilla of Cleves. This small coach was shown this year at the Exhibition of Arts at Munich; the iron hoops by which it had been suspended are still on the body. There are also two small coach-bodies, which are to be seen at Verona, and are shown at the Palace Sarego Allighieri, with the story that they were used by Dante the poet. This is, however, a fable. Count Gozzadini, in his recent work on ancient coaches, says that, by the heraldic shield still on one, he finds it was built in 1549, at the marriage of Ginevra, the last of the race of Dante Allighieri, with Count Marc Antonio di Sarego. These, you will observe, are beautifully shaped and ornamented. They were still but skeleton bodies, and had to be covered, to keep off the sun or rain, with leather, cloth, and silk curtains. There are curious sumptuary laws cited by Count Gozzardini as passed during the sixteenth century in various Italian cities, against the excessive use of silk, velvet, embroidery, and gilding in the coverings of coaches and the trappings of horses.

In 1564 Pope Pius IV. exhorted the cardinals and bishops not to ride in coaches, according to the fashion of the time, but to leave such things to women, and ride themselves on horseback. Duke Julius of Brunswick issued an edict in 1588, that his subjects should desist from indolent riding in coaches, and should return to the useful discipline of riding on horses.

The use of coaches in Germany, in the sixteenth century, was not less than in Italy; the current of trade, especially from the East, had for a long time poured into those two countries towards Holland, enriching all the cities in its progress, and the rich traders built fine houses, and churches, and town halls, and would have their coaches handsomely decorated as well as their houses. Macpherson, in his history of commerce, says that Antwerp possessed 500 coaches in 1560, in the time of Queen Elizabeth. France and England appear to have been behind the rest of Europe at this period.

The first coach was made in England in 1555, for the Earl of Rutland, by Walter Rippon, who also made a coach in 1556 for Queen Mary, and in 1564, a state coach for Queen Elizabeth; and in 1580, the Earl of Arundel brought over a coach from Germany. Queen Elizabeth, however, preferred the use of a coach which William Boonen brought her from Holland in 1560, and made him her coachman. Taylor, called the water-poet, wrote in 1605, that old Parr gave him this information, and adds that since "coaches have increased with a mischief, and have ruined the trade of the waterman by hackney coaches, and now multiply more than ever." This William Boonen's wife brought out of Holland the art of clear-starching, and was appointed to prepare the Queen's famous cambric ruffs, which in pictures of her are displayed round her neck. Another writer complains that "now the use of these coaches brought of Germany is taken up and made common, that great ladies caused coaches to be made for them, and rid in them up and down the counties to the great admiration of all the beholders, and little by little they grew usual among the nobility and others of quality, so within 20 years there grew up a great trade of coach-building in England."

A curious tract or pamphlet was published in London in 1636, entitled "A Dialogue between a Coach and a Sedan-chair." In the figure of the coach as given in this tract, there are no leather braces marked, but the artist may have omitted what he considered unnecessary details, just as the artists of the present day, making a cheap view of a procession, will figure coaches and chariots of a shape that was obsolete fifty years ago, and even in pictorial journals that should draw better, the shape and details of carriages are unfaithfully rendered. Still, on the whole, we may consider this gives the coach of the period—a long body, a domed roof, the sides open, with curtains to draw down when requisite, no door, but a leather screen hung across the doorway, a very small coachman's seat, and swingletrees for the horses' traces.

In 1641, on November 25th, Charles I. passed through the City of London on his return from Scotland, and banquetted with the citizens at Guildhall. He was met at Kingsland by the city authorities and 500 horsemen of the city companies, each with his footman and torch-bearer, and was accompanied to Whitehall after the banquet by the liverymen with their torch-bearers. It is worthy of notice that the king's coach is the only coach spoken of, and that the King, Queen, the Elector Palatine, their brother-in-law, the Duchess of Richmond, and three of the royal children, seven persons in all, rode therein. In France, King Henry IV. was assassinated in his coach by Ravaillic on May 16th, 1710. The account states that the coach was surrounded by blinds or curtains, but the king had drawn them back, that the people might see him; with him in the coach were seven noblemen, that is, two persons on each seat, and two in each boot. A drawing of this coach has been preserved, by which we see the roofs and supports (somewhat resembling the outline of a Roman or Asiatic vehicle) and the curtain hanging over the doorway in front of the boot.

A coach belonging to a Duke of Saxe-Coburg is still to be seen at the Castle at Coburg; in this the body is 7 ft. 6 in. long in the middle, the wheels are 4 ft. and 4 ft. 10 in. high, the roof and upper quarters are of black leather nailed on with brass nails, the heads as large as a sixpence and rounded. On either side of the doorway are iron bars to form the sides of the boot, and the doorway is guarded by a wooden cross-bar padded which drops upon two pins, and from which bar the curtain would fall over the doorway. With such a length of body we can understand how eight persons could ride in it. In prints of this period all coaches are drawn like this, with the bodies suspended on leather braces—with domed roofs and with the front wheels generally rather low—with a coachman seated upon a cross-bar or cushion suspended between the two front standard posts, and his feet upon a board projecting at the bottom of the posts over the pole.

Some coaches are depicted so wide that they may have held three persons on each seat, but the general appearance is that of Louis XIV.'s first coach; no trace of glass windows or perfect doors seem to have existed up to 1650. But plain and rude as was the first coach of Louis XIV., it was in his reign, which lasted till 1715, that the most rapid progress was made in coach-building. From the simple waggon-like skeleton body was developed by degrees a beautifully shaped, carved, and pannelled piece of cabinet work, such as we can justly allow to be worthy the name of a coach, and this delighted our ancestors in the reign of Queen Anne. The credit of this transformation is equally due to Germany, Italy, France, and England; in each country improvements seem to have been made simultaneously.

The following is the description by a French author, M. Roubo, of the change that took place in Louis XIV.'s reign. The corbillards are the earliest French coaches of which we know the exact form. These were straight-bottomed, open at the upper sides or quarters, which were furnished with curtains of cloth and leather; at first these were tied on, and would roll up when air was required; they had no doors, but were entered on either side by a moveable rail, over which a leather screen was hung. Behind these screens were seats, a little above the floor, where the pages of the owner of the carriage sat sideways. Sometimes there was a projection on either side called a boot, in which the pages sat.

The next coaches had curved bottoms, and were made with a wooden door half-way up the body, and the whole of the lower part of the body was pannelled instead of being covered with cloth; this change is supposed to have taken place about 1660. As the coach began thus to be built in, carving, gilding, and painting were introduced, and beauty in shape increased. Next came the introduction of glass to the sides. A complete door reaching to the roof, with sliding glasses, followed.

There is very little mention made by historians of steel springs, but they were first applied to wheel carriages about 1670. At this period a vehicle drawn by men, and called a *Brouette* (or wheelbarrow) was introduced at Paris. It was a Sedan chair, to hold one person, with the door in front like the sedan chairs are now made, but on two wheels, about 3 ft. 6 in. high, and with two poles or shafts projecting forward, between which one man ran, whilst another pushed behind if the weight required it. There is a vehicle now much in use in Japan and China that seems a revival of the brouette; I think it is called a Jin-rik-sha.

The brouette was improved by Dupin, who applied two elbow-springs beneath the front, and attached them to the axletree by long shackles, the axletree working up and down in a groove beneath the inside seat. This is the first record of the application of steel springs to carriages. Many bath-chairs have springs from the body to the axletree in this method, and there is a tradition in the north of England that small broughams, drawn by men, on two wheels, were used 60 years ago, as well as sedan chairs, for the conveyance of ladies to evening parties.

It has been said that a Mr. Thomas brought springs first before the notice of the scientific body of the Academy at Paris in 1703—but this is erroneous. The spring Mr. Thomas mentioned is a small spiral spring to be placed between the double leather brace of a carriage.

The first use of a steel spring to a coach body was beneath the bottom of the body; the loop of the brace was hinged, and between the body and the loop were placed two elbow-springs.

The Company of Coach and Coach-harness Makers was founded in May, 1677, by Charles II., and was confirmed by King James II. in the third year of his reign. In Germany, there was invented about 1660 the vehicle called the berlin. It will be remembered that in the German waggon the bottom of the body is formed by two long poles, which afford a certain amount of spring when weighted only in the middle. Acting on this principle, Philip de Chiesa, a Piedmontese in the service of Frederick William, the Duke of Prussia, invented and built a carriage, which received the name of Berlin. It had two perches instead of one, and between these two perches, from the front transom to the hind axletree bed, two strong leather braces were placed, with jacks or small windlasses, to wind them tighter if they stretched. The bottom of the coach was altered from being straight to an easy curve, and it was fixed upon these braces of leather, which allowed it to play up and down with the motion of the carriage, instead of swinging to and fro from four high posts. Philip, the inventor, died in 1673.

In the Imperial mews at Vienna are four coach berlins, which, I think, may belong to this period. They are said to have been built for the Emperor Leopold, who reigned at Vienna from 1658 to 1700, and Kink describes this emperor's wedding carriages as covered with red cloth and as having glass panels; he also says they were called the Imperial glass coaches. It is possible that the coaches have been a little altered from the time of their construction, but I consider that in these four we have the oldest coaches with solid doors and glasses all round that exist in Europe. Whether they are identical with the Emperor Leopold's wedding carriages matters much less than the influence the berlin undoubtedly had upon the coach-building of that period. It was the means of introducing the double perch, which, although it is not now in fashion, was adopted for very many carriages both in England and abroad, up to 1810. Crane-necks to perches were suggested by the form of the Berlin perch; and as bodies swinging from standard posts suggested the position of the C spring, so bodies resting upon long leather braces suggested the horizontal and elbow springs to which we owe so much. The first berlin was made as a small *vis-a-vis* coach—small because it was to be used as a light travelling carriage, and narrow because it was to hang between the two perches, and was only needed to carry two persons inside. It was, therefore, such an improvement in lightness and appearance upon the cumbersome coaches that carried eight persons, that it at once found favour, and was imitated in Paris, and in London especially. At Vienna there is also to be seen a horse-litter of this period, which is interesting as another specimen of a small *vis-a-vis* coach with glass windows. In shape it exactly resembles the coaches on the arms of the Coach and Coach-harness Makers' Company of the City of London. It is a singular instance of the length of time that some old patterns exist, that this horse-litter exactly resembles the shape of the sedan chairs still in use at the public baths at Ischl, in Austria—that is, if this litter were cut in half, you would have two sedan chairs. It is said that the Spanish wife of the Emperor Ferdinand III. rode in a glass carriage, so small as to contain two persons only, as early as 1631. It is possible that this horse-litter may be the carriage spoken of. Glass was in common use then for windows; but plate-glass, such as was used for State coaches in 1700, was not made at all in England until 1670.

Towards the end of the seventeenth century, among the wealthier classes, decoration was applied to coaches to an extent that would surprise us now-a-days. Wheels were again ornamented, as in the times of the old Roman empire; the spokes were shaped and carved, the rims moulded, and the naves highly embossed. The panels had beautiful paintings upon them; sometimes the whole was the subject of a picture in which a landscape and figures appeared, sometimes surrounded with a continuous ribbon border of flower work, or the panels were divided into squares or diamonds of diaper work, each little partition bearing a flower or device. The inside linings were of brocaded silk or velvet. But all this century the use and number of coaches in England was increasing, and at length the use of springs in lessening the weight of coaches was fully understood; and this demands a short explanation. First it was found that when the body was suspended upon springs, the vibration, and consequently the wear and tear of not only the body, but in a degree of the underworks or carriage, was reduced, and the entire amount of timber used could be safely diminished, and with it the load behind the horses. And secondly, when the wheels had to be pulled over an obstacle or out of a ditch, the weight of the entire coach had not to be lifted as formerly, since the elasticity of the spring allowed the wheel to rise without lifting all the body and its passengers with it. It is of importance to understand this clearly, and anyone may convince himself by watching the motion of two loaded carts over a bad road, one having springs and the other being without them.

In Mr. Samuel Pepys' diary during the year 1665, we find on May 1st, "After dinner I went to the tryall of some experiments about making of coaches go easy. And several we tried, but one did prove mighty easy [not for me to describe here, further than that the whole of the body lies upon one long spring], and we all one after another rid in it, and it is very fine, and likely to take." (This may have been a berlin car.)

On September 5th he writes, "After dinner comes Colonel Blunt in his new chariot made with springs, as that which was made of wicker, and wherein a while ago we rode at his house. And he hath rode, he says now, this journey, many miles, in it with one horse, and outdrives any coach, and so easy he says. So for curiosity I went in it to try it, and up the hill to the heath, and over the cart ruts, and found it pretty well, but not so easy as he pretends."

In 1666, January 22nd, "I went with Dr. Wilkins, Mr. Hook, Lord Brouncker, and others, to Colonel Blunt's, to consider again of the business of chariots, and to try their new invention, which I here saw Lord Brouncker ride in, where the coachman sits astride upon a pole over the horse, but do not touch the horse, which is a pretty odd thing."

In 1668, November 5th, Mr. Pepys went with Mr. Perry all the afternoon among the coachmakers in Cow-lane, and "did pitch upon a little chariot, whose body was framed but not covered, it being very light, and will be very genteel and sober."

December 2nd, "Abroad with my wife, the first time that I ever rode in my own coach."

In 1669, April 19th, "Calling about my coach which hath been to the coachmakers to be painted and the window frames gilt again." We see from this entry that in 1669 coaches were made in England already with glass windows.

April 30th, "To the coachmaker's, and find many ladies sitting in the body of a coach, which must be finished by to-morrow, the Lady Marquess of Winchester and Lady Bellasis eating of bread and butter and drinking of ale; my coach is silvered over, but no varnish yet laid. I stood by it till at eight at night, and saw the painters varnish it, and it dries almost as fast as it can be laid on. I sent the same night my coachman and horses to fetch the coach home;" and on May 1st, "At noon to dinner, and after through the town with our new liveries of serge, and the horses manes and tails tied up with red ribbons, and new green reins."

Sedan chairs came into fashion in England in 1634, and were in general use by the middle of the century. The alteration in the form of the coach, from the long, barge shape of Charles I.'s time to that of Charles II. was, no doubt, suggested by the shape of the sedan chair, in London as well as in Germany. The improvements mentioned by Mr. Pepys show that coaches were being altered, but the progress of springs was slow. We appear, in England, to have taken the lead, in at the same time introducing springs and lessening the weight of coaches. In 1770, an elaborate treatise on coach-making was published at Paris by the Academy of Arts, written by Mons. Roubo. In this work we find that even at Paris then, springs were not at all universal. They were applied to the four corners of a perch carriage, and placed upright, and at first only clipped in the middle to the posts of the earlier carriages, and the leather braces went from the tops of the springs to the bottoms of the bodies, without any long iron loops such as we now use; and, as the braces were very long, we find that complaints were made of the excessive swinging and tilting, and jerking of the body. Another method of the application of springs was beneath the body, The Queen's coach is thus suspended. Four elbow-springs, as we should call them, were fastened to the bottom of the body, but again the ends did not project beyond the bottom, and the braces were still kept too long; and Mons. Roubo doubts whether springs were of much use.

It seems clear from this work, that one hundred years ago the art of coach-building was in some respects equal to that of the present day. Their timber was carefully selected and dried, the bodies were framed and pannelled, the shape, and curves, and side sweep, and turn-under was regulated by very careful drawings, the grooves for the blinds and glasses were well made. Blinds were made both panelled, perforated, and to open, just the same as those which we call venetian blinds, and a fourth sort with fixed open slats, as are now used in Turkey and India. Panels were then, as now in France, chiefly of walnut-wood, and M. Roubo describes the method of curving them by wetting one side and exposing the other to a hot fire. He also gives designs for the various tools used by the woodmen and the smiths. He enumerates the various classes of workmen, including painters and trimmers, and adds "all these are independent workmen, yet who should have a knowledge of one another's work, that the work of one hinders not the work of another, their mutual knowledge should concur in the acceleration and perfection of the whole." Coaches at this period were hung comparatively high, being necessarily above the perch. Berlins, so called from their invention at the city of that name, were hung between two perches, and therefore nearer to the ground. The body of some berlins also had a solid top or roof, but the sides and ends were of leather, which could be rolled up to admit of more air. These may have given the idea of a singular carriage which preceded the landau. Some coaches had windows in the side quarters. A few were still made to hold eight persons inside. The shapes admitted of considerable variety; the elbow line was straight or in 3 or 4 curves; the quarters either what we call the britchka quarters, or a concave single sweep from the elbow to the end of the bottom side, like the shape of her Majesty's state coach. Chariots were made with the hind quarter similar in shape to the front pillar, that is with a concave sweep. M. Roubo goes on to tell us that chariots, being smaller than coaches and lighter, were at first called diligences. But in consequence of the speedy passage of a stage coach from Paris to Lyons, it obtained the name of diligence, which has since remained to those large double coaches still in use on the Continent. We also find the drawing of an invalid or Dormeuse coach, very ingeniously contrived, and descriptions of the different summer open carriages, some with and some without springs; there are a few of really elegant shapes. He enumerates chaises, phaetons, cabriolets, caleches, "*Angloises desobligeants*" (or what we should call sulkies, that would only contain one person), and lastly woursts, a vehicle introduced from Germany for sporting, and which is a Russian drosky, but very much longer than those we have seen in England, a crane neck in the perch to allow the wheel to turn, and the seat, which is hung on braces, is very narrow, for the passengers to sit on it astride.

M. Roubo describes at length, and gives a plan of the angloise. It is a chariot, with the modern curved lower quarter panel suspended upon a double swan-necked perch, rather high front wheels, and four whip springs, and with a small hammer-cloth in front. There is one very similar preserved in the Museum of the Hotel Cluny at Paris. But on the vehicle M. Boubo remarks, "I see no beauty nor grace in the *voiture à l'anglaise*, but it is no doubt sufficient that the invention of this vehicle comes from England, to make all the world desire to have them, as if there existed some law which obliges us to be the servile imitators of a nation who is our rival, and which, although it is respectable, and admirable even, in some respects, can never be equal to us for works of taste in general, and above all in coach-building."

Whilst we may smile at M. Roubo's jealousy, we must allow the general truth of what he says, viz., that in works in which taste reigns paramount, the French do usually surpass the English; and as regards coach-building, although we have the name for superior vehicles, and deservedly so as regards quality, durability, and ease, the French are beyond us in applying tasteful painting, trimming, and decoration of all sorts.

In the French Encyclopedia of 1772, by Diderot, there are elaborate descriptions of the art of coach-building, the workshops and tools used, and plates of the different carriages in use. I have mentioned these two works, one by M. Diderot on his own account, and the other by M. Roubo for the French Academy, partly to show the great care taken by our neighbours to instruct the people in the technical principles on which their manufactories should be conducted. It may be that having these superior models before their eyes, and being assured by the wise men of the day that thus carriages should be constructed, the French coachbuilders were content with their achievements, and allowed other nations to advance more rapidly, during the remainder of the century, with daring innovations in lighter and easier vehicles.

But the teaching of the Academy would nevertheless tend to create a careful and thoughtful body of workmen, who, if they developed but slowly, would develop carefully, and turn out good work in their generation.

There is one vehicle which appears almost solely in this epoch, and had a marked effect in introducing our English post-chaise. This was the *chaise de poste.*

From the engraving and description in the Encyclopedia, it appears to have been a small chariot body, very little longer than a sedan chair, and, like a sedan chair, it had the door in front; this door, however, was hinged at the bottom, and fell forward on to a small dasher like a gentleman's cabriolet; in each side were windows. It was hung upon two very lofty wheels and long shafts for one horse, and the body was rather in front of the wheels, so that the weight on the horse's back must have been considerable. It was suspended at first upon leather braces only, but later upon two upright or whip springs behind, and two elbow springs in front from the body to the cross-bar, joining the shafts and carrying the steps.

Count Gozzadini tells us that in 1672 cabriolets, or gigs with hoods, were introduced from Paris into Florence—"an affair with a curved seat fixed on two long bending shafts, placed in front on the back of a horse and behind upon two wheels; to this was given the name of gig, and they so increased in number that in a few years there were nearly a thousand in the city of Florence."

These vehicles, in which the shafts were really very long, appear to be the origin of the carriole of Norway, the calesso of Naples, the volante of Cuba; of one of these, but without a hood, we have a specimen in the Museum at South Kensington which is adorned with elegant carving. The seat is very small. Beneath the shafts are two long straps of leather and a windlass to tighten them; this apparatus was, no doubt, to regulate the spring of the vehicle to the road travelled over.

There was a smaller edition of this vehicle called *cabriolet*, the body only a shell, with a hood which would put up and down, composed of three iron hoop-sticks, jointed in the middle to fall upwards; the setting joints are straight, the covering appears to have been cloth or canvas.

Although these French books appeared about 1770, they describe carriages that had been a long time in use.

In the meantime the English had been making a great many small chariots. Dean Swift in 1770 speaks in his journal of driving down to Hampton Court and to several gentlemen's country houses near London in a chariot and pair of horses, to dine with some great man, and returning after dinner to town. He mentions that he could not have done the same in the neighbourhood of Dublin on account of the absence of turnpike roads. He drove from Windsor to London, 23 miles, in two hours and forty minutes, and from Wycombe to London, 27 miles, in five hours, and from Windsor to Bucklebury, near Newbury, 26 miles, in four hours.

We are told in 1744, by Lady Hervey's letters, that light-bodied chariots were at that period advertised as fit for town or country. As a further illustration of this period, there is a chariot in the South Kensington Museum belonging to the Earl of Darnley's family, which is supposed to have been built in 1750. I should think, however, it is of rather earlier date, probably 1700. The body is small, and abounds in curves and sweeps, like furniture of the date of Louis XIV. The glasses of the doors and of the front rise and fall in frames. There is a broad perch, with two iron handsomely-forged cranes (exactly like those in the *diligence anglaise*, which, unfortunately, did not please M.

Roubo). The body is slung upon leather buckle braces, with small elbow springs at the bottom of the body at the hinder part. There is a small hammer-cloth on which the coachman could sit (the origin of the name is supposed to be from its original use in covering the budget which held the hammer and other tools that were frequently carried with carriages, especially travelling carriages, as late as the year 1840); the footboard is framed to the carriage part. There is a splinter-bar, by which the horses would be attached, and the wheel-irons hook on to this bar, and are attached at the hinder part to the ends of the front axletree. The front wheels are 2 ft. 9 in. high, and the number of spokes eight. The hind wheels have twelve spokes, and are 5 ft. high. The whole is hung low. We can well suppose that this was not a heavy carriage after the horses, When the first coach quarters were covered with leather they were nailed on and the heads showed. After 1660 these nail heads were covered with a strip of metal made to imitate a row of beads; from this practice arose the name of "beading," which has been retained, although beading is now made in a continuous level piece, either rounded or angular.

The use of coaches had by this time spread from Europe to the colonies, and in 1740 there were many coaches and chariots in use at Spanish Town, Jamaica, and other large towns in America, wherever colonised by Europeans.

State Coaches.

In Count Gozzadini's work on ancient carriages, there is an account of a state coach which was built under the direction of an Italian at Brussels, for the ceremony of the marriage of Alexander, the son of Octavius Farnese, Duke of Parma, with a Portuguese princess. The wedding took place in 1565 at Brussels. There were four carriages Flanders fashion, and four coaches after the Italian fashion, swinging on leather braces. The chief, or state coach, is described as built in the most beautiful manner with four statues at the ends. The spokes of the wheels like fluted columns. There were seraphim's heads at the end of the roofs and over the doorway, and festoons of fruit in relief on the framing of the body. The coachman was supported by two carved figures of lions, and similar lions at the hinder ends, and the leather braces that supported the body, and the harness, were embossed with heads of animals. The ends of the steps were serpents' heads. The whole of the wood and ironwork was covered with gold relieved with white. The coach was drawn by four horses, with red and white plumes of feathers, and the covering of the body and of the horses was gold brocade with knotted red silk fringe. The cushions of embroidered gold stuff were perfumed with amber and musk, that infused the soul of all who entered the coach with life, joy, and supreme pleasure. The horses were cream colour. All this description would fit very much with the coach of the Duke of Saxe Coburg built twenty years later, except that the carving of the Brussels coach was superior, which is probably due to Capt. Franscisco Marchi, of Bologna, who designed the whole.

A state coach on a far more ambitious scale is described in the same work, which was built in Italy, for the marriage of Duke Edward Farnese with Lady Margaret of Tuscany, in 1629. The body was lined with crimson velvet and gold thread, and the woodwork covered with silver plates, chased and embossed, and perforated in half relief. It could carry eight persons; four on the seats attached to the doors, and four in the back and front. The roof was supported by eight silver columns, and on the roof were eight silver vases, and unicorns' heads and lilies in full relief projected from the roof and ends of the body here and there. The roof was composed of twenty sticks, converging from the edge to the centre, which was crowned with a great rose with silver leaves on the outside, and inside by the armorial bearings of the Princes of Tuscany and Farnese held up by Cupids. The curtains of the sides and back of the coach were of crimson velvet, embroidered with silver lilies with gold leaves. At the back and the front of the coach-carriage were statues of unicorns, surrounded by Cupids and wreathed with lilies, grouped round the standards from which the body was suspended; on the tops of the standards were silver vases, with festoons of fruit, and wrought in silver. In the front were also statues of Justice and Mercy, supporting the coachman's seat. The braces suspending the body were of leather, covered with crimson velvet; the wheels and pole were covered with polished silver. The whole was drawn by six horses, with harness and trappings covered with velvet, embroidered with gold and silver thread, and with silver buckles. It is said that twenty-five excellent silversmiths worked at this coach for two years, and used up 25,000 ounces of silver; and that the work was superintended by two master coach-builders, one from Parma and the other from Piacenza.

An embassy was sent in the latter years of his reign by King James II., to Pope Innocent XI., at Rome, headed by Lord Castlemaine. An account was written of all the state and pomp with which he was received in Rome; a copy of this work is at the hall of the Coach and Coach-harness Makers. On Lord Castlemaine's state entry into Rome, January 8th, 1687, a procession was formed of 330 coaches. The ambassador had 13 coaches of his own, built at Rome for him in all probability. Two of these were state coaches, and were certainly built at Rome. The bodies of these coaches were similar to that of Louis XIV., without glass in the doors or side. The bodies were hung inside and out with beautifully embroidered cloths, the one coach with crimson, the other with azure blue velvet, and gold and silver work. The roofs were adorned with scroll work, and vases gilt; under the roof were curtains, with silver fringes, and the ambassador's armorial bearings. The carriage of the principal coach was adorned in front with two large Tritons, of carved wood, gilt all over, that support a cushion for the coachman between them, and from their shoulders the braces depend. The footboard is formed by a conch shell, between two dolphins. In the rear of the coach were two more Tritons, supporting not only the leather braces of the coach, but two other statues of Neptune and Cybele, who in turn held a royal crown. Below Neptune and Cybele, and projecting backwards were a lion and a unicorn, and several Cupids, and wreaths of flowers. The wheels had moulded rims, and the spokes are hidden by curving foliage carving. The second coach had plainer wheels and fewer statues about it. In both, the size of the wheels were, as well as I can judge, 2 ft. 6 and 4 ft. high, and the length apart 12 ft. The whole appearance of these coaches may have been magnificent, but certainly not beautiful.

There are a few records of a magnificent state coach that was built in 1713 for the Duke of Ossuna, ambassador from Philip V. of Spain on the occasion of making the peace of Utrecht. The body was in shape somewhat similar to Lord Darnley's chariot at the South Kensington Museum, with the doorway projecting downwards some ten inches below the bottom sides, the quarters rake towards the roof considerably, the roof over the doorway is arched upwards, the upper quarters are fitted with large glasses of mirror plate-glass. It is elaborately and beautifully carved with figures of Tritons and Nymphs and Cupids and lions. The wheels have carved spokes and felloes. It is hung upon leather braces from the usual standard posts, which are carved into figures of men and women, and the supports into figures of boys and baskets of fruit. There is a hammer-cloth cushion in front, and a footboard supported by Tritons blowing horns. The description of this coach was published at Amsterdam.

There is at Madrid a very old coach of a similar shape to this, with many small points so similar as, I think, clearly to mark it out as belonging to the same period. The standards both in front and behind of the Spanish coach are, however, of beautifully wrought scroll ironwork. The body and wheels are of carved wood stained black, the whole of the panels and framing are worked over with very elegant carving, the centre of each panel is a medallion containing figures of females of beautiful forms. There is a photograph of this at Coachmakers' Hall. It is, however, ascribed erroneously to the time of Jeanne La Folle, as Queen Joanna, the mother of Charles V., died in 1555. It is certain that the Spanish tradition of its age is incorrect. The wheels have the spokes turned in spiral form, the rims of the wheels are moulded and carved. The windows, eight in number, I am informed have been refitted with wooden frames. This coach is deserving of careful study; it is certainly in many points what a State coach should be. There are no fittings for servants or driver. It was the custom for many years in Spain to drive postillion, because a coachman of the Duke of Olivarez having overheard and betrayed a State secret, the duke ordered that coachmen should no longer be allowed in Spain.

Our excellent ambassador at Madrid, who takes a great interest in antiquarian researches, has kindly sent me the particulars respecting this Spanish coach, and obtained from the king's librarian the further information that it is not mentioned in any inventory of the royal goods until the early part of the eighteenth century; the librarian's opinion is that the coach belonged to Charles II. of Spain, who died in 1700, and left his kingdom to Philip V., the grandson of Louis IV., King of France. The coach in shape so closely resembles the coaches of 1700, that there is no doubt it belonged either to Charles II. or Philip V., Kings of Spain.

One of the most beautiful of state coaches is that belonging to the Imperial family at Vienna. There are photographs of it in Coachmakers' Hall, but to be perfectly appreciated it should be seen. The proportions are almost perfect, and the finish of the mouldings and carvings are exquisite. It was built in 1696, and is shaped with all the curves that are familiar to us in cabinets and furniture of the style called Louis Quatorze, and in which a straight line is so carefully avoided. The body is very deep, and longer on the roof than at the elbows; the doorway is depressed to hide the steps. The panels are beautifully painted with nymphs in the style of Rubens; indeed, one is told at Vienna that Rubens painted them himself, but that is another instance of the inaccuracy of many local traditions, as Rubens died in 1640. There is an unusual quantity of plate-glass in the panels of the coach, that help to give it a light and airy appearance. The centre of the roof has a large Imperial crown, and large tassels hang from the four corners of the roof where modern coachbuilders would place lamps. The body hangs very low. The carriage has a single perch with double cranes, corresponding very closely with those on Lord Darnley's chariot at South Kensington. The standards in the front and hind parts are lofty, and elegantly shaped and carved, and strengthened with boldly curved iron stays. The body is hung upon eight leather braces, four of which are arranged on the berlin plan, and four are attached to short elbow springs beneath the bottom of the body. There are six of these little steel springs at each corner. The wheels are about 3 ft. and 4 ft. 9 in. high, and are very elegantly formed with carved rims, and the spokes each of a shape, with three curves in it. There are no fittings for coachman or footman. The whole of the wood and ironwork is gilt, the panels only are in the colour of a landscape, and figures.

It is a singular thing that there is a second coach of the same shape and date, but with the wheels and other fittings of a plainer description, and all black inside and out, with the Imperial arms in bronze relief on the doors. This black state coach is for funerals.

There was a number of state coaches built about this period for the different Courts of Europe; but without illustrations of each, descriptions would not give much idea of their shapes. The general character of each is that of a rather lumbering body, profusely carved, gilded, and adorned, placed on a very lumbering carriage, on some of which are introduced figures of gods and goddesses or animals, appearing to hold up the heavy body by leather braces. The last, and probably much the largest of these, is the state coach of England, built for King George the Third. It is not known who built it; it was designed by an amateur, who could not be expected, perhaps, to consider so much its usefulness as a certain massive grandeur which he expected to gain from an exaggeration of some of the principal parts, such as the body, the total length, and the hind wheels. This coach was built in 1761, and was designed by Sir William Chambers; the length is 24 feet, the height 12 feet, the width 8 feet; the weight is stated as 4 tons. The introduction of the figures of four Tritons, to support braces, is probably imitated from Lord Castlemaine's coach of 1687, but it would have been better to have introduced such figures as leaning against the standard-posts, than to make the figures themselves the bearers. Why the coach was not hung upon **C** springs, or rather whip springs, it is very difficult to say, as they were in common use in 1760.

The City state coach was built in 1757, about the same time as the royal coach. It is, in some respects, in better taste and proportions, but is very unwieldy still. It deserves, however, some study, recollecting in how many City shows it has borne a conspicuous place. The body is the Louis Quatorze shape. The panels would look better if they were re-painted; fresh colours would lighten the whole coach. It is to be regretted that the name of the builder is not on record at Guildhall. But, in the same year, a state coach was supplied to Sir Charles Asgill by Messrs. Runciman and Barker, for £860; it was refitted the following year for Sir Richard Glyn, and successively for Sir Thomas Chitty, Sir Matthew Blakiston, and Sir Samuel Fludyer, lastly for Mr. William Beckford. It was, probably, from the original cost, only a second coach, and appears to have been newly painted and otherwise adorned for each successive Lord Mayor.

If the present City state coach is to be kept for state use, it should be supplied with springs. The City coachmaker, who has for some time had the charge of this coach, could add springs without any difficulty, and without much expense.

MISCELLANEOUS.

TRADE OF BRITISH INDIA WITH THIBET.

Upon the question of improved communication with Thibet, the preference has been given by the Lieutenant-Governor of Bengal to the Jeylup Pass, which is believed to present the best and shortest route. This pass is open all the year round, and is the lowest in the Chola range, which, again, is one of the lowest sections of the Himalaya. It leads into the Thibetan territory of Choombee; and the journey from the pass to Lhassa is said to be from 250 to 300 miles over a not very difficult country. The distance to Jhansu Jong, the principal mart of Eastern Thibet, is only 150 miles, and to Tashilumbo, on the great Narichoo river, where one of the best tracts of Thibet is situated, it is 200 miles. From Darjeeling to Fedong (37 miles) the route is tolerably good, except where it crosses the Teésta, where a cane bridge has been provided for foot-passengers, and a raft for the passage of laden animals, which, however, is useless in the rains. From Fedong to Jeylup (56 miles) the trade is carried on the backs of men. The construction of a suspension bridge over the Teesta has been ordered by the Bengal Government, as also the survey of the route; but the improvement of the road from Fedong to the Jeylup Pass has been deferred for the present for the want of funds.

The present annual exports from Darjeeling to Thibet consist of broad cloth, flannels, chintz, and cottons, American twill, tobacco, indigo, catechu, umbrellas, iron hooks and pots, brass utensils, looking-glasses, goor, hookahs, &c., and amount in value to £16,455. The exports from Sikkim to Thibet comprise millet, rice, oranges, madder, &c., value £675. The imports from Thibet into Sikkim and Darjeeling consist of ponies, blankets, salt, jewellery, yaks' tails, china cups, musk, silk, tea, sheep, value £7,505. The total value of all the ascertained exports from Darjeeling and Sikkim to Thibet being £17,130, while the value of the imports amounts to £7,505, there remains a balance of £9,625 due by Thibet. This balance is said to be paid in British rupees, which the Thibetans obtain by selling their cattle, salt, and other produce in Assam and Nepaul. There are other items of merchandise which enter the trade route at various points, and which are believed to bring up the total value of the trade to nearly £43,000.

Dhumsong has been selected as a site for an annual fair. The Government of India, in expressing their approval of this selection, observe that it is a fine open plateau, and that, if connected with the plains by a fair and easy road, it will doubtless, in time, become the depôt of trade between the hills and the plains. The indigo and tobacco of Rungpore are much appreciated by the Thibetans, whose intercourse with the plains is, however, restricted, owing to their dread of cholera and fever, and of the heat.

INDUSTRIES AND AGRICULTURE OF THE PROVINCES OF GHILAN AND ASTERABAD.

Notwithstanding the repeated failure of the silk crops in Ghilan of late, the importations and exportations seem to maintain their importance, and this result Consul Churchill states is due to the fact that Ghilan is on the main road between Central Persia and Russia, and that the trade between these two countries is scarcely affected by local misfortunes. It is to be regretted that, viewing the repeated failure of silk in these provinces, the inhabitants, who are by no means unmindful of their interests, have not turned their attention more than they have done to other sources of gain, such as the cultivation of rice and wheat, for which both the climate and the soil of ancient Hircania are most favourable.

In the years 1866, 1871, 1874, and 1875, the produce of silk in Ghilan was respectively valued at £743,200, £286,700, £331,280, and £104,600, showing no analogy with the general trade of the place. The total exports of all goods for 1874 amounted to £415,160, and the imports to £467,200; while the value of the produce of the interior of Persia, which passed through Ghilan in transit, is represented by £225,600, making altogether £1,107,960. During the year 1875, a very unfortunate year for the inhabitants of the province, the exports amounted to £435,300, and the imports, £489,840, besides £215,200 worth of produce that found its way out of the country through the province in transit, in all £1,130,340. The only British merchandise that finds its way to the markets of Resht is printed cottons, imported into Persia by a mercantile house under British protection, established at Tabreez. These British prints are sold in lots, at the head-quarters of the establishment, to Persian merchants and others, who send them into the interior, according to the tastes of the various localities for which they are destined.

The whole trade of the province of Asterabad amounts to about £160,000 a-year. The customs of the port of Jez are farmed for 4,000 tomans per annum. Jez is the only port of the province, and through it most of the trade of that locality is carried on. The Mercury and Caucasus Company steamers anchor within a quarter of a mile of the village of Jez; they convey most of the trade of the province to Bakon and *vice versâ*, Constantinople being the destination of the greater part of the exports. 600 bales of manufactured goods (mostly Manchester goods), 8,000 boxes of Marseilles sugar, 50,000 tomans worth of spices, mostly from Turkey; besides iron, steel, spirits, hardware, china, wine, and copper utensils from Russia, are annually imported; while 25,000 bales of cotton, 6,000,000 lbs. of wheat, and 600.000 of caviare are yearly exported to Russia and the Caucasus. About 100 ballots of silk, 160,000 tomans worth of opium, originally from Yezd, go to Constantinople; and wool, silkworms' eggs, grebe skins, dried fruit, &c., find their way out of the province through Jez. The southern coast of the Caspan is reputed for its fisheries, and vast quantities of caviare, isinglass, and dried fish are every year exported to Russia and the Caucasus. The sturgeon, called the *seg mahi*, or dog fish, the salmon and salmon trout, called *azad mahi* and the *sefud mahi*, abound in the creeks and rivers along the coast of Ghilan and Mazanderun. The former, the most valuable of the three, produces the much-prized caviare, of which so large a consumption is made in Russia and Turkey; while the *sefud mahi*, when dried, supplies the poorer classes of the provinces, as well as those of Shirvan, with salt fish at a very low price all the year round—a luxury which to them is very palatable with their rice, which constitutes their principal food. When the winter sets in, and the fish seek shelter in the creeks and rivers to spawn, upwards of 500 fishermen are employed. It frequently occurs that the fish are so plentiful—coming as they do in shoals—that they are baled out of the water at the mouth of the creeks and rivers. Under such circumstances as many as 30,000 fish are caught in a day. At other times prongs, and hooks, and nets are used. The sturgeon, which is a large fish, 4 or 5 feet long, and is deemed "*haram*," or unlawful food by the Persians, is cut open for the purpose of extracting the roe and the gelatinous substance on the back. It is then salted and put into casks, as also the caviare and shipped to Astrakan. There the caviare is put into tins, and sent to all parts of Russia. It is calculated that the produce of these fisheries exceeds 200,000 tomans a year.

With regard to the agriculture, Consul Churchill remarks that there is a great difference between the climate of the southern shores of the Caspian Sea and the Plateau of Persia, between which rises the elevated range of the Elburz; for, while the latter is dry, these provinces are reputed for their dampness, and their vegetation is quite tropical. Swampy forests cover the whole surface of the lowlands lying at the foot of the Elburz in its northern face, in which every description of forest tree grows luxuriantly; thus, walnuts, nuts, pomegranates, mulberries, plums, grapes, pears, hops, and various kinds of berries grow wild in the forests; their quality is necessarily inferior, but they afford ample subsistence to the poor, who are, in consequence, inclined to be indolent. In summer, the vegetable gardens produce every kind of melon and cucumber, and the vast quantities of this crude fruit consumed by the lower classes generates various sorts of fevers, which prevail between the months of July and October. Owing to the great abundance of water on the surface of the soil everywhere, rice is grown very considerably, but the culture of the mulberry-tree absorbs the greater part of the attention of the inhabitants. There are extensive plantations of this tree to be seen all over the plains. The younger the trees the more is the leaf prized as food for the silkworm, and old trees are usually cut down to make room for new plantations. Near the foot of the mountains boxwood grows in abundance, particularly in the district of Tenekapoun, in the province of Mazanderun. In the valley of the Elburz, through which the Sefudrood runs from the plateau of Persia to the Caspian Sea, the olive tree grows freely, and olive oil of a very fair quality might be produced if proper presses were employed; as it is, the oil extracted by the most primitive methods is thick, and unsuited for the table; it is principally used in the manufacture of soap. Oranges, lemons, mandarins, and all the various descriptions of this kind of fruit, are plentiful. Tobacco, of the quality grown on the shores of the Black Sea, and known under the name of *tafra*, has been tried at Resht, and the quality produced is not inferior to the original stock.

It is only of late years that cattle have been exported in any considerable quantities. The oxen are of the Indian breed, with a hump on the back, and of a diminutive species. They are not used for draught, and are only killed for butchers' meat in winter. Sheep and goats are not so plentiful; their wool is of a fine texture, but very dirty, and in this state it is sold in the markets. The Turcoman breed of horses, procurable in the province of Asterabad, is peculiar to Persia. It is a large-boned animal of the English hunter type, very hardy, and up to any amount of work. They fetch high prices in Persia, and are much prized at the capital. In some parts of Ghilan, horses as wild as the roebuck and the stag are met with at times, animals born and bred in the jungle.

CEYLON TEA.

With regard to the introduction and cultivation of tea in Ceylon, the following notes from Dr. Thwaites' annual reports on the Botanic Garden at Peradeniya, extending over a period of about twelve years, may be of interest:—During the year 1864, some gentlemen interested in the cultivation of tea in India visited Ceylon, and expressed a favourable opinion as to the capability of the island to produce tea of very excellent quality, with the likelihood of its cultivation being very remunerative. Seeds of the tea-plant were obtained, and plants were raised in the Botanic Garden, as well as at Hakgalle, for the purpose of distribution.

In 1865, Dr. Thwaites reports:—"A considerable quantity of the seed has been distributed during the past year. The climate of Ceylon seems admirably adapted for the successful cultivation of tea. The plant grows well from the elevation of Peradeniya (1,600 feet) to that of Hakgalle (5,000 feet), and it would no doubt thrive in situations somewhat higher than the latter; and as there are extensive tracts of forest land in the island too high for coffee, but quite suitable for tea, it may reasonably be anticipated that the cultivation of the latter will at some future time assume large proportions. In view of such a contingency, and in order to secure the production of a larger quantity of seed than is at present procurable in the island, an addition is being made to the number of tea-plants now growing in this garden, a certain number have been planted out at Hakgalle, and several planters are, at my suggestion, forming small nurseries of tea upon these estates."

A year later the cultivation of tea had become more decided, and had advanced to a considerable extent. An experienced planter was also sent under Government auspices to inspect and report upon the cultivation and preparation of tea as carried on in the tea district of India. The information so obtained, bearing on the gathering of the leaves, the quality of the produce, the differences of climate, &c., was embodied in a report, and issued from the Government press.

In 1869, young plants of the Assam hybrid variety, raised from seed, were growing vigorously at Hakgalle in a small plantation which had been formed, and which contained 270 plants. All the varieties of tea are reported to succeed far better at Hakgalle than at Peradeniya. The China tea is stated to be the only one which grows at all well at the lower elevation, where it is more stunted in its growth than when planted on the hills. From the plants in the small tea plantation at Hakgalle and Peradiniya, quantities of seeds, more especially of the Assam hybrid variety, were distributed in 1870. Dr. Thwaites says, "the tea plant thrives so luxuriantly upon our hills at an elevation slightly above that suited for coffee cultivation, that it is difficult not to believe that our slopes will before very long be covered with thriving tea plantations." In 1871, the report says, "the different kinds of tea are being propagated to some extent for the purpose of supplying seeds to persons who would undertake to sow them and carefully cultivate the plants raised from them." "Tea," Dr. Thwaites says, "is slowly getting into cultivation here, and I am glad to be able to announce that an experiment on a tolerably large scale, and with the proper appliances, is about to be made in the preparation of leaves by one of our principal planting firms. It has been suggested that, as there are several plantings of tea on different estates, it might be desirable too btain from the Assam tea districts two or three respectable men who are experts in the manufacture of tea suitable for the English market. These men might instruct a certain number of planters and intelligent natives in the proper system of preparation of the tea, from the picking of the leaves to their being ready for exportation as the finished article of commerce. In 1872, the tea cultivation is reported to be still making rapid advances in the island; the manufactured article is pronounced to be of excellent quality, producing a bright, clear, fragrant, and palatable infusion. The Assam hybrid variety being still greatly in demand, the same demand continued in 1874, and if plants and good seeds could have been procured in larger numbers, the cultivation would have advanced more rapidly. Dr. Thwaites says, "There cannot be the least doubt, however, that these difficulties will not long operate as a check, the climate of the island being so admirably adapted for tea-growing. I would strongly recommend trials being made of the ordinary Bohea-tea of China on abandoned coffee estates, rather than that weeds should be allowed to take possession of the land. There can hardly be a doubt that the expense of such a step would be more than repaid, if tea is one day to become, as it most probably will, one of the most important staple products of the island."

In 1875, tea cultivation is reported as progressing most rapidly in the island; and the last report, for the year ending March last, says, "it is now a well-established fact that commercial tea of a very superior quality indeed can be produced in Ceylon." Such then is a brief history of tea cultivation in Ceylon.

FAC-SIMILE TELEGRAPHY.

An American paper, the *Philadelphia Times*, gives the following description of a system of *fac-simile* telegraphy, invented by Messrs. W. E. Sawyer and J. G. Smith, which was first put into practical operation last September at the Centennial grounds, being connected with a transmitting apparatus at the chief signal-office at Washington. Its reproductions of messages and charts have been extensively published, and the Signal Service Department, pronouncing the invention to be perfectly satisfactory, has adopted it for the telegraphic transmission of weather charts.

The present invention is the first to accomplish, practically, that great revolution in telegraphy by which the *fac-simile* of a man's handwriting, a map, or anything drawn upon a limited surface, can be transmitted in a moment from one end of the world to another. The circuit of the present apparatus is 150 miles in length. Before this invention the weather maps showing the results of meteorological observations at the various signal stations throughout the country, the isotherms, or lines passing through points having the same temperature; the isobars, or lines passing through points having the same barometrical indication, with other important information, were prepared in Washington only, being thence despatched by mail to all parts of the country, arriving at such places as San Francisco and New Orleans too late to be of any use, except as records. This difficulty appears to be overcome by the present invention. The operation reproduces exactly, at any distance to which a message can be sent by the ordinary telegraph, *fac-similes* of anything drawn upon paper.

The operation and construction of the instrument are extremely simple. A message is written, or a map is drawn, on ordinary paper with copying ink, or any ink to which has been added one-fourth its bulk of glycerine or other oily substance. The marked surface is then sprinkled with finely powdered shellac, which adheres to the lines for several hours.

The paper is then put, with the marked surface inward, upon a hot, thin zinc plate, and both are passed between pressure-rollers; the shellac is thus transferred to the zinc, and a perfect negative of the message or map is obtained in shellac, so as to give a copy of the message in a non-conducting material on a metal surface. This zinc plate, which is about six inches long, and five in width, is then wrapped, with the shellac impression outside, closely round a cylinder having a convex surface of equal area to its own, and this is caused to revolve horizontally by an electric motor. A screw of the same length as the cylinder, to which it is placed near and parallel, is also caused to revolve by the same motor. Along two rods parallel to this screw, and a little below its plane, moves from right to left of the cylinder a block of brass, in which is fixed a steel point touching the surface of the cylinder. This block has only a lateral motion, being worked by the screw, which acts merely upon its under edge. As it moves, the point describes an imaginary spiral line on the surface of the revolving cylinder. At the station at which the message or map is to be received, is an instrument similar to that just described, except that the imaginary spiral line is traced upon chemically-prepared paper, wrapped round the cylinder instead of the zinc plate. The cylinders revolve exactly at the same rate, as if they were both fast on one axle. When the transmitting point touches the shellac line the electrical current is broken, and the receiving point at the distant station strikes the chemical paper, and causing decomposition, leaves a dot there. Thus the operation continues until both points have traversed the entire surface of their respective cylinders, and the message or map on the transmitting instrument is reproduced on the receiving prepared paper. Whatever may be the original, whatever pictures, hieroglyphics, or writing, it will be exactly reproduced.

It has been stated that by the present system of telegraphy an error is made for every three messages sent, whereas by the above-described method, whatever has been drawn or written on the original, must be reproduced at the other end of the line; one word cannot possibly be sent for another.

The chemical paper is taken from the cylinder, and the *fac-simile*, if that of weather lines, is traced upon a clay mould bearing the outline map. A cast of this mould is then made in type metal, and the weather charts may then be struck off *ad libitum*. Such is the dispatch attending this invention, that within two hours after the meteorological reports have been received in Washington, from one hundred or more signal stations in the United States, weather charts showing the conclusions arrived at, after studying all these reports, can be had in any part of the country.

The number of applications for patents amounted to 5,069 during the year just ended. This very greatly exceeds the number in any former year, the highest number previously having been 4,561 in 1875. The rapidity of the increase may be judged from the fact that the number in 1870 was 3,405.

The Commissioners of Patents have given notice that in every case where a specification is out of print, they will be willing to reprint the same and supply copies thereof, at cost price, on prepayment of a sum of money sufficient to cover the cost of reprinting by the person requiring them. The usual practice hitherto has been to keep the specifications always in print, reprints being made as required.

A step towards the advancement of technical education is about to be taken in South London, it being proposed to establish technical classes especially adapted to various trades, such as masons, carpenters, &c., at the Working Men's College, Blackfriars-road.

TWO YEARS' STREET-WORK IN LEEDS.

From a report made to the Council of the Borough of Leeds by Mr. Alderman Tatham, the Chairman of the Streets and Sewerage Committee, it appears that during the last two years as much as 25 miles 4 furlongs and 148 yards of sewers have been laid in that borough, and, in addition to this great length of sewers, there have been laid 5 miles 3 furlongs and 88 yards of branch-pipes from the sewers towards the houses, *i.e.*, as far as the kerbstones of the footpaths; and that 1,801 street-gullies have been made and connected with the sewers by the contractors who have done the other work; but, in addition to these, the workmen regularly employed and paid by the Corporation put in 395 new gullies, rebuilt 396 old ones, and repaired the large number of 2,024.

The cost of these extensive works has, of course, been great. The total cost of sewerage works, including the branches, has been, in the two years, £29,390.

If we regard the surface-work of the streets the amount done appears equally large. The number of streets paved and flagged during the two years has been 146, being in length 7 miles, 3 furlongs, and 171 yards. When houses are built, and new streets laid out by the owners of the land, these are paved and flagged at the expense of those owners. They may do the work themselves, if they please, provided it be done under the direction, and according to the rules, of the Corporation; but as they cannot in general do the work for less money than the Corporation can do it for under their periodical contracts, the custom is that, in general, the Corporation pave and flag the new streets, and charge the expenses to the owners. It is usual to allow the greater number of houses intended to be built in a new street to be built before the paving or flagging is done, but inasmuch as, without some guide, the levels of the several door-sills would not be at all uniform, the ground is roughly levelled, and the kerbstones set from end to end of the intended street, from which, opposite to them, the levels of the several door-sills are fixed. With this explanation it is less surprising than it otherwise would be to see the total length of kerbing done in the last two years set down as being 17 miles 3 furlongs and 127 yards.

The total cost of paving, flagging, and kerbing, chargeable to owners has been £32,450, and the total cost of paving and flagging paid out of improvement rates, £1,860. Thus the total cost of sewers and paving has been £64,120, or upwards of £30,000 a year, taking a mean of the two years. These are works of and under the surface.

According to another report presented to the Council of the Borough of Leeds by the Chairman of the Building Clauses Committee (Mr. R. Gallsworthy, the present mayor), there were presented to that committee for approval during the last two years plans for the building of 7,559 houses, of which 4,874 were approved. The numbers for the year 1876 were about one-seventh greater than for the previous year, being 3,546 in 1875 and 4,013 in 1876 presented for approval, and 2,074 in 1875 and 2,800 in 1876 approved.

During the same two years the plans of 553 buildings were approved, consisting of mills, warehouses, stables, workshops, &c., and there were submitted plans for three churches, fifteen chapels, six mission-rooms, and one synagogue, one Roman Catholic seminary, twenty-seven schools, two skating-rinks, one theatre, two circuses, three bridges, one orphanage, one dining-hall.

One thousand two hundred and forty-four dwelling-houses have been completed and certified for occupation during the present year. The population is, we believe, estimated at about 280,000 at this time.—*Builder*.

The winter term of the Birkbeck Literary and Scientific Institution will commence on Monday next. In addition to other prizes, the Chancellor of the Exchequer has offered an English essay prize of five guineas.

CORRESPONDENCE.

WHEAT FROM INDIA.

Last February we had a paper read by Mr. Magniac on the "Suez Canal and its Influence on the Trade of the East," and in the course of the discussion which followed, several of the speakers, Mr. John Fleming, Dr. Burn, myself, and others, referred to the large trade in wheat which had sprung up since the opening of the canal had so greatly shortened the voyage, and practically got rid of the difficulty from the "weevil." In the subsequent discussion on Mr. Seyd's paper on the "Depreciation of Silver," I referred incidentally to the same subject, and expressed my belief that the great fall in value of silver and rates of Indian exchange was largely attributable to the bad state of the Indian trade, and the decrease in the total value of Indian exports, and that one of the most effectual remedies to this must be found in an increase in value of what India sends us, and that a low exchange could not fail to help us in this direction.

It is notorious that there has been a large advance in the price of silver and rates of India and other Eastern exchanges; but my present object is merely to refer to the matter given in the heading of this letter.

As many of your readers may not have seen it, it will probably interest them if I send the accompanying extract of the report of the directors of the East India Railway Company, the oldest, the largest, and, I may add, the most prosperous company in London. Their report is for the first half of the year 1876, and shows a nett increase in revenue of £160,811, and they say "these satisfactory results have arisen from a progressive general increase in the internal traffic of the country, and more especially from heavy consignments to Calcutta of grain (wheat in particular) from Cawnpore and other distant marts, and of oil seeds from Patna, consequent on the reduction of rates for those staples, and other facilities afforded by the company to enable traders to meet the large demand for foreign exports caused by the fall in the exchange, and the remission of the export duties by the Government."

In 1875, the Government of India wisely and boldly took off the export duty on wheat and seeds, and they have had their reward in the increased extension in the trade in those articles, an extension which, however, I believe, has only now commenced.

The *Economist* newspaper has always strongly and consistently urged the vital importance of increasing the value of Indian exports, and shown how the recently low exchanges have aided this. In the paper of last Saturday they have published the foregoing extract from the report of the East India Railway Company, and they have added some figures as to the export of wheat from Calcutta. They are as follows:—

	Tons.
Half-year ending 30th April, 1875	9,480
" " 1876	64,651
In the commercial year ending 30th April, 1873	13,134
" " 1874	50,494
" " 1875	33,891
" " 1876	83,936

And it is added, and this is the most striking fact of all, that in the four months, April to July, 1876, the exports had got up to as much as 107,150 tons, and during all this time exchange has been low and freights very moderate. It is known that the exports from Bombay has largely increased, but I have not seen the figures, and I believe they are only given for grain generally.

Under any circumstances, this great increase in our trade with India in wheat must be very satisfactory, but it must be specially so in view of the cloud which hangs over the Eastern question, and which may at any time burst in a war, at all events between Russia and Turkey, and a still further injury to our great grain trade with the Black Sea ports.

William Maitland.

2, Royal Exchange-buildings, 27th December, 1876.

LIBERIAN COFFEE.

As I have been acquainted with Liberian coffee growing for the last ten years, and am much interested in the subject, will you allow me to correct what must be an inaccuracy in your note upon the subject in the *Journal* of last week? It is there stated that the tree "becomes capable of yielding twenty pounds, and some very old trees have been known to give twenty-four pounds each;" a statement which, I think, is likely to mislead. Such a crop, if it has ever been gathered from one tree, must have been quite exceptional; as far as my experience goes, the Liberian trees yield on the average less than those of Ceylon; this I am of opinion is due, however, to want of higher cultivation rather than to any peculiarity in the species, as the yield has been steadily increasing as more care and knowledge is brought to bear on the subject.

I had some seed very carefully prepared of last year's growth for a gentleman who is interested in coffee planting in India, and I look forward with great interest to the result of the experiment, as I believe the commercial interest, at least for some time to come, attaching to Liberian coffee, will have to be developed in other than Liberian plantations.

With regard to the quality of the coffee, there can, I think, be no two opinions, especially when about two years old. When possible, I have the berries dried in the red husk, and put away for use until, at least, the year after picking; it is then broken from the husk and roasted as required.

H. C. Criswick.

27th December, 1876.

SPELLING REFORM.

Now that the School Board for London has invited the provincial School Boards and the Society of Arts to unite in asking for a Royal Commission of Inquiry as to the best way of meeting the English spelling difficulty, it would be interesting to know how much we are already indebted to the Society of Arts for directing public attention to the matter. In the *Journal of the Society of Arts* for April 22nd, 1870 (vol. xviii., No. 909), will be found a paper by Mr. Alexander J. Ellis, proposing his remedy—glossic, a form of phonetic spelling without new letters, and in the discussion which followed the reading of the paper, Mr. Chadwick, who presided on the occasion, made some exceedingly apt and pertinent remarks. He said that the importance of the question of spelling reform was well appreciated by the Council of the Society, and spoke of the necessity that would arise for avoiding all needless waste of time in the education of "the great new army of little enforced conscripts," whom the compulsory clauses of the then proposed Education Act would send to the National schools. Mr. Chadwick also touched upon the money aspect of the matter, which alone is sufficiently important to arrest the attention of all true economists.

It is the more important that the Society of Arts should now resume its useful work in this direction, because it is plain that the newspaper press,* although fully alive to the nature of the difficulty, does not appreciate the benefit which would spring from the reform, nor understand the method in which it is proposed to bring it about. Looking at the assumed position of the daily press as an organ of popular enlightenment, the words irresistibly suggest themselves, "for if the light that is in you be darkness, how great is that darkness."

If some such plan as Mr. Ellis's were followed, no grown man or woman able to spell in the present fashion, would have to go to school again, either to learn or to unlearn spelling or grammar. The present system would be held quite sacred and undisturbed. Children and beginners would, however, be taught English pronunciation and spelling at the same time, and "wuod soon bee aibel too reit widh eez in a konsistent steil ov speling intelijibel at seit too aul Ingglish reederz aul dhi world oaver." These new spellers, after two or three years' familiarity with educational books printed in the new spelling, would be able to read books and newspapers in the spelling now current almost without instruction, certainly with no more difficulty than we of this day have in reading the following:—"In Engglande many wyll saye that these are customes that hathe of long bene yoused; yett in mine oppynyon, and if they be never so olde, and not for the honour or profett of the realme, they may well be broken." No link of the past worth maintaining will be snapped by the introduction of a judicious spelling reform. A long time will no doubt be required for the reform to become thorough. The greater reason why it should be begun without further delay.

The common-sense view of the matter is this. People who understand English when it is spoken will not fail to understand it when they see the spoken sounds expressed by simple symbols mutually agreed upon. In Mr. Ellis's "English Glossic," the symbols are drawn from the English alphabet exclusively. English sentences written in them can be read by *all* English readers, new and old, at sight.—*Q.E.D.*

Languages have an organic growth. The grand and flexible English language is rapidly growing. It bids fair, in fact, to cover the earth. Under the operation of a law common enough in the organic world, it is now, I believe, about to slough its integument, the present "effete and corrupt" spelling,* often mis-called orthography. The operation may take a long time, and there will doubtless be ample opportunity for those who admire the motley cast-off skin to cling to it to the last, leaving to others the enjoyment of the vigorous and healthy new life.

Will you, in conclusion, allow me to quit metaphor, to which I am all unused, and to observe that what we now want is a Royal Commission of sensible and practical men, to say whether the would-be reformers of English spelling are merely, as some think, troublesome lunatics, or whether, to use a homely phrase, they are men thoroughly awake to the need of the day, who have "got hold of the right end of the stick."

J. B. Rundell.

27th December, 1876.

OBITUARY.

Sir Titus Salt.—Titus Salt might be instanced as one of the finest specimens of a British manufacturer. For a quarter of a century he had been a member of the Society of Arts, and liberally promoted its objects when applied to. He greatly aided the Exhibition of 1851. He was a large guarantor to the Exhibition of 1862. He established a Scholarship in the National Training School for Music with £1,000. He was among the first to take a box in the Albert-hall. He died at Crow-nest, near Halifax, on the 29th December. The *Times* has given a biography of him, from which the following extracts are made:—"Sir Titus Salt was born on the 20th of September, 1803, at the old Manor-house, Morley. His father, who was a woolstapler, moved with his family from Morley to Crofton, near Wakefield, and at Heath

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* See *Times* leader, Monday, 18th December.

* Max Müller.

Grammar School, near that town, his son received his education. It was just at the time when the worsted manufacture was beginning to rise from a domestic operation to a factory institution; and, as the change was distasteful to the older stuff manufacturers in the district around Wakefield, the trade shifted its quarters and settled at Bradford. Among those who moved with it were Daniel Salt and his family. The father continued to confine himself to the purchase and sale of wool. The more ambitious son determined to attempt the manufacture of stuffs, and gave the first indication of his speciality in the utilising of raw materials heretofore unappreciated. The wool called 'Donskoi,' from the south-eastern parts of Russia, grown on the banks of the River Don, was a coarse and tangled material, then considered unavailable for purposes of manufacture. How to overcome the difficulties of spinning and weaving this article was the first problem Mr. Titus Salt set himself to solve. For this purpose he set up his machinery in what was known as Thompson's Mill, Silsbridge-lane, Bradford. Successful in this enterprise, he extended his operations in this and other branches of the worsted manufacture, and added a large factory in Union-street. His trade grew rapidly under his hands, and in a few years he was carrying on his works, not only in the two places just named, but also at Hollings' Mill, Silsbridge-lane; at Brick-lane Mill; and in Fawcett-court. It was in the year 1836 that he achieved his greatest success, in becoming for practical purposes the discoverer of the wool or hair known in almost all parts of the civilised world as alpaca. The existence of the animal called the paca, or alpaca, had, indeed, been known nearly 300 years before, and its long fleeces were boasted of by the Spanish Governors of Peru in the sixteenth century. But no one in England had operated upon the article with much success, and it was shown to Mr. Salt by a Liverpool broker as a novelty in 1836. While thus founding his private fortunes, he was not unmindful of his more public obligations. He was elected Mayor of Bradford in 1848, and discharged the duties of that office with punctuality and efficiency. Meanwhile, his reputation as a manufacturer was advancing, and the increased demand for his goods rendered necessary improved facilities for their production. Accordingly, in 1851, the year of the 'Great Exhibition,' the works at Saltaire were commenced. They were opened on the 20th of September, 1853, the fiftieth anniversary of their owner's birthday, on which occasion he gave, in one of the vast rooms of the factory, a banquet, at which he entertained 2,500 workpeople. The works started with such *éclat* received subsequently various additions and improvements, and furnish employment to a very large number of persons, for whose accommodation he erected the dwellings now grown into the town of Saltaire. These comprised, at the last census taken, 820 houses, occupied by 4,389 persons. In 1859 he erected the Congregational Church at Saltaire. In 1863, by erecting buildings for baths and wash-houses, he provided for the cleanliness and consequent self-respect of his workpeople. He had before this furnished them with facilities for the education of their children by building a large schoolroom: but as, with the extension of his works and the increase in the numbers of his workpeople, this provision had in his judgment become inadequate, he built a fresh range of school-rooms in 1868, with accommodation for 750 scholars. During the past summer a new Sunday-school was built by Sir Titus in connection with the Saltaire Congregational Church, costing, with site, nearly £10,000. It may be mentioned, also, that he contributed in a munificent manner towards the cost of the handsome Congregational Church at Lightcliffe, and has very recently offered a site for a Board school at Saltaire. A hospital and infirmary have also been added to his erections, so that the needs of the sick might be relieved; while for the widows and aged he provided forty-five alms-houses, with a lawn and shrubbery in front, all so neatly kept as to be models of cleanliness and comfort. The married couples receive 10s. per week, the unmarried inmates 7s. 6d. In 1871 a beautiful park, fourteen acres in extent, on the banks of the River Aire, and within an easy distance of the factory and the town, was given by Sir Titus Salt for the use of the public; and in November of the following year a large and handsome building was provided by him to serve as a Club and Institute, where a large library is to be found, evening classes assemble, lectures on science and literature are delivered, and the games of chess and billiards may be played. In the year 1859 he was elected member of Parliament for the borough of Bradford. So long as he filled this post he attended regularly the sittings of the House of Commons, but the post was somewhat of an irksome one to him, and he resigned his office in 1861 and came back to his admiring followers and friends. Previous to entering Parliament, however, he had filled a number of important public offices. Besides being a magistrate for the borough of Bradford, he was appointed on the commission of the peace for the West Riding, and was also made a deputy lieutenant of the Riding. In 1857 he filled the office of President of the Bradford Chamber of Commerce. In September, 1869, the Queen conferred a baronetcy upon him—an act which was universally recognised as a well-merited bestowal of the Royal favour. During the last few years he has lived in retirement at Crow-nest, although never relinquishing his connection with the works at Saltaire. During the twenty-three years over which the history of Saltaire now extends, there have been many public manifestations of the high esteem in which Sir Titus Salt was held both by his own workpeople and the public generally. On the 20th of September, 1856, a marble bust of Sir Titus, executed by Mr. T. Milnes, was presented to him by the people of Saltaire. In July, 1869, the residents of the alms-houses presented him with a pair of gold spectacles and a silver-mounted staff. In September, 1870, two silver-plated corner dishes were given to him by the children of Saltaire. An oil portrait of himself, painted by Mr. J. P. Knight, R.A., was subscribed for in 1871, and on the 26th of August in that year was presented to him in the Bradford Mechanics' Institute, along with an address expressing in flattering terms the affection and esteem of the subscribers. In 1829 Sir Titus married Caroline, daughter of Mr. George Whitlam, of Grimsby, by whom he had a family of eleven children. Several of his sons have become partners in the firm now known as 'Sir Titus Salt, Bart., Sons, and Co.,' and have shown an activity in carrying on the gigantic works at Saltaire, and a zeal in promoting the welfare of the workpeople, that are warmly appreciated."

GENERAL NOTES.

Fish Culture at Huningue.—A report, recently published by the Government of Alsace and Lorraine, gives some details respecting the great establishment for fish culture at Huningue. Various additions have been made during the past season at this establishment, the principal of which include several tanks for breeding young carp, and two for rearing this fish for sale, as also a large tank for trout. The rearing of gold-fish, carp, and especially trout, was successful in 1875. For the first time, the fecundation of the spawn of the fish, called "hunchen" has been effected, the acclimatisation of which fish in the Rhine would be of great advantage as an article of food. This fish, which is only met with in the Daunbe, is of considerable size, often reaching as much as 70 lbs. in weight, its flesh is white and firm, and quite equal to salmon. Apart from the results obtained in this establishment itself, it appears to have a beneficial influence on the principal rivers and streams in Germany, and the salmon fisheries in the Rhine, the Weser and the Oder, were never more productive than in 1875, thanks to the stocking of these rivers with young fry from Huningue. During the past year the eggs of 1,565,000 salmon, 247,000 salmon-trout, 254,000 saibling, 924,000 trout, 318,000 féras, 40,000 hybrid fish, making a total of 3,348,000, were artificially hatched, and of this number about two-thirds have been sent away to stock the rivers. The féra is a fish peculiar to the Swiss lakes, and the saibling is only met with in the Alpine lakes; it is of excellent quality.

Wood Paving.—In reply to inquiries made by the Corporation of London, the Commissioner of Public Works in New York states that the experience of that city, where a considerable amount of wood paving has been under trial for some years past on an extended scale, is very unfavourable to it. It has been found after being laid two or three years to be very expensive to renew or keep in repair. It decays and soon gets out of order, notwithstanding that a great variety of attempts have been made to preserve it by saturating it with tar, corrosive sublimate, and other chemicals. Since the decay has taken place in the wood pavements many complaints have been made of the offensive and unhealthy effluvia emitted from it. It is recommended that it be all taken up and replaced with stone.

Colour Blindness on Railways.—A St. Petersburg medical paper states that an examination of the employés of the Finland railway has been made recently by Dr. L. Kzohn, with a view to test their capacity for distinguishing colours. It was found that 43 persons were unable to distinguish red from green, amongst whom were a station inspector, and a pointsman, who had been employed for eight years at the St. Petersburg station. Similar examinations have been made in Sweden and in Hungary. On one of the Swedish lines 10 per cent. of the employés were effected with colour blindness to such a degree, as to be unable to distinguish red, green, or white from each other. In Hungary, out of 400 employés who were examined, one only was found to be totally colour blind, and 3 per cent. partially affected with this infirmity.

NOTICES.

PROCEEDINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday evenings, at 8 o'clock. The following arrangements have been made:—

January 17.—"The Cultivation of Common Fruits in England economically considered," by G. C. T. Bartley, Esq. "Railway Wastes and Reclamations," by Hyde Clarke, Esq. Lord Alfred S. Churchill will preside.

January 24.—

January 31.—"Ventilation of Rooms generally, and the way to make Workmen's Cottages comfortable, warm, and healthy," by Frank E. Thicke, Esq.

February 7.—"Street Tramways," by Captain Douglas Galton, C.B., R.E., F.R.S.

February 14.—"Zinc White as Paint, and the Treatment of Iron for the Prevention of Corrosion," by Prof. Barff, M.A.

February 21.—"Silkworm Grain," by Benjamin Francis Cobb, Esq.

February 28.—Middle Class Education in Holland," by John Yeats, Esq., LL.D., F.R.G.S.

African Section.

Tuesday evenings, at 8 o'clock. The following arrangements have been made:—

January 23.—"The Trade of Central Africa, Present and Future," by Commander Cameron, R.N., C.B.

February 13.—"The Geographical and Commercial Character of the District between Mogador and Cape Juby, North-West Africa," by N. Grammal, Esq.

March 13.—

April 10.—"The Social State and Prospects of the South African Communities," by Robert Richards, Esq., of Grahamstown.

April 24.—"The Trade and Resources of Morocco," by Dr. Archer Leared.

May 8.—

Indian Section.

Friday evenings, at 8 o'clock. The following arrangements have been made:—

February 2.—"Indian Tea; its Origin, Progress, and Prospects," by A. Burrell, Esq.

February 16.—"Indian Railways," by Julaud Danvers, Esq.

March 2.—"The Progress of Trade in Central Asia," by Sir Douglas Forsyth.

Papers will also be read on "The Wonderful Trees of India," by William Tayler, Esq.; "The Connections between Persia and India," by Major-General Sir Frederick John Goldsmid, C.B., K.C.S.I.; and on "The Native Indian Press," by Dr. George Birdwood, C.S.I.

Chemical Section.

Thursday evenings, at 8 o'clock. The arrangements for this Section will be shortly announced.

MEETINGS FOR THE ENSUING WEEK.

Mon. ...Royal Geographical, 1, Savile-row, W., 8½ p.m. Mr. Robert Michell, "The Russian Expedition to the Alai and Pamir."

British Architects, 9, Conduit-street, W., 8 p.m. Mr. John Lanyon, "Sanitary and Practical Appliances Calculated to Increase the Comfort of Dwellings."

Medical, 11, Chandos-street, W., 8 p.m.

Victoria Institute, 8, Adelphi-terrace, W.C., 8 p.m. 1. Mr. R. Laming, "The Form of Causative Energy for Material Creation." 2. Dr. Winn, "Materialistic Philosophy."

London Institution, Finsbury-circus, E.C., 5 p.m. Dr. B. W. Richardson, "Health Improvements in Great Cities." (Lecture I.)

Tues. ...Royal Institution, Albemarle-street, W., 3 p.m. (Juvenile Lectures.) Dr. J. H. Gladstone, "The Chemistry of Fire." (Lecture VI.)

Medical and Chirurgical, 53, Berners-street, Oxford-street, W., 8½ p.m.

Photographic, 5a, Pall-mall East, S.W., 8 p.m. Mr. S. Fry, "Carbon Printing."

Anthropological Institute, 4, St. Martin's-place, W.C. 1. Mr. H. N. Moseley, "The Inhabitants of the Admiralty Isles, and Fragments of their Language." With an Exhibition of Objects procured by him from the Islanders. 2. Mr. J. Park Harrison, "Report on Recent Excavations at Cissbury, in October, 1876." 3. Colonel A. Lane Fox, "Report on Measurements for the Anthropometric Committee."

Wed. ...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 7 p.m. (Juvenile Lectures.) Mr. R. A. Proctor, "Comets, Meteors, and the Stars."

Geological, Somerset-house, W.C., 8 p.m.

Graphic, University College, W.C., 8 p.m.

Royal Literary Fund, 10, John-street, Adelphi, W.C. 3 p.m.

Royal Society of Literature, 4, St. Martin's-place, W.C., 8 p.m.

Thur. ...Royal, Burlington House, W., 8½ p.m.

Antiquaries, Somerset House, W.C., 8½ p.m.

London Institution, Finsbury-circus, E.C., 7 p.m. Mr. Prof. Morley, "The History of the English Novel." (Lecture II.)

Historical, 11, Chandos-street, W., 8 p.m. 1. Mr. Hyde Clarke, "The Destruction of the Empire of Khita, by the Accad, Egyptian, and Jewish Invasions." 2. Mr. Jenkyn J. Ingram, "The Great Fire of London."

Society for the Encouragement of the Fine Arts, 9, Conduit, W., 8 p.m. Mr. Ferdinand Praeger, "Richard Wagner's Tetralogy." With illustrations.

Inventors' Institute, 4, St. Martin's-place, W.C., 8 p.m.

Royal Society Club, Willis's Rooms, St. James's, S.W., 6 p.m.

Mathematical, 22, Albemarle-street, W., 8 p.m.

Fri. ......Astronomical, Somerset House, W.C., 8 p.m.

Quekett Club, University College, W.C., 8 p.m.

Clinical, 53, Berners-street, W., 8½ p.m. Annual Meeting.

Sat. ......Trades' Guild of Learning and National Health Society (at the House of the Society of Arts), 8.30 p.m. Prof. W. H. Corfield, "The Laws of Health." Part I. (Lecture VI.)

EDINBURGH

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,260. Vol. XXV.

FRIDAY, JANUARY 12, 1877.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

SCIENCE LECTURES.

The Council have made arrangements for the delivery of six lectures on various scientific subjects, which will take the place of the usual papers and discussions, on six Wednesday evenings during the Session. The following gentlemen have each kindly consented to deliver one of the lectures:—Sir John Lubbock, Bart., F.R.S.; E. J. Reed, Esq., C.B., M.P.; Professor W. K. Clifford, M.A., F.R.S.; Professor Alexander Kennedy, C.E.; Dr. B. W. Richardson, F.R.S.; James Baillie Hamilton, Esq. Further particulars will be announced in a future number of the *Journal.*

JUVENILE LECTURES.

Mr. Proctor's second lecture was delivered to a large audience on Wednesday evening last, the 10th inst. Its subject was "Comets, Meteors, and the Stars." It was illustrated by a large number of photographs, shown by the oxy-hydrogen light.

NATIONAL TRAINING SCHOOL FOR MUSIC.

A fourth Liverpool Scholarship, in connection with this school, was competed for on Thursday, the 21st ultimo, by seven candidates, and was gained by Miss Ward, aged 16 years.

At Newcastle-upon-Tyne, Northumberland, on Wednesday, the 3rd instant, a competition was held for the Scholarship recently vacated by Eugène d'Albert, now the Queen's Scholar, and for a new Scholarship which has just been founded by the county. There were seven competitors, who were examined by Dr. Monck, organist of York Minster. The Scholarships were awarded to Miss Hall, aged 16 years, and Miss Emerson, aged 18 years.

The School re-opened for the Easter Term, with 78 scholars, on Wednesday, the 10th instant.

CANTOR LECTURES.

THE HISTORY OF THE ART OF COACH-BUILDING.

By G. A. Thrupp, Esq.

Lecture III.*

Carriages from 1790 *to* 1876.

"In the year 1790," according to a very competent judge, a coachbuilder then alive, Mr. Felton, "The art of coach-building had been in a gradual state of improvement for half a century past, and had now arrived to a very high degree of perfection, with respect both to the beauty, strength, and elegance of our English carriages." "The superior excellence, too, of English workmanship has not only been the occasion of a very great increase in their number in this country, but the exportation of them to foreign nations is become a profitable and considerable branch of British commerce."

These statements might have been made again and again, for many years after this date. Our carriages, as I will endeavour to show, have continued to improve; but no longer, I regret to have to say, are they exported in large numbers. The cost has so much increased, from the date of 1790, that foreign nations prefer to deal with manufacturers who can give them a vehicle which, to the eye, appears as good as our own, and in colours and finish is more to their taste, whilst the price is from 10 to 30 per cent. less than the British carriage.

Although I shall have occasion to treat this part of our subject in the last lecture more fully, I will here guard against misconception, by pointing out the example set us by our energetic brothers in the United States, who have secured a very large market for their carriages, even in English colonies, by building good and light vehicles at a moderate price. In confirmation of the statement of Mr. Felton in 1790, we find that English carriages had been exported to the North American and West Indian Colonies as early as 1740.

To return to Mr. Felton's work. He states that the coach trade was prosperous, and was not confined to coach-builders proper, but that harness-makers and others opened repositories for the sale of carriages. This practice was not confined to England, it was also a French custom, and so much so, that in the French Encyclopædia, coach-making is described under the heading of "Sellier" or "Saddler," and even now in some towns on the Continent, one may see "Sellier" painted on the front of a coach factory, without any other description of the trade.

The principal improvements in carriages in London from 1770 to 1790, were the invention of Mr. John Hatchett, of Long-acre, whose taste in building appears to have been prominent, and other coach-builders generally copied him.

Mr. Felton adds that many gentlemen took great pleasure and pride in getting a handsome coach built, and that his treatise was intended to aid them in forming a judgment thereon.

The following remarks are principally taken from Mr. Felton's work, as far as regards this period of 1790:—

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* Delivered December 4th, 1876.

"Carriages should always be built adapted to the places for which they are destined, whether for town, country, or Continent; as a greater stress is laid upon the carriage in drawing over stones than on a smooth road. This makes it absolutely necessary to build stronger for the town than if intended for the country only, owing to the general goodness of our English roads; it is also necessary to build stronger for the Continent than even for the town, as the badness of their roads obliges them to use six horses where we should use two.

"The construction of every carriage should be as light as the nature of the place for which it is destined will allow. It is folly to give unnecessary weight to the horses, as the pleasure of conveyance arises from expedition and ease, which cannot be effected in a cumbersome, heavy carriage.

"A false opinion pervades the minds of many persons, which is, to build strongly, regarding the durability of the carriage in preference to the preservation of the horses. Superior strength is only effected by additions in weight of the materials used.

"In the usual meaning of the word carriage among coach-makers, it is the lower framework on which the body containing the passengers is fixed or suspended, and to which the wheels are attached. Although, speaking generally, all vehicles are called carriages, yet, in speaking technically, the distinction must be observed.

"It is the body, however, which contains the passengers, which varies most in shape and size, and which is most conspicuous to the eye, and from which, therefore, we derive the particular name of each sort of vehicle."

In coach-building accordingly, the first process is to draw out a side view of the body, and carefully to assimilate the lines and curves to the prevailing fashion of the day. Secondly, to draw out the plan, or view from above, of the bottom and roof dimensions, with the sweep or cant lines downwards, and backwards, and forwards. The body-maker afterwards makes patterns in thin wood of all the different pieces of timber he requires; these are laid upon planks of ash timber, and marked with chalk, and sawn as nearly to the size as possible. The body-maker then proceeds to smooth one side of the pieces of wood and frame them together. It is unnecessary here to give further details of framing the body, it is sufficient to say that the chief timbers are called the bottom sides; upon them all the superstructure is raised, and upon their stability all depends; they are, therefore, of stout timber, and generally strengthened with iron plates several inches wide, and from a quarter to three-quarters of an inch thick. It is necessary to mention the bottom sides also, because we can hardly describe the shape of a body without mentioning them. The panels are of soft-grained mahogany, which was used in 1790, as well as at the present day in England; although our neighbours in France preferred then, and generally still use walnut and poplar-wood for panels. The roof, and bottom, and lining boards are of deal. The roof of a coach is covered with a hide of leather stretched on in a wet state.

The widths usual for the inside of bodies in those days was 3 ft. 5 in. for two persons, and 4 ft. o 4 ft. 2 in., for three persons on each seat. The eight of the seat from the floor was 14 inches, and from the roof 3 ft. 6 in. to 3ft. 9 in. These dimensions will serve to show how little we have varied from them to the present day.

The body being planned out and in progress, the carriage underworks were prepared, and Mr. Felton's description answers to the description in most particulars of the method of building from that time to this. The axles were common axles, with a single large nut and linch-pin, such as we now use to agricultural carts and street cabs only. There were improved axle-trees, with double nuts at each end of the axle-trees and patent axles, which were not then furnished with the loose collet now used, and mail axles; all these are carefully described, and evidently very closely resembled the axles in use in 1876. The axles were strengthened by wooden additions called beds, in which the axles were recessed and clipped. The front and hind axle-beds were joined by a long timber called a perch, with wooden side stays or wings behind. In front the under fore-carriage was joined to the perch by a large iron perch (or king) bolt. To secure a steady bearing for the upper and under carriages in locking round, a circle of iron and wood was added, termed wheel-plate in England, and the fifth wheel in America. Beneath the wheel-plate were the futchels (or fourchils) to support the splinter-bar and pole, or shafts. All these timbers were heavier in 1790 than those used in the following years; the ironwork was lighter and broke very frequently. The iron used by coachbuilders in those days was decidedly inferior to the iron of 1830. This remark applies chiefly to the smaller pieces of iron. When a large piece of work, such as an axle-tree or a crane was required, it was forged of a number of bars, welded together, and hammered into a tough, secure mass.

The wheels were the distinguishing feature of the carriages of that day, from their great height and light appearance, and demand some consideration from us.

The extreme height of wheels extended to 5 ft. 8 in., which were made with but 14 spokes; wheels 5 ft. 4 in. high had 12 spokes; wheels 4 ft. 6 in. had 10 spokes; and the lowest wheels, 3 ft. 2 in. high, 8 spokes. The naves were of elm, the spokes of oak, and the rims or felloes of ash or beech. The rims of the higher wheels were often of bent timber, in two or more pieces, and were bolted to the tyres by one bolt between each pair of spokes. The tyre was generally put on in pieces, the end joining in the middle of the felloe. But the better sort of wheels had the tyre put on in one piece, and called, as in the present day, "a hoop tyre."

"Many persons," Mr. Felton says, "prefer the common sort of wheel, on account of their being more easily repaired than the hoop tyre wheel; but though the repairing the latter is more difficult, they are much less subject to need it." In consequence of the great height of the wheels, it was necessary to make the carriages very long, and the distance from the front to the hind axle-tree was 9 ft. 2 in. in a chariot, and 9 ft. 8 in. in a coach, or about 8 in. in each longer than we should think necessary now. In hackney coaches a shorter perch was customary. Crane-neck perches were still used. The springs were chiefly what is termed the whip spring, namely, an upright spring, slightly curved at the top towards the body. The same spring, if united at the point to another, became a nutcracker or elbow spring. The same united at the thick end with another became the grasshopper, or horizontal spring, and was used for gigs. The **C** spring was also occasionally used. There was also a small conical spring placed between the double of the braces, after the manner recommended by Mr. Thomas to the Academy of Sciences at Paris, in 1703.

Having thus described the making of the body and carriage, we naturally proceed to the product. What was the actual appearance of the coach of 1790? We are again assisted here by the existence of a coach of that period. In the museum of South Kensington may be seen the Lord Chancellor of Ireland's coach, a large body with deep panels, flat-sided, longer on the roof than at the elbow, with windows in the upper quarters; the carriage with two crane perches, Berlin fashion, whip springs, and very high wheels. There is no hind footboard, whilst a hammer-cloth for the coachman is raised upon scroll ironwork, very well made. The shape and appearance corresponds with the designs in Mr. Felton's book, and with drawings now in the possession of the well-known firm of Barker and Co., of coaches built by their house for the Duke of Bedford and others during 1780 to 1800.

The chariot was something like the chariot of later days, but was made with smaller windows, deeper panels, a very shallow rocker, and with a sword case; this was an ugly excrescence at the back of the body, to which there was an opening from behind that squab against which the shoulders rest. The sword-case was at first intended to contain weapons, too frequently required by the many highway robbers that were encountered by travellers, and for fifty years it was considered essential to almost every carriage that was built; but it was a relief to every critical eye when coach-makers were allowed to omit it.

Landaus were originally invented about the year 1757, at the fortified town of Landau, in Western Germany.

The landaus in 1790 were like the coaches, but made to open in the centre of the roof, the framework of which fell back at an angle of 45 degrees only, to allow the admission of air, and the sight of the country, more freely than in a coach; but for nearly fifty years there was no improvement in the method of opening and closing the top, technically termed the "hood" of the landau.

Landaulets were chariots made to open. The hoods of both landaus and landaulets, and other carriages, were then made of greasy harness leather, disagreeable to touch or smell, and continually needing oil and blacking rubbed into them to keep them supple and black. This was certainly much against their popularity; but, considering that they were two carriages in one, and would serve for day and night work, and summer and winter, it is not surprising that they found a large amount of patronage.

Besides these vehicles there were phaetons, barouches, sociables, curricles, gigs, and whiskies. Of these phaetons there were several sorts, but all for self-driving by the owners. Young England, in those days especially, delighted in very lofty phaetons and fast driving. The romantic tales of this age, as well as the biographies, are full of anecdotes of adventures by upsets out of these dangerous machines, and yet of the fearful pleasure there was in driving them.

One was called the "Perch-high Phaeton." It was shaped like a curricle, and had a hood. The centre of the body was hung exactly over the front axle-tree, the bottom of the body was 5 ft. from the ground, the front wheels were 4 ft. high, and the hind wheels 5 ft. 8 in. The hind wheels were far behind, as we see them in a horse-dealer's skeleton brake. There was a large platform board over the hind axle-tree, for servants or luggage. On such a carriage George IV., when Prince of Wales, used to drive to the race-course, or round Hyde-park. It was on such a carriage that the Hon. Col. Onslow, generally called "Tommy Onslow," performed his feats of driving.

"What can Tommy Onslow do,
He can drive a chaise and two;
What can Tommy Onslow more.
Oh, he drives a chaise and four."

Another sort of phaeton, with the wheels 6 in. or 8 in. lower, and the body slung between the wheels, was used driving and posting. A third sort was used for small horses, with the front wheels 3 ft. 2 in. and the hind wheels 4 ft. 9 in.

Then there was a one-horse phaeton, the body of which was over the hind axle, and it was hung on grasshopper springs, bolted to the axle, and connected with the body by scroll-irons; the body was joined to the fore carriage, which was without springs, by wooden stays, and the wheels locked round in front of the body. This distance of the horse from the driver, though it gives but an indifferent command of his head, yet secure the passengers from the danger of his heels.

The sociable in those days was, in shape, a double-cab body, made both with or without doors, and with or without a driving seat. Sometimes an open body, like this sociable, and a chariot had but one under carriage between them, which was used according to the year, either with the open or the closed body.

The larger wheeled carriages were hung upon framed carriages with whip springs behind and elbow springs in front, like the gentlemen's cabriolets of the present day. When drawn by two horses they were called curricles, or by one horse, chaises. There was a little variation in the shape of the body, namely, the full curricle patterns, and the half curricle with or without a boot—similar to a Tilbury or a gig body. The wheels were from 4 ft. 3 in. to 5 ft. in height. Lancewood was then used for shafts.

Another two-wheeled carriage was the whisky or gig fixed upon the shafts—which again were connected with the long horizontal springs by scroll-irons. The gig was also made with a moveable hood.

The rib chair was a similar vehicle, but without springs; the body had a solid board for a seat, rounded into a semi-circular form vehicle, with an upper rail of the same shape, supported by a number of small sticks hardly differing at all from the Stanhope shape of later days. This vehicle was made in the country towns for twelve pounds. The tax in 1790 upon two-wheel vehicles in general was £3 17s. each, but if the cost was only £12, and the words, "tax cart" were painted upon the gig or cart, the yearly tax was reduced to twelve shillings, hence a very large number of these "rib chairs" came into use among the gentry; whilst farmers used a similarly cheap cart without springs, and, to obtain some slight ease, had the seat slung upon straps fastened to the side of the cart. The tax upon four-wheeled carriages was £8 16s. for the first, and £9 18s. for the second carriage, but if three or more carriages were kept the owner had to pay a tax of £11 on each carriage.

It is difficult for a Government who must raise money to so adjust the taxes as not to impede at the same time the industry of the country. Looking back now at the alterations which took place from time to time in the taxes upon carriages used and carriages hired, we can have no hesitation in saying that sufficient attention has never been given to the remonstrances of coach-builders and hackney carriage owners at the offices of the Inland Revenue, and that consequently the owners and users of carriages have suffered an amount of annoyance that might and should, have been avoided; whilst the amount raised in taxes might been higher if it had been more judiciously apportioned.

I have now given a description of the principal vehicles of this period of the history of English coach-building. I wish to add that most, if not all, were used for travelling purposes, as well as for driving in the cities. By an ingenious arrangement the hammer-cloths could be removed, and the cushions on which the footmen stood behind the coach or chariot gave place to a trunk or rumble. Boxes fitted to the shape, and called imperials, were put upon the roofs. Dragshoes and chains, toolbudgets and dragstaff were added, and the vehicle could then be used as a comfortable travelling carriage. The curricles and phaetons were all used to carry trunks, and these are described by Mr. Felton very minutely, so as to make it clear we have not much improved upon the fittings of a travelling carriage since 1790.

Looking once more at the history I have given of the state of the coach-trade in 1790, it is impossible not to be surprised at the considerable advance from the clumsy vehicles of Queen Anne and George I.'s time. But during the reigns of George II. and George III., all our manufactures had received an immense impulse from the energy of the men of the time. Discoveries were continually being made in arts and manufactures. Books were written and experiments tried, and debates were held in every workshop as to the best method of construction and arrangements of all the parts, and improvements by the artisans employed became a matter of course. It is true that, with the increased wealth of England, there was an increased demand for carriages, and a demand will always produce a supply, but all must admit that the supply in those days was a very good supply, and all the varied demands were met with considerable pains and ingenuity.

In the year 1769, the Society of Arts had given 60 guineas to Mr. T. Hunt for improvements in tyring wheels, and 20 guineas to Mr. Joseph Jacob, of St. Mary-axe, for improved coach springs. This same Mr. Jacob wrote a clever treatise on carriages in 1773 and 1777; he repaired the City State coach. In 1772, the Society of Arts gave 20 guineas to Mr. W. Bailey, for improvements in the locking of waggons; and in 1773, the Society of Arts had experiments made in the draught of carriages, and rewarded a Mr. Cuthbert Clarke with 15 guineas, for an essay on the height of wheels. Later, Dr. Edgeworth, in 1816, conducted a series of interesting experiments at Dublin, with a view to ascertain the difference that high and low wheels, long and short carriages, and springs placed between the axles and the vehicles, would have upon the draught of the vehicles.

In the year 1804, Mr. Obadiah Elliott, a coachmaker of Lambeth, patented his plan for hanging vehicles upon elliptical springs, thus dispensing with the heavy combined wood and iron perch and cross beds, that had been invariably used in four-wheeled carriages up to that time, with the exception of a few one-horse phaetons. Elliott was rewarded by the grant of a gold medal from the Society of Arts, and extensive orders for his carriages from the public, who appreciated his important enterprise and invention.

I have a print, published by Ackermann, in 1816, which shows a landaulet upon elliptical springs. There is a square boot, framed to the body, with the driving-seat on ironwork high above the boot; what are usually called the pump-handles behind are straight, and support a footboard. The whole is upon four elliptical springs, 3 ft. 6 in. long, and with a span of 10 in. The wheels are 3 ft. 8 in. and 4 ft. 8 in. high. The body is very small, and the bottom is 3 ft. 6 in. above the ground. But the centres of the axletrees are only 6 ft. 6 in. apart.

In the same book of drawings there is a full-bodied barouche, only 5 ft. long, hung likewise high, with high wheels, and a very short carriage, with whip springs; a coach and a landau, all painted yellow, are likewise with very small bodies and are hung high, with short carriages, and the perches nearly straight; also a mail phaeton, with a curricle-shaped body, and a rumble boot framed to it, hung upon a carriage with 3 ft. 4 in. centres, the wheels 3 ft. and 4 ft. 4 in. high, with full-shaped **C** springs behind, and elbow-springs and braces from a high scroll iron on the transom bed.

It is interesting to observe how the demand for light vehicles had begun to work, in decreasing the size and length in every way, and had also lowered the height of the wheels from Felton's time. Exactly the same revolution was taking place in mail coaches. The improvements carried out in England were repeated on the Continent. In 1810 three beautiful carriages were built at Milan on the occasion of the wedding of the Emperor Napoleon Buonaparte with the Princess Maria Louisa of Austria. These carriages are still preserved at Vienna, and consist of a state coach, a chariot, and a barouche, all upon **C** springs. The perches are double, Berlin fashion, with elegant cranes at each end; each perch is octagon and very well shaped, and forged from solid iron from end to end. All three carriages are small and light and well finished. The coach has a large crown on the roof and windows in the sides, the hammer-cloth is supported on scroll ironwork, and all the decorations are in a good state and well proportioned. At the Court of Spain are preserved two handsome coaches built for Charles IV. before 1800, with side windows, an elegant metal fretwork standing above the edge of the roof, hammer-cloths on scroll ironwork and **C** springs. They have iron crane Berlin perches, and are suspended upon long thick leather braces passing from the hind **C** springs to the front under the body without any iron loops. Photographs of these vehicles are preserved at the hall of the Coach-builders' Company.

I have mentioned the designs in the Carriage Fashion Book of 1816. In further illustration I can say that, in 1812, a large coach-builder's stock-book, which I have seen, contained over 200 carriages, mostly let for terms of years. Of these one-half were chariots, fifty were landaus, and the remaining fifty coaches and landaulets.

In 1814, there were 23,400 four-wheel vehicles paying duty to Government; 27,300 two-wheel, and 18,500 tax-carts; a total of 69,200 carriages in Great Britain. We shall see by later returns how much these numbers have increased, by the reduction of Government duties, and the introduction of elliptical springs.

A carriage was much in fashion at this period called the curricle; it had been in use for many years in Italy; it was derived, I believe, from the British *essedum*, which had been adopted by the Romans. The Italians of the middle ages brought the body forward in front of the wheels, and at length suspended the body from braces; the French added springs, and the English altered the shape, giving the back panel an ogee curve and improved the hood, and now added a spring bar across the horses' backs, rendering it a graceful and easy vehicle, which could be driven at great speed. The want of perfect safety, however, checked their popularity, and it was gradually superseded by the gentleman's cabriolet with one horse, and the mail phaeton with two horses. It lasted, however, from 1700 to 1830. The celebrated Romeo Coates drove a curricle in the shape of a shell. Charles Dickens drove one as soon as his writings procured him the means, and Count D'Orsay and Lord Chesterfield had new curricles from Messrs. Barker's as lately as 1836.

The coach-builders of London of the greatest celebrity in 1815 were the large firm of Collinridge, Rowley, Mansell, and Cook, of Liquorpond-street; Windus, in Bishopgate-street, in the City of London; Barker, of Chandos-street; Hatchett, of Long-acre, Houlditch and Hankins; and Luke Hopkinson, of Holborn. In 1818 Mr. Windus introduced undersprings to perch carriages. It was found that in bad roads the elliptical springs did not give sufficient ease, but the addition of horizontal springs below the **C** springs had the advantage of rendering the carriages not only easier but more durable, by relieving the perch and beds from the direct concussions caused by nuts and holes. About the same time concealed hinges were invented. Collinge's patent axles, which had first been made in 1792, became more generally used; their high price had been much against them, but the advantage of carrying a supply of oil for two or three months, avoiding also the noise and rattle of the common axles (which require fresh greasing daily), gradually secured their use, and when the patent expired they were universally adopted. Now this patent axle and the mail axle are in general use throughout the civilised world.

In 1820 the greatest improvements in the shape and style in the manufacture and finish of English carriages were commenced by the celebrate Samuel Hobson, who may be truly said to have improved and remodelled every sort of carriage whic came under his notice, especially as regards the artistic form and construction, both of body an carriage. He lowered the wheels of coaches an chariots to 3 ft. 3 in. in front and 4 ft. 5 in. behind, and lengthened the carriage part once more to such a true proportion to the whole vehicle as has approved itself as correct to each succeeding generation of coach-builders and users of carriages. H lowered the body so that it could be entered by a moderate double step instead of the three-fol ladder previously in use. He perfected the curves of the bodies and the springs, besides making th numberless small details of the body and underworks of the requisite strength, and the most agreeable shape and proportion. Mr. Samuel Hobson learnt the art in the firm of Barker and Co., of Chandos-street, and rose to be a partner in the firm, but after a few years in that position he left about the year 1815 and set up for himself in Long-acre, and ultimately moved about 1824 to the large premises previously Messrs. Hatchett's. In his improvements he was assisted by his experience gathered at Messrs. Barker's, and aided by the enlightened minds and good sense of most of the trade who copied him as they had copied his predecessor, Mr. Hatchett, in 1780.

The briska, or britchka, had been—about 1818—introduced into England by Mr. T. G. Adams, from Austria. It was built both upon elliptical springs and **C** springs, and was made in various sizes, large for family use, smaller for posting, with a rumble behind, and still smaller to be drawn by one horse. This briska was nearly straight along the bottom, according to the fashion of the wicker waggons still so much used in Germany. The hind panel was ogee-shaped, the front terminated in a square boot, and the door was lower than the hind quarter, and was fitted with a solid folding apron, or knee-flap. The carriage was short, and the front wheel rather lower than usual. The carriage came, in 1824, to be very much used, and lasted in favour until about 1840.

Two-wheeled carriages had much increased. The dennett, invented by Bennett, of Finsbury, was a great improvement on the whisky, or gig, of 1790. It was, like those, hung upon two long horizontal springs.

The stanhope was built under the superintendence of the Hon. Fitzroy Stanhope, brother of Lord Petersham, by Tilbury, the builder, also, of the easy vehicle of that name. The stanhope was shaped like the old rib gig, but hung upon four springs, two of which were bolted between the shafts and axle, and the other two crossways, parallel to the axle at either end of the body, and shackled to the side springs. These stanhopes are very easy, and do not rock so much as other gigs behind a rough-trotting horse, but they are heavier than the dennett, as it is necessary to add iron plates all round the shafts.

The tilbury was made without any boot, but otherwise the body was shaped like a stanhope; the shafts were equally strong and plated with iron. It was hung in front by two elbow-springs and leather braces to the shafts or front cross bar, and behind by two elbow-springs passing from beneath the seat to a cross-spring raised to the level of the back rail of the body by three straight irons from the hind part of the cross bar. Later two more springs were added between the axletree and the shafts by scroll irons. The tilbury was an elegant carriage, and when well made, a particularly good vehicle, but the weight of so many springs and so much ironwork gradually took away the public favour; they lasted until nearly 1850. They were perhaps more in favour for export to Italy, Portugal, and other foreign countries, than our other two-wheel carriages, because they would hold together over the roughest roads, and lasted a long time without repair.

The dog-cart and tandem-cart belong also to the beginning of the present century in their origin. Dr. Edgeworth speaks with horror of the reckless height to which they attained in 1817. "Carriages" he says, "have arisen to a preposterous elevation. That private phaetons and barouches should be mounted out of the town dust, and above the country hedges, is a dangerous luxury, but it does not materially effect the public. The invention of that daring vehicle, 'the suicide,' will not probably be much imitated among Christian people; and fortunately the laws have limited the elevation, to which, by the absurdity of coachmen, mail coaches might have been raised." The suicide was the name of a very high tandem gig, wherein the groom was mounted upon a seat three feet above the driver. It received its name in Ireland.

The first dog-carts had a large and deep boot with Venetian slats in the sides, to contain greyhounds or pointers, and the four passengers sat back to back. Tandem-carts were made in a similar manner with a large boot, the driver's seat raised, something like the Salisbury boot fashion, whilst the groom's seat was, like the hind seat of a drag, raised from the boot on ironwork. The gradual development of the dog-cart in all its varied shapes of high cart and low cart, Newport Pagnell, Malvern cart, Whitechapel, sliding body cart, Norwich cart, &c., are too well known to need enlarging upon. They have afforded facilities of agreeable locomotion to millions at a very moderate cost, and, if carefully driven, are as reasonably safe as any vehicle. Who drives faster than a butcher boy, and over roads of all sorts—dry, rough, slippery, or newly made—the horse's head held with a snaffle-bit only—and yet it is very seldom that the horse falls.

With the growth of our trade and manufactures, the system arose of sending commercial travellers throughout England, to call the attention of shopkeepers to the goods and novelties manufactured. It was found advantageous to send these travellers in light vehicles which could convey samples of the manufactures, and the custom led to the multiplication of gigs in far greater quantities than would have been otherwise required by the public. About 1830, one coach factory in London supplied several hundreds of these vehicles to commercial travellers at annual rentals. Now, this sort of travelling, to show samples and solicit orders, is performed by railway, and the greatest number of two-wheeled vehicles belong to farmers.

In 1810, a duty was levied by Government upon carriages for sale. It was repealed in 1825, but the returns give the number of vehicles built for private use in 1814 as 3,636, and in 1824 as 5,143, whilst the number of carriages in use in 1824 had grown to nearly 29,000 four-wheeled, and 36,000 two-wheeled, besides 15,000 tax-carts, a total increase, since 1814, of 20,000 vehicles.

Travelling carriages had now become very much in demand, and were taken on the Continent. Some noblemen and gentlemen began to travel abroad every year. The fittings had become more elaborate. It was usual to cord the C springs from the top to the bottom, to strengthen them, and provide against the jolts of very bad roads; so that, if one or two of the steel plates broke, the cording would still hold all together. Also, long ropes were provided, extending beneath the body, from the front to the hind springs, to support it should the body-loops give way under the quantity of luggage stowed in boxes, and imperials, and cap-cases. A dragstaff was provided, to prevent the coach sliding back when the horses rested in going up hill, and two drag-chains were provided against going down hill. Notwithstanding these precautions, it became usual, at the top of the Alpine passes, for the courier who attended the traveller to procure from the post-houses two sabots, or logs of wood hollowed out to fit a wheel, and these were substituted for the iron shoes during the long and steep descent of the Alpine mountains.

In 1824, a carriage was introduced which has become of almost universal use—the pony phaeton. In that year King George IV. desired a low phaeton, and one was built for him of a shape and size in which there has been little alteration during the fifty years that have since passed away. It was a cab shape, half caned, with a skeleton bottom side, hung upon four elliptical springs, with crane ironwork back and front, two elbow-wings, bow-steps, and large dasher, and it was drawn by two ponies; the wheels were only 21 and 33 in. high.

Another carriage had been introduced from Germany, called a droitska, an open carriage with a hood, on a perch, and with C springs. The peculiarity was that the body hung very near the perch; the place for the legs was on either side of the perch, so that the seat was only 12 in. above the hind axle-tree; the chief merit of the droitska consisted in its lightness, compared with briskas and barouches, and the shortness of the whole vehicle. In appearance it resembled a *pilentum*, and it is probable that Mr. David Davies took his idea of a *pilentum* from the shape of the droitska. Mr. David Davies, a coachmaker, of Albany-street, and afterwards of Wigmore-street, had considerable inventive faculties. He originated a number of vehicles, the pilentum phaeton, about 1834, which was an open carriage with the doorway very near the ground, and a driving seat also low, the whole hung upon elliptical springs, and of different sizes, to carry four or six persons, and adapted for one or two horses.

The invention of the cab phaeton is also attributed to him; this was also a cab body with a hood on four elliptic springs, and a low driving seat and dasher for one horse. It was soon generally adopted, and became the pleasure carriage of thousands. The cab phaeton was dispersed throughout England, and also on the Continent, where it became known under the name of "Milord."

About 1850 it had become the hack carriage of several of the Continental cities, and went out of fashion with the gentry. During the last few years, however, it has been revived under the name of Victoria. In 1869, I think it was, that the Prince of Wales bought one at Paris of the curved shape, and Baron Rothschild brought another from Vienna of the square shape, and the Victoria became again the popular carriage. Light, low, easy, fit for one horse, and looking very well behind a pair of cobs, it is not surprising that the Victoria meets with so much patronage, and it is pleasant to observe how little difference there is made by different coach-makers in the size and shape of this useful and elegant vehicle. I have had occasion to notice the influence that certain coach-builders have had upon the progress of this art, and it will not be right to omit to mention the great influence that Messrs. Peters have exercised upon the whole trade, by the sound and good workmanship which has for so many years characterised their establishment. As early as 1836 their mail phaetons were noted for the steadiness with which they followed the horses, and the firmness with which they encountered rough roads.

The year 1838 claims special notice in the annals of coach-building; it was probably the climax of the efforts of modern coach-builders in what is called " dress " or " State carriages."* These vehicles had long passed the period in which beautiful carving and elegant painting had been used to disguise, as far as possible, the clumsy State carriages of the 18th century. Ever since the building of the Irish Lord Chancellor's State coach by Hatchett or Baxter in 1790, coach-builders had endeavoured to produce a graceful outline of body, and of a size no larger than was necessary, the **C** springs had been made of a perfect curve, the perch followed the sweeps of the body, the carving was reduced to a moderate amount, the ornamental painting was confined to the stripes upon the wheels, and the heraldic bearings of the owners of the carriages were beautifully emblazoned on the panels. For further ornament they relied upon plated work in brass or silver round the body and on the loops and wheel hoops. In every capital of Europe such carriages had superseded the old style, and London and Paris had supplied other countries with most of these State carriages. In this year, 1838, was the Coronation of our Gracious Queen, and the different Ambassadors of foreign countries and our own nobility had prepared for the occasion a larger number of Court dress carriages than had ever been hitherto seen in London. Of these carriages it was generally considered that Marshal Soult the French Ambassador's coach bore away the palm. Engravings of some of these carriages were published. Marshal Soult's coach was built by Mr. Dalringen, at Paris. The body had four upper quarter glasses, with a very elegant deep and pierced cornice of silver round the roof, there were four lamps with large coronets on the tops, and the coach bore a coronet on the roof also. The colour of the painting was a lovely blue, such as was then called Adelaide blue; this had been varished with white spirit varnish, and seemed almost transparent in lustre. The whole coach was ornamented with silver and was finished in great taste.

About this period a noted coach-maker, named Luke Hopkinson, of Holborn, introduced the briska landau. The peculiar shape is now of little consequence, but with this carriage commenced those improvements upon landaus which have since rendered them so popular.

Up to this time the landau head had opened just as it did in 1790, and no more; the pillars which now lie nearly flat fell usually only at an angle of 45 degrees. Mr. Hopkinson cut away the corners of the back rails, which hindered the hoop-sticks from lying on the elbows, took away the heavy squabbing that bulged into the body when the head was lowered, and lined the upper quarters with plain cloth only, as in a briska head. He also made the seats and bottom to rise 6 inches when the landau was open, to give the persons inside more air and freedom.

To Mr. Laurie we must give the high credit of improving upon Mr. Hopkinson's improvements, and persisting in seeing that his workpeople kept on improving, instead of, as workpeople used to do in 1838, hinder their employers by vexatious objections to all alterations.

This period was noted also by the patronage by the Duke of Wellington of a vehicle called the equirotal, invented by Mr. W. Bridges Adams. This was a gig without a head, and a curricle with a head, made so that each could be used with one or a pair of horses, or combined into a mail phaeton by adding two couplings between the two bodies; the four-wheels being of equal height, gave it the name of equirotal. The invention has some very good points, and may be revived some day, with a more perfect connecting joint than Mr. Adams attained in 1838.

But the greatest improvement of this period was the introduction of the brougham. Lord Brougham and others had for some time used a one-horse chariot. The pilentum chariot for one horse had already been built at Paris, and other small close carriages called clarences had been constructed; but none of these, although some were really light enough for one horse, took thoroughly the taste of the public. Mr. David Davies introduced some shapes, and Messrs. Laurie and Marner perfected them. I think it was in 1839 that the first vehicle, which was nearly the shape of the present brougham, was built by Mr. Robinson, of Mount-street, for Lord Brougham. Messrs. Thrupp built one in the following year 1840 of the same shape. In a few years they were built by nearly all coach-makers, and proved so convenient that they superseded even the cabriolet for gentlemen's use. The size of the first brougham was much as now in vogue, about 4 ft. long in the body, and the same breadth outside measure, the wheels, 2 ft. 11 in. and 3 ft. 7 in., the driving-boot was made without any arch, in a single sweep from the body to the foot-board; it was hung on elliptic springs in front, and five springs behind, without any body steps. This was preceded by the pill-box brougham, as it was called, with straight front pillars, and the body very much contracted in front, to look light. A street cab was the forerunner of both.

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*An analysis of the sale of Messrs. Cook and Rowley's stock in 1830, and Messrs. Hobson's stock in 1838, shows the proportions of 70 chariots, 60 coaches and landaus, 32 barouches and briskas, 12 cabs, 6 mail phætons. Total, 180.

In a year or two, Mr. Edward Lytton Bulwer (afterwards Lord Lytton) had a small clarence of the shape called Imperial clarence, which was painted brown with white wheels, and had a small hammer-cloth of brown and white; the whole was tastily fitted-up and finished, but the attempt to introduce a miniature chariot did not succeed, although it was built with considerable care by Messrs. Laurie and Marner.

In 1845, waggonettes werebuilt of some size; the first, it is said, was built under the superintendence of the late Prince Consort, and was successful as being theforerunner of averylarge numberof light, roomy, and useful vehicles. Brake waggonettes are also an improvement upon the uncomfortable conveyances called brakes in early days. The principle of riding sideways was not new. The Irish car, the four-wheeled inside car of the Westmoreland Lake district, the old breaks, and the omnibuses, all contribute to the design.

In the modern waggonette we have, however, not only a good looking, comfortable carriage, but one which possesses the advantage of carrying a greater number of persons, on a vehicle of given weight, than any other on four wheels.

In 1846 was introduced and perfected by Messrs. Hooper the system of suspending carriages on a single wrought iron perch, supported by horizontal undersprings. The perch being light, and to a certain extent elastic, enabled all the beds and iron stays to be proportionately reduced in weight; the wheels and axles, having less to carry, were also made lighter. This system at first was only applied to broughams and sociables, but it has gradually been applied to the largest carriages, especially barouches and landaus, not only in England, but in all countries were carriages are made, so that it is quite the exception for a new carriage to be built with a perch that is not of solid wrought iron. These perches are not, however, made now quite so light as at first; it is found that unless the hind wheels follow steadily, not only is the carriage heavier behind the horse, but the perch itself is frequently bent against very small obstructions; a stronger and stiffer perch is therefore now used, and it is found both easier to the horse and to the occupants of the vehicle.

We have now reviewed the principal varieties of carriages introduced into England during the present century; to enumerate the whole would be tedious. At our great exhibitions in London, Paris, Vienna, and other cities, new shapes have continually appeared, and some have found favour and some have appeared no more. They are evidence that the ingenuity of coach-builders is not less than the ingenuity of the workmen in other trades. The history of the last twenty-five years is, however, sufficiently fresh upon the memory not to require repetition. We have, too, in the reports of the juries of those several exhibitions, drawn up by Mr. George Hooper, a record of the most noteworthy objects. It would be for the benefit of all persons engaged in carriage-building if those reports could be re-issued with the addition of a report of the interesting Philadelphia Exhibition now in progress. M. Guiet, of Paris, will probably write a report for use in Paris.

I will here mention that, by the kind permission of Mr. W. H. Smith, of the Treasury, I am able to give some further returns of carriages paying duty. Four-wheeled carriages amounted in 1834 to 49,000; in 1844, 62,000; in 1854, 68,000; in 1864, 102,000; and in 1874 there were actually 150,000 four-wheeled carriages paying duty, but these last numbers now include vehicles which were formerly taxed under the Postmaster's and Stage duties, and these vehicles in 1864 had amounted to 25,000, still without them the increase in ten years is 23,000, quite as many as were kept in the year 1814. In 1814, that is 23,000 four-wheeled carriages paid duty, and in 1874 they had increased to 125,000.*

The return states there were of two-wheeled carriages in—

1834	..	50,000	including the tax carts.
1844	..	33,000	,,
1854	..	137,000	,,
1864	..	170,000	,,
And in—			
1874	..	285,000	two-wheeled carriages, including basket and other four-wheeled traps under 4 cwt.

Carriages of both sorts then have increased from about 60,000 in 1814 to 432,600 in 1874, a benefit to the general population it is clear, as well as to the workmen.

It is a satisfaction that our trade contributes to the comfort, happiness, and respectability of the community in general, and is also a very healthy trade to the workmen.

MISCELLANEOUS.

LOAN EXHIBITION AT SOUTH KENSINGTON.

Meteorological Instruments.—Anemometers.

By Dr. R. J. Mann

(Late President of the Meteorological Society).

It has been stated in a previous page, that the motion of the wind is due to the difference of the pressure of the atmosphere at places not very far asunder on the surface of the earth; that the force of the wind is, in the main, proportional to the amount of this difference, and to the nearness of the spots at which the extremes of the pressure are found; and that changes of weather are largely caused by its being warm air or cold air which is brought in at the time through this instrumentality. For these several reasons the velocity with which the wind moves, the lateral pressure which it exerts upon resisting objects which lie in its path, and the direction from which it comes, are matters of the utmost moment to the scientific study of meteorology. The instruments which are termed "anemometers" have been devised by skilful mechanicians to enable this class of observations to be carefully and exactly made.

The instrument most generally employed for marking the velocity of the wind is that which is known as

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* In Saint Petersburg the Russian Emperor had an Imperial carriage factory, originally established in 1821. At these works are now employed two hundred and fifty men, under Messrs. Brautigam, to whom they now belong. Fifty new carriages a year are built for the Royal family, besides the repairing and altering of others. There is a steam-engine on the premises. There is also at St. Petersburg a museum, in which repose travelling carriages on the ground floor, and State carriages on the first floor. There are post-chaises of 1746 and 1762, and seven carriages which were in use by the Empress Catherine, many decorated by well-known painters such as Watteau, Boucher, Gravelot, &c., and superbly fitted up in the interior with velvet and silk. There are twelve sledges of the elaborate build of former days.

Robinson's anemometer, and which consists of four hemispherical cups placed on cross arms and a vertical central pivot, so that they can be driven round freely when the wind blows upon them. One of the most simple forms of this useful instrument is the one which has been selected for their observing stations by the Meteorological Society, and which was shown as made by Casella, in connection with this society's group of instruments, placed immediately in front of the first window of the Room L. The length of the arms, and the size and form of the cups, are so proportioned, that the cups travel 3·14 feet for each revolution, and move as they do so with just one-third the velocity of the wind; thus a wind in moving 9·42 feet turns the cups once round on their vertical pivot. If this quantity be multiplied by the number of revolutions registered by the hand upon the dial beneath the cups between two observations, the result therefore expresses the distance the wind has travelled in that time. If five minutes elapse between the two observations, and 9·42 feet multiplied by the number of revolutions be again multiplied by 12, that gives the rate of the wind's velocity in feet per hour, and this, of course, is converted into miles per hour when divided by the number of feet in a mile. The vertical pivot communicates its revolutions to the first movement of the dial through two endless screws and an intervening cogged wheel. There were several varieties of this hemispherical cup anemometer in the upright case nearly opposite to the three large Herschel telescopes in the mahogany tubes. No. 2,835*a* was a simple form by Darton, analogous to the Casella instruments which has been described. No. 2,845 was a very pretty little portable anemometer of quite pigmy size, in which the recording part contains a series of dials, and an outer circle with a large index-hand, which marks hundredths of a mile up to one mile, the several dials taking up the record in their turn for the large quantities of 10 miles, 100 miles, 1,000 miles, and 10,000 miles.

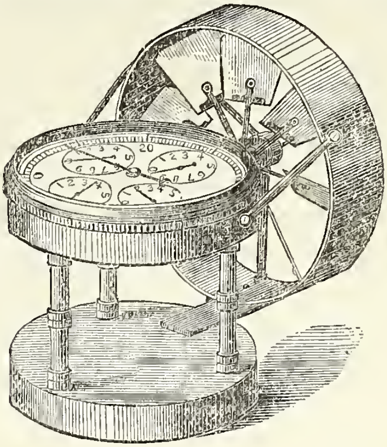
Negretti and Zambra exhibited an instrument (2,788*a*) with two dials, on the left-hand one of which each division on an outer circle represents a tenth of a mile and five miles on an inner one, with 500 miles for an entire revolution. Each division on the right-hand dial represents in its turn 500 miles, and the entire revolution 5,000 miles.

No. 2,843 was Robinson's anemometer, by Pastorelli, in which an electrical record of the revolutions of the cups is made by a current from four Leclanché cells, a distinct registering dial, to be placed any desired distance apart from the cup vane of the anemometer, and registering up to 1,000 miles, being used to receive the impression.

No. 2,844 was a yet larger recording train, capable of registering up to 10,000 miles. In these instruments the recording contact is made for each tenth of a mile, and the record is effected by the simple expedient of an electro-magnet, formed for the instant by the passage of the current through a coil. The magnet acts by pulling an armature, which twitches a lever, and hitches a toothed wheel forward one tooth.

No. 3,388 was a simpler form of registering dial, placed diagonally before the eye, and especially designed to receive the indications of ventilation-currents from a deep mine by a similar transmission of electrical action to a coil and core placed in this piece of apparatus.

A still more compact and portable form of anemometer, for measuring the velocity of wind and air-currents, catalogued as "Lowne's Portable Air Meter" (No. 410), was shown in the third case at the south end of the Room H, near the window. There are several modifications of this convenient instrument, intended to adapt it to various useful purposes, which deserve notice, alike on the ground of compactness and efficiency. One of the greatest recommendations of this anemometer is the facility and safety with which it can be carried about in the pocket. This will be readily understood by a reference to the form in which the instrument was originally introduced by Casella (No. 410), and to that in which it was afterwards presented by Stanley (No. 410*d.*) The instrument essentially consists of a vertical wheel, carrying a series of inclined fans, sloped like the sails of a windmill, and of a horizontal dial with a large index hand, and five small hands revolving in five small graduated circles. The vertical fan revolves when moving, air is driven through it, and its revolutions are conveyed, through an axle and a pinion, to a train of wheels contained within the case of the dial. This instrument is so sensitive that its fan begins to move with a current of air that has a velocity of thirty feet per minute, that is to say, if it is carried in the hand of a person walking thirty feet in a minute the fan commences its revolutions. At slower rates the air slips over the fan, instead of turning it round, because the inertia and friction of the moving surfaces in contact resist to that amount. The fixed quantity of 30 revolutions per minute is, therefore, always added as the proper allowance for this slip, to all observations that are made. Each instrument has also a further small error of its own, which is carefully ascertained by direct experimental test, and then noted as the correction which has to be made to render its records exact. The graduations are so arranged that the large hand upon the dial goes round once under the impulse of a current of 100 feet, and marks one foot with each of the 100 graduations, into which the outer rim of the dial is divided. The smaller dials then mark the higher quantities of one thousand, ten thousand, one hundred thousand, one million, and ten millions; so that the instrument is capable of recording a current up to ten million feet without having to make a fresh start. The fan revolves without affecting the recording movement until it is thrown into gear by pressing a pin and lever towards one side, when the indexes immediately begin to mark the revolutions. By pressing the pin in the other direction the fan is thrown out of gear, and ceases to record, although it still revolves. The velocity of the current which gives movement to the indexes is ascertained by making a watch a party to the arrangement. The time is observed by the watch when the fan is started, and then again when the fan is stopped. The interval between the two observations gives the time in which the recorded movement of the wind has taken place. Thus, if the time allowed for the observation by the watch be one minute, and the revolutions recorded upon the dial within that time be 150, that means that the wind is moving 150 + 30, or 180 feet per minute, or nearly two miles per hour. If the fan were found to revolve 2,200 times in the minute, that would indicate a wind of 25 miles per hour. Held up on a railway train, travelling through the air with a speed of twenty-five miles an hour, the instrument would revolve 2,200 times



in one minute. The great convenience of the instrument will be readily understood from this description. No. 410 differs from No. 210 only in the arrangement of the dials, which are placed in the same plane with the fans, and receive their motion from them by the intervention of a small connecting rod, with an appropriate system of pinions and toothed wheels. The flatness in this form permits the instrument to be packed into a case of about the dimensions of an ordinary book. In the magnetic anemometer, 410*a* and 410*c*, the case containing the wheelwork of the registering dials is hermetically sealed, in order to protect the pivots and other delicate parts from the injurious effects of corrosive vapours, by the ingenious expedient of making the end of the pivot of the fan-wheel carry a small transverse magnet, and the corresponding end of the pivot of the first registering wheel a similar short bar of plain iron. The thin brass plate of the case alone intervenes between the magnet and the bar; and, as the magnet revolves diametrically across the line of the pivots, the bar, which has been converted inductively into a magnet with opposite poles, follows its motion turn for turn. In 410*c*, which is intended to be used on shipboard, the instrument is suspended in gymbals, and has a vane attached to keep the fans up across the current of the wind. There is also with this a cap, which, when applied, reduces the clear aperture that admits the wind across the fans by one-half; this is required because, with the high velocities that belong to strong winds, the fan-wheel is apt to revolve so fast that the magnet over-runs the bar, and the count of some revolutions is lost. This source of inaccuracy is, however, quite removed when the force is diminished one-half by shutting off half the wind. The revolutions marked on the dials then only need to be multiplied by two to get the correct record. All the simpler forms of this instrument are eminently suited for measuring ventilation currents of air; but in 410*b*, which is shown in one of the cases of instruments of applied science in the upper gallery, the registering dials are connected with a large fan-wheel of the size and form of the ordinary Byron's anemometer employed to test the ventilation of mines. In this "Colliery Air-meter," constructed by Mr. Lowne, the fans are however made of incorrodible vulcanite, which has not more than a fourth part of the specific weight of aluminium, and the revolving axle is practically air-tight where it passes through the collar to enter the chamber of the movement of wheels.

The quantity of fresh air that passes through an aperture of fixed dimensions in order to minister to the ventilation of dwelling apartments, or workshops, is easily estimated through the instrumentality of these anemometers. Thus, to take an illustration in its simplest form, if fresh air entered a room through an aperture in the wall one foot square with a velocity of 88 feet per minute, there would be 88 cubic feet passed into the room in the course of the minute. But if the inlet were only 6 inches square, with the same velocity the quantity introduced in the minute would be a fourth part of 88, or 22 cubic feet. If the inlet were 3 inches square, the quantity would be again a fourth part of this, or five and a half cubic feet. If the 3-inch hole were round instead of square, the quantity introduced, according to Mr. Bramwell's simple rule for ascertaining the relative superficial area of circle and a square of the same diameter, would be further diminished by very nearly two-ninths. The rule is to take seven-ninths of the superficial area of the square, and add to it one per cent., to express the square contents of the circle. A circular aperture, three inches in diameter, which has air passing through it at the velocity of 88 feet per minute, would, therefore, admit 4·3 cubic feet of fresh air per minute. This, therefore, would be about the amount of fresh air introduced into a room through the ventilating aperture of George's ventilating gas stove, or calorigen, exhibited in action in the small laboratory furnished with gas which opens out of the Room G, when the air is shown by the anemometer to be passing through the aperture at this rate. The exact technical process for ascertaining the quantity of air introduced through a circular aperture, is to multiply the square of the diameter expressed in decimal parts of feet, first by the velocity in feet per minute, and then by ·7854. The product gives the number of cubic feet of air per minute passed through the aperture.

There are several forms of anemometers, in which the instrument registers its own readings, both in the particular of velocity and direction. In Whewell's anemometer, by Elliott, No. 2,880, the direction vane carries round with it a frame, contained in the hollow case beneath, and this frame has a pencil attached to it, which makes a mark upon a white japanned cylinder, to indicate the direction in which the vane lies. But the pencil, at the same time, is carried down in the frame by a slowly revolving endless screw, which is driven by a revolving fly-wheel, with eight sails, carried with the vane, so that the position of the pencil after any given interval expresses the velocity with which the wind has been blowing. The pencil has to travel about two feet to get from the top to the bottom of the cylinder, and it is carried one inch down by a wind blowing 200,500 feet, or nearly 40 miles. 10,000 revolutions of the sails correspond to one revolution of the screw, which shifts the pencil through 44 thousandths of an inch. The reading from this instrument is taken once in 24 hours, and shows what the movement of the wind has been in that interval. In Gordon's anemometer, No. 2,876, both direction and velocity are printed off every quarter of an hour by the instrumentality of an electric current. A strip of white paper, covered by a black web, is drawn out slowly by a clock, under the rim of a wheel, which has steel letters, expressing twenty different bearings of the compass, projecting from it. The direction vane turns this wheel round so that the letters which correspond to its proper direction at the time are immediately above the paper. Every quarter of an hour an electric current is established, and this at the instant makes an electro-magnet, which pulls down the wheel against the paper, and so causes the embossed type to be imprinted upon it. The black web leaves its black pigment on the white paper in the form of the letter when pressed against it. A fly-wheel is at the same time turned round by wind, and for every mile of current that the wind blows, an electric current is also established, and a second electro-magnet made. This second electro-magnet draws down a sharp point, or pricker, which makes a small hole upon the paper band by the side of the direction letters. The number of holes that are pricked off during four quarter-of-an-hour's records of directions, thus tells how many miles the wind has moved in that hour. The particular hour referred to is ascertained by simply marking the first one that is stamped when the instrument is started. The velocity movement is driven by a double wheel furnished with windmill-like sails, which are always kept across the current of the wind by appropriate mechanism.

In Casella's recording anemometer, which is a conspicuous instrument, of large size and beautiful finish, placed in front of the second window from the south of the Room L, a paper-covered drum is carried round by a clock, beneath two cylinders, which have each a spiral edge scrolled round them. The cylinders revolve horizontally, and the spiral scroll presses upon the drum at a point which is shifted longitudinally, according to the part of the spire that is brought into play over the drum. The spiral edge leaves a trace upon the paper covering the drum at the point where it touches it. One of the cylinders is turned round by the vane, so that the impression which it leaves on the drum indicates the direction of the wind at that time. The other cylinder is turned round by a pair of mill-sails, set radially in a circle, and leaves a trace which indicates the velocity of the wind. The drum itself is carried at an even and adjusted rate, and so marks the time at which the several indications of direction and velocity are made.

The self-recording anemometer of Yeates, of Dublin, No. 2,842, is a very pretty instrument. It consists of a set of Robinson's hemispherical cups, with an electrical current record. The black transverse bar seen in the apparatus is lifted whenever a certain number of revolutions have been made, and an electrical current is turned on by the contact of its point with a brass pin. When the current is established, an electro-magnet is formed, which drives a train of wheel works, placed in a square glass case, one tooth on. Each contact and each single tooth movement of the wheel work records one mile of velocity on the left-hand dial on the frame, and when the left-hand dial is turned once round, the right-hand dial records, in its turn, one hundred miles.

In Professor Osnaghi's anemometer (No. 2,874) the record of velocity is transferred to a band of paper drawn out from an ordinary Morse's apparatus. A prick is made upon the paper for each kilometre of velocity.

The most elaborate and complete of all the self-registering anemometers, however, is the one which is catalogued as Professor "Von Oettingen's Self-acting Wind Components Integrator." The complexity and mechanical finish of this beautiful instrument are manifest at a glance, and although an adequate comprehension of its details of plan can only be acquired by very close inspection and study, a general idea of its method of operation may be formed under the advantage of a very little guidance. It might have been observed that the clock, which was stationed at the further side of the instrument, serves two distinct purposes, and in both instances operates by turning on an electric current from a battery, through a contact, which it effects at regulated intervals. It draws a long slip of paper out, upon which the record is to be made, and at the same time it makes an electro-magnet every half-hour, which then presses the slip of paper against printing types fixed on the rims of a series of four revolving discs, which are capable of being turned, each on its own account, by the mechanism. The moving power of the mechanism which turns the discs is, however, the wind. Four Robinson's hemispherical cups, mounted upon a vertical axis, acting through a pinion, turn a large flat brass disc, which is seen at the far end of the instrument conspicuous amongst the other parts by its size. The disc consequently moves with a velocity that is proportioned to that of the wind. Four smaller discs stand up vertically upon the top of the horizontal disc at four opposite points of its circumference. These four vertical discs belong to the four cardinal winds, North, East, South, and West. They are capable, however, of being twisted upon vertical axes running through their own planes, and they are so twisted by mechanism connected with a direction vane, which stands with the Robinson cups above the apparatus. When the vane is directed due north, the north disc stands parallel to a true tangent of the part of the circumference on which it rests, and it then revolves *pari-passu*, or in equal quantity, with the surface on which it rests. At such time, however, the east wind disc stands directly across the tangent of the circumference of the disc on which it rests, and, consequently, does not turn round at all, as the large disc below it revolves; it only slips along upon it sideways. When the vane is directed half-way from the north towards the east, both the north and east discs stand half inclined to the tangent, and then both half revolve and half slip. If the vane is three-fourths towards the east, then the north disc is inclined three-fourths, and turns one-fourth and slips three-fourths, whilst the east disc is inclined one-fourth and turns three-fourths and slips one-fourth; and so for any other proportions. The exact proportion of the components of the wind blowing at the time is indicated by the position of the two vertical discs. The other two vertical discs, which belong to the south and west wind, are for the time lifted up, and disengaged from contact with the horizontal wheel. They are out of gear, and not operative. The four large vertical wheels, or discs, which carry the type upon their rims, are connected electrically with the four small vertical discs, each one with its own appointed associate, one for north, one for east, one for south, and one for west. Each small disc makes an electrical contact at each half-revolution, constructs an electro-magnet, and pulls its own printing-wheel round one tooth. The position of the printing-types on the wheel is thus directly influenced by the quantity of wind of a particular kind which has passed. Each half-hour signal printed by the clock thus tells how much north wind, and how much east wind, or whatever other constituents may have been in the ascendant, has blown by to turn its own proper wheel of the printing discs. The types are a series of small numbers, which increase at a regular rate with each further revolution of the wheel. The numbers impressed upon the paper strip thus show how many times each vertical wheel has revolved in successive half-hours, and how much wind from the particular direction which that wheel represents has, in consequence, passed by. Tables prepared for the purpose indicate what the actual movement of each particular wind is for the numbers that are recorded by the printing types.

It will be noticed that the electrical wires which convey the currents go up from the four vertical wheels to the centre pillar above, and are thence carried to the printing discs and their mechanism. The electrical contacts on the small vertical discs are most ingeniously made, through the intervention of a metal spring pressing upon an ivory disc fixed on the inner surface of the brass. The ivory thus intercepts the current, until the spring passes for an instant over a metal pin, which is introduced for the purpose of metallic contact into the ivory at each half circumference of the disc, when the current flows for that instant to generate the electro-magnet. The coils surrounding the vertical magnets, which work the type wheels round, are easily distinguished, as are also larger horizontal coils which work the printing magnets at half-hour intervals, and which, it will be observed, receive their electrical wires from the clock. It must be understood that in the exhibition the large horizontal disc was disconnected with the driving shaft of the hemispherical cups, which might be seen just thrown out of gear, and that it was connected instead with a second clock, which could be wound up, and made to do the part of the wind, and drive the machinery. This is, however, of course, only a temporary arrangement contrived for the purpose of illustration. No second clock is used when the instrument is in gear with the wind vanes, and engaged upon its proper work.

All the anemometers which have been thus far described only give the pressure of the wind through the intervention of calculation. It is known that wind which moves with any given rate of velocity exerts a definite amount of pressure upon rigid objects that stand in its path. Tables are, therefore, prepared which at once express to the observer what the pressure upon a square foot is for the number of feet per minute that are passed over by the air. It is for the most part found to be more convenient to get the pressure of the wind, in this way, out of its velocity. There are, however, instruments which have been devised for getting direct measures of the pressure. The one which is best known is that which was invented by Lind, and which is still distinguished by his name. A characteristic specimen of this instrument, in its simplest form, was shown in the large upright case nearly opposite to the Herschel telescopes. It consists of a wide horse-shoe shaped glass tube with open ends, turned upwards, and filled with water in the lower bend to mid height. The instrument is so fixed to a revolving wind-vane, that one of its mouths is always opposite to the pressure of the wind. The wind then drives the water out of one branch of the tube up into the other branch, and to a height which expresses the amount of pressure exerted in any case.

Graduations upon a scale mark degrees of pressure from half a pound to 15 lbs. on the square foot. The weak point of the instrument is that it is difficult to use on account of the gustiness of the wind. The water is in constant rapid movement up and down as the pressure varies. A modification of this instrument is shown amongst the instruments contributed by the Meteorological-office, in which the branches of the tube are placed very close together, and in which provision is made for the reading of a much larger pressure, and in a yet better pattern. This is catalogued as "an improved form of Lind's Wind Guage, by Harris," the branch of the tube which the wind enters is of larger size, and the pressure is read off by coloured liquid in a narrower tube bent into a quadrangle, the first three-tenths of a pound of pressure being marked in the horizontal stretch of the tube. In Howlett's anemometer, by Elliot (2,835*b*), a large copper sphere, whose hemisphere has a value equal to a known proportion of a square foot, is mounted on a vertical rod, which is suspended on transverse knife edges, so as to permit a free swing in all directions. A pencil, attached to the bottom of the vertical rod, makes traces upon a flat slab of slate beneath as the ball swings, travels outwards when the pressure is great, and is drawn back by the elastic band used to confine it, when the pressure is small. The slate is marked with the cardinal points of the compass, and so the direction as well as force of the wind is indicated. In a small pressure plate anemometer, invented by Dickenson, and constructed by Casartelli, a small counterpoised flap is raised by the wind, and its degree of elevation is indicated upon the arc of a graduated quadrant, so placed that the edge of the flap ranges along its side. The most complete of the series of anemometers which mark the pressure of the wind, was the large self-registering instrument constructed by Mr. Cator (No. 2,879*a*), which stood between two of the windows. In this instrument a large vane carries a flat-bottomed cone with its base turned to the wind. As the cone is driven back by the pressure, it drops a cord through the centre of the supporting pillar to the groove of a wheel, and to a counterpoise hanging down beyond. A second cord passes from the large wheel over a small one, and so on to a pencil which runs to and fro horizontally against the surface of a paper-covered drum; being dragged in one direction by the revolution of the wheel, and in the opposite direction by a weight. The drum is carried round by clock-work at a regulated rate, and the pencil thus leaves a trace upon the surface of the drum, which indicates the distance to which it has been drawn by the wind pressure. The direction is registered at the same time by a trace left from the spiral knife edge of a horizontal cylinder, acting exactly in the same way as the one which has been described in Casella's large recording instrument. The apparatus is thus properly a system of counterpoised weights and cords passing over grooved wheels, which revolve backwards or forwards as the pressure increases or diminishes, and a pencil, which marks upon the surface of a clock-driven drum the direction in which the grooved wheels turn, and the extent to which they go.

A large model, placed not altogether inappropriately amongst the instruments obtained for recording the movement of the wind, illustrated a system of weather signalling that has been contrived by Major Kromhaut, and adopted to some extent in Holland. The model was contributed by the distinguished meteorologist, Professor Buys Ballot, of Utrecht. The signals are constituted by the varying combinations of two hollow drums and four flat discs. It will be observed that the drums are placed one over the other, and that each drum has one disc above it and one beneath. The discs also can be drawn out of sight into the drums by cords and pulleys. In this way a series of 54 signals are arranged. The upper discs are used to indicate the height of the barometer at Helder and Groningen, and the lower discs to express its height at Flushing and Maestricht. This at once shows the direction of the gradient which connects high and low pressures, and therefore inferentially marks the direction of the wind. The position of the inner discs, which are between the drums, further expresses the amount of the gradient, or, in other words, the amount of difference between the high and low pressure, and consequently the force of the wind. It will be observed that this system is very much more elaborate than the Fitzroy storm signals, which are used by our own Meteorological-office, in which a drum and a cone are employed to indicate that heavy winds may be expected from the southwards, when the drum is above the cone, with its point downwards, and from the north when the cone is above the drum, with its point upwards.

In front of the first window, in the Room L, the Meteorological Society of London exhibited a group of the complete series of observing instruments which it adopts at its stations. The series, it will be observed, comprises a thermometer screen containing wet and dry bulb thermometers, and a mercurial maximum and spirit minimum (Rutherford) by Negretti and Zambra, placed as they would be when in use. By the side of the screen, upon their proper supports, are a pair of solar radiation thermometers, by Casella, one with a bright bulb and one with a blackened bulb. The earth radiation thermometer is a spirit minimum with a forked bulb, by Casella. The barometer is a Fortin standard by Negretti and Zambra, intended to be placed in any safe, sheltered position, near to the other instruments. The rain gauge is a 5-in. funnel and receptacle, by Casella, with the deep snow-rim to the funnel. It is sunk into the basement board of the stand as far as it would be into the earth when in actual use. The anemometer is the simplest form of the Robinson's hemispherical cups, with the dial beneath recording a drift of 9·42 feet for each revolution. This, of course, has to be mounted upon a staff sufficiently high to remove it from the influence of all obstacles and impediments. This group of instruments is deserving of attention in its connected form, on account of the purpose it serves of indicating the apparatus that is essential to the equipment of a complete observing station. A smaller and less costly set of instruments, exhibited by Pastorelli, is intended for employment in colleges and schools, where it is deemed desirable to give some instruction in meteorological methods. The thermometers belonging to this set were placed in their proper screen in the first case of the south end of the room, and consist of a wet and dry bulb thermometer, a maximum and a minimum registering thermometer, a solar radiation thermometer in a vacuum tube, and a very sensitive terrestrial-radiation thermometer with bifurcated bulb. The barometer and rain gauge were grouped with their proper companions in the barometric and rain gauge department. The barometer is a convenient standard, upon a mahogany board, of the Marine pattern, without fiducial point adjustments, but with a scale corrected for capacity. The rain-gauge is a five-inch japanned funnel and receiver with appropriate glass measure. This set of instruments, which is a really excellent one for the purpose for which it is designed, is supplied for about £10. A complete series of very excellent instruments is also catalogued by Negretti and Zambra as "A Special Set of Observatory Standard Meteorological Instruments (2,788 *a*)," consisting of a standard Fortin barometer, mercurial maximum thermometer, Rutherford minimum thermometer, mercurial minimum thermometer, wet and dry bulb thermometers, solar radiation and terrestrial radiation thermometer, Robinson's anemometer, and Glaisher's pattern rain gauge. These instruments, however, have been distributed into their proper departments, for the convenience of arrangement and classification, and have been specially described in connection with them.

The Meteorological-office of the Board of Trade exhibits some instruments which are of special interest on account of the purposes to which they are put. The Casella copper rain gauge indicates the form of instrument which is employed at the stations of this office. A wall-screen contains a maximum and a minimum registering thermometer by Negretti, mounted as they are supplied for general use. A still more compact louvred case shows the wet and dry bulb (Casella) furnished to ships. Two marine barometers by Adic, supported on their long arms and gymbals, are the instruments selected for the Royal Navy and for the marine department in general, and there is also an aneroid barometer by Elliott, which is provided for the same service. The maximum and minimum thermometers, distributed from the marine department, are by Hicks, and there is also a complete case of hydrometers by Hicks and Casella, for testing the gravity of sea water, one being especially for the dense water of the Red Sea and of the Suez Canal. The simple and bold form of barometer which is provided as a weather glass for the fishery stations, is by Hicks. The solar radiation thermometer adopted by the Meteorological-office is the usual form in the vacuum tube with a blackened bulb.

The Russian official instruments which are exhibited by the Meteorological-office, and which have been all alluded to in their proper places, consist of a large white rain gauge, a "double barrelled syphon barometer," a set of thermometers, wet and dry bulb and registering maximum and minimum, in a double cylindrical revolving metal screen, and a De Saussure's hair hygrometer. The screens, No. 2,938 and No. 2,939, which are associated with the Meterological-office contribution, are those that are used for thermometers at the stations of the Norwegian Meteorological Institute, and which have been contrived, and recommended by, Professor Mohn.

NATIONAL MUSEUMS AND GALLERIES AND PUBLIC EDUCATION.

An important result has followed the action taken by the Society, in 1873, by the establishment of its permanent Committee to promote National Museums and Galleries and Public Education. A conference of municipal representatives, convened by the Mayor of Birmingham, was held at Birmingham on the 5th of January, with the object of obtaining Government grants in aid of local museums, and a portion of the surplus under the control of Her Majesty's Commissioners arising from the guarantee fund raised for the purpose of the Exhibition of 1851. There were present representatives from Manchester, Salford, Liverpool, Leeds, Bradford, Derby, Newcastle-on-Tyne, Bristol, Leicester, Worcester, Coventry, Kidderminster, Swansea, &c. The speeches were numerous and to the point, but these columns only admit of an abridgement. Those who are sufficiently interested should consult the *Birmingham Post* and *Gazette* of 6th January. The **Mayor of Birmingham** presided.

The **Chairman** said the objects of the resolutions to be brought before the Conference were threefold. They could only use 1d. in the pound per annum for free libraries and museums, and they wanted to supplement that amount by a grant from the Government, in the same way that grants were made to the different institutions in London, Edinburgh, and Dublin. Another point was to obtain a share of the large amount that had been accumulated by the Commissioners of the Exhibition of 1851. The whole country having contributed to the success of that Exhibition, and become guarantees for its success, the provinces were as much entitled to a share in the distribution as the metropolis, and the funds were so ample that they could go with a very good grace and ask for a slice of what they had to dispose of. There was a third point, and that was to obtain loans or grants from the pictures, casts, and drawings now stowed away in the chambers of the British Museum or the National Gallery. They were practically useless where they were, but would be of immense benefit if they were distributed over the various large centres of population in the country.

Alderman Collings then read the following statement:—

"The Free Libraries Committee desire to submit the following statement, upon the facts contained in which the Mayor of Birmingham, at their request, has called this Conference together:—The penny rate allowed to be levied under the Free Libraries and Museums Act is the only permanent source of income for the maintenance of libraries, museums, and galleries of art. This rate is insufficient for the purpose for which it is intended. It is in most boroughs—certainly in the case of Birmingham—scarcely adequate to the maintenance of reference and lending libraries and news-rooms, and it consequently affords no fund available for the formation of scientific or industrial museums, or for the purchase of examples for galleries of art. The fund yielded for the libraries is most seriously trenched upon by the payment of interest and sinking fund of money borrowed under the Act for building purposes; and thus, independently of considerations affecting museums and picture galleries, the libraries themselves are cramped and limited, the committee being unable, for want of means, to supply deficiences in their original constitution, or to purchase to an adequate extent the new books of value which are constantly appearing in all branches of literature and science. It may be worthy of consideration by the Conference whether an increase of the rate should not be recommended to the several Corporations represented, and by them to Parliament. In the meantime, other means of extending the usefulness of the libraries and museums must be sought, and it is believed that, by timely and united efforts, such means may be rendered available.

"These means consist in applications (1) to the Government for grants in aid of building museums and galleries, and in supplying them, by gifts or loans, with suitable objects for exhibition; (2) to the Commissioners of the Exhibition of 1851 for grants of these purposes from the surplus funds at their disposal; and (3) to the Trustees of the National Gallery and of the British Museum. for loans of works of art, &c., for permanent or temporary exhibition in provincial galleries. It will be convenient to take these recommendations in the above-named order.

"1. Applications to the Government.—Large grants are made annually to the Department of Science and Art, and to the institutions under its control. In these the provincial towns have only an indirect share, by means of prizes, &c., given, on examination, to the students of science and art classes; and by payments to schools of art, and by loans of objects to such schools and to galleries of art, from the South Kensington Museum. Large grants are also made for museums and institutions in Edinburgh and Dublin, in which the English provincial towns have no share whatever It is submitted that, in connection with the Department of Science and Art, there should be a fund for the special purpose of making grants to provincial museums and galleries—(*a*) for the erection of suitable buildings, and (*b*) for the provision of examples for exhibition. It is submitted also that from all collections under the control of the Government, or in any way supported by grants from the national funds, there should be established, on an extended scale, a system of loans of works of art and of scientific objects for exhibition in provincial galleries—regard being had, in such loans, to the industrial characteristics of several localities.

"2. Application to the Commissioners of the Exhibition of 1851.—The Commissioners had a large surplus (about £186,000) remaining in their hands as the result of the above-named Exhibition. By careful investment in land at South Kensington, this original fund has been largely augmented, and, it now completely realised, would yield a capital sum of more than £1,000,000, after defraying all the liabilities incumbent upon it. The Commissioners have lately directed their attention to the best means of dealing with the property in their hands, and a committee, consisting of the Marquis of Ripon, Earl Grauville, Earl Spencer, the Earl of Carnarvon, and the Right Honourable Lyon Playfair, M.P., was appointed to prepare a scheme to be laid before the Commissioners for their approval. The committee has recommended several alternative plans for dealing with the property. Of these, the committee particularly recommend two schemes. That which they specially prefer is that the Government should buy from them, for purposes of science and art, the Horticultural Gardens at South Kensington, with the galleries and arcades adjoining them, at half their present value. This plan would give the Commissioners the command of a sum of £720,000. The other plan is to sell a portion of the ground, and to retain the Exhibition buildings and the Horticultural Gardens, with a view to their future use for public purposes; and this mode of dealing with the property would yield upwards of £350,000, free from all liabilities.

"Whatever may be the amount realised by the Commissioners, the committee propose to expend part of it—not exceeding £100,000—in the erection of a building in connection with the South Kensington Museum, for art and science libraries, in the first instance, with the ultimate view of converting it into an educational and scientific library and museum of scientific instruments and objects, the want of which is very much felt. The remainder of the available sum the committee propose to employ in two ways—(1) promoting museums of science and art throughout the country, by grants in aid of buildings or collections of suitable objects; and (2) in founding scholarships of science and art in connection with central institions and provincial colleges of science and art now arising at Manchester, Birmingham, Bristol, Leeds, Nottingham, and elsewhere.

In reference to this project, the committee observe in their report —'In recent years a great impulse has been given to the scientific instruction of the populations in our great centres of industry. It would be a great benefit to these new institutions if their more promising students could be brought up to the laboratories of chemistry, physics, and biology, which are in active work at South Kensington. The same system of aid would be of equal importance to the more advanced schools of art, as a supplement to the aid now given by Government.'

"The Birmingham Free Libraries Committee urge upon the Conference the importance of taking means, by a deputation to the Royal Commissioners, of pressing upon them the main recommendations of their committee which have yet to be considered by the general body of the Commission. The points to be specially insisted upon, as promising to yield the greatest advantage to the country are—(1) The realisation of the funds of the Commission to as great an extent as may be possible; (2) the application of the realised fund in grants to provincial museums for building, and for the purchase of suitable objects for exhibition, and to the creation of scholarships for the benefit of advanced students in science and art. Such scholarships, it is suggested, should be made tenable, not merely at central metropolitan institutions, but also at provincial centres, it being in all respects unadvisable that the growing tendency to centralisation should be fostered in an additional degree. The claim of the provincial towns to share in the Commissioners' funds may be most forcibly supported by two considerations. In the first place, the Exhibition of 1851, from the profits of which the fund was originally derived, was rendered possible only by the guarantees which were given by the provincial towns; and, therefore, as a matter of justice, these towns are entitled to participate in the benefit secured by their own enterprise and spirit of self-sacrifice. In the second place, the claim of museums under the control of Corporations is based upon the permanence of such institutions, and the guarantee afforded by public management for the just administration of money entrusted to them, and also upon the difficulty which is felt in raising, by means of rates, amounts adequate to meet the expenses of building and maintaining scientific museums and galleries of art. In all towns were such museums exist, large sums have been expended in their construction and in the provision of suitable objects, and this outlay constitutes a burden which the limited rate is unable to bear, and the pressure of which interposes an insuperable barrier to the extension of the museums from the same source. It is necessary, therefore, to find other means of increasing the funds at the disposal of Corporations for the above-named purpose. The Birmingham Free Libraries and Museums Committee submit that the property held in trust by the Commissioners of the Exhibition of 1851 affords a source of supply specially adapted to this end; and they consequently advise that the strongest pressure should be brought to bear upon the Commissioners, to induce them to approve the principle of realisation and distribution recommended in the report of their committee.

"Applications to the Trustees of the National Gallery and the Trustees of the British Museum.—It is submitted that the collections contained in these national institutions, to a large extent provided and supported by public grants, should, as far as possible, be rendered available for the benefit of museums under the charge of provincial Corporations. It is not proposed that works of special value, or of unique quality, should be removed from the national museums; but that grants or loans for public exhibition should be arranged from whatever duplicates may be possessed by the National Gallery or the British Museum, or from excess stores which, from want of space, they are unable to exhibit. With regard to the National Gallery in particular, it is known that a large collection of drawings by Turner—amounting to several thousand specimens, in various states of progress—is at the disposal of the trustees, and from this treasure selections of great value might be made for the benefit of provincial towns. The trustees have, indeed, already recognised the principle of loans, by making a selection of Turner drawings, lent first to the Leeds Exhibition, and afterwards to the Corporation of Birmingham. In both places the loan was greatly valued by the public, and materially assisted in the work of raising the standard of taste, and of creating a true appreciation of art; and it is much to be desired that the experiment then initiated should be repeated, and made the subject of permanent arrangement. In regard to the British Museum, collections, it is suggested, might easily be made up from the galleries of antiquities, and from the print-rooms, and might, without injury to the museum itself, be lent to provincial Corporations for exhibition in their galleries. Duplicates of books not required in the British Museum Library might also be contributed to the provincial Corporation Reference Libraries; and permission might be given, under proper regulations, to reproduce objects of art, suitable for the instruction of the designers and artisans in our chief industrial centres.

"It is not proposed in this paper to do more than to make a statement of the facts; and therefore argument in support of them is omitted. But it may, in conclusion, be pointed out that if the people of the great provincial towns are to be instructed in science and art, if their education is to be extended, their taste improved, and their knowledge rendered capable of being turned to practical account, The national collections and national funds applicable to science and art must be more directly and largely applied for their benefit. There is no better or more immediate method of accomplishing this purpose than by the formation and adequate maintenance of local museums under the management of Corporations. Large sums, raised by rates or gifts, in the various localities, have already been expended upon such museums, and much voluntary labour has been bestowed upon them by the committees entrusted with their management. The time has now arrived when local self-help—strained to its utmost capacity—must be supplemented by a liberal system of assistance from central sources, such as Government grants in money, loans, or gifts of objects from national collection of Science and Art, and grants from such a fund as that at the disposal of the Commissioners of the Exhibition of 1851. In the belief that representatives of other Corporations will agree with them in this conclusion, the Birmingham Free Libraries and Museums Committee have requested the Mayor to convene this Conference; and they are convinced that by earnest, intelligent, and united efforts, the object they have in view may be secured.—Signed on behalf of the committee, Jesse Collings, Chairman."

Alderman Collings added:—They had in Birmingham spent £100,000 out of the rates on free libraries and art galleries, and their 1d. rate brought in £5,500 per annum. By great economy, by retrenching the supply of books, they had ventured to decide on the erection of new art galleries, to cost about £13,000. After they had built the galleries they would want to fill them in a proper manner. Nearly 300,000 people visited the Birmingham gallery in a year, while at South Kensington there were only about three times that number, in Edinburgh about 300,000, and in the British Museum about half a million. With regard to loans from the National Gallery and the British Museum, that was an important matter. They did not want them to send down any of their big things, but whenever they had duplicates or excess copies, instead of being uselessly locked up, they would be better employed in the great provincial towns. The last point was an application to the Commissioners of the 1851 Exhibition. They must approach and state their case to gentlemen who they presumed were as anxious for the good use of the money at their disposal as they could be, and represent to them that they could not do better for the advancement of art and science than by largely distributing the funds among the large towns in the provinces. He moved:—

"That, in the opinion of this Conference, the large outlay already made, and the debts incurred by Municipal Corporations in the chief provincial towns for the establishment and maintenance of free libraries and museums, entitle them to a direct share in national grants for the promotion of science and art, and that such grants should be made in aid of the provision of buildings and for the acquisition of collections of objects suitable for exhibition.

"That arrangements should be made for the loan of examples selected from the National Galleries and museums for exhibition in museums established by Municipal Corporations. That it is desirable to urge upon the Royal Commissioners for the Exhibition of 1851 the propriety of realising the property under their control, and of applying it in part, as recommended by their Special Committee, to grants in aid of building museums in connection with Municipal Corporations, and in making provision for the purchase of objects suitable for exhibition in museums.

"That an adjourned meeting of the Conference, with the addition of representatives of other Corporations, be convened at an early period after the assembling of Parliament, for the purpose of taking measures, by deputation or otherwise, for giving effect to the previous resolutions."

The Mayor of Leeds seconded the resolution.

The Mayor of Manchester (Mr. Heywood) said he was not prepared to vote for the first part of the resolution.

Alderman Collings withdrew, for the present, the first part of the resolution.

Mr. J. A. Picton (Liverpool) cordially concurred in the resolution. There were a number of books which were issued at the public expense, and which were distributed in a very capricious and arbitrary manner. The Parliamentary papers were very useful in free libraries, but they had to pay for them, and he thought the geographical maps in connection with the Ordnance should be given to their local museums. A little pressure on their members, he thought, would produce the effect they desired. On principle he considered that loan collections would be more valuable than grants for buildings. To ask for grants out of the taxes he thought would be objectionable in principle, unfair, and unjust.

Mr. J. Chamberlain, M.P., said the funds which were at the disposal of the Commissioners were in all respects national property, and if they were to adopt the principle of the Mayor of Manchester, he did not see how they could ask for a share in what were really national grants or contributions in the way of national publications. The collections also were the fruit of national taxation, and what they did in one case, as in the other, was to ask that everything should not go to London alone. He hoped the conference would not commit itself to asking for loan collections alone. They wanted different collections in every locality, illustrative of the art and manufacture of the special locality. That, above all, was what would be useful, and it was in accordance with the principles laid down at the time of the Exhibition of 1851. They did not want loan collections to educate a single generation, but a permanent exhibition of articles useful and proper to their particular locality. Their experience in Birmingham did not lead them to expect that collections formed for the purpose of loans in the provinces would be most valuable. They had to complain that they had received, not collections suitable to their wants, but rather collections which were sent to them because they were not wanted in London. His notion was that they should ask the Commissioners, in proportion to the sum at their disposal, to make proportionate grants; that was to say, a local contribution of so much should be proportionately supplemented by a grant from the national funds, and in that way everybody would be served according to their claims and merits, and the help would take the form of helping themselves.

The second resolution, advocating loans from the National Museums, was supported by **Mr. A. Paget** (Leicester), **Mr. W. Bragg** (Sheffield), **Mr. Lupton** (Leeds), the Chairman of the Free Libraries Committees of Swansea, by representatives from Bradford, Derby, and Kidderminster, and carried unanimously.

Mr. Collings next moved the first part of the resolution having reference to public grants in aid of free libraries.

Mr. P. H. Muntz, M.P., seconded the resolution. He said if a portion of the grants could be given to the large provincial towns, he saw no reason why it should not be so given. Although some objection had been taken to it, he thought the principle ought to be thoroughly discussed, and he suggested to the Mayors present that they should confer with their members on the subject, and ask them to draw their attention to these matters when brought forward, because he could say that the representatives of the large towns intended to press the question and take decided votes upon it.

Alderman Stephenson (Derby) and the **Mayor of Salford**, heartily supported the resolution.

Mr. Chamberlain, M.P., said probably the Mayor of Manchester was only giving his individual experience, and he would like to know if the Manchester City Council or the ratepayers were content to be taxed twice over for this particular purpose. He had made a calculation, from which he found that Birmingham contributed £3,000 and Manchester £4,000 per annum of the money spent upon the art institutions of London. Was it fair, while they were doing their own work, that they should also contribute to the imperfect national work which was being done in London? No doubt, to a certain extent, these metropolitan institutions were reference libraries and galleries, but Parliament had gone further, and contributed to a local museum—the Bethnal-green Museum.

Mr. Picton (Liverpool) opposed the motion.

The Mayor of Manchester said he approved the principle, but he thought it was impracticable at present, and would imperil the success of their other application.

Mr. J. T. Bunce, as representing the Free Libraries Committee, reviewed and combatted in detail the objections urged against this portion of the scheme.

After a lengthened discussion,

Mr. Chamberlain, M.P., moved, and the **Mayor of Manchester** seconded, an amendment postponing the consideration of the first resolution until the next meeting of the Conference, which is to be held in London.

The amendment was unanimously agreed to, and the proceedings terminated.

The members of the Society may be congratulated that the efforts of the Society to connect public museums with national education will thus be aided by the valuable assistance of the municipal corporations, and that, by the action of all parties, the Government will be induced to regard public museums, galleries, and free libraries as necessary instruments in promoting the national culture of all classes of the people.

GRATUITOUS COMMERCIAL INSTRUCTION IN FRANCE.

Three courses of free lectures were opened last month at the Mairie of the Ninth Arondissement of Paris, Rue Drouot, especially intended for the benefit of those employed in commerce, trade, or banking. These courses, which are public and gratuitous, have been founded by a committee for the encouragement of commercial study in France, due principally to M. Bamberger, who has already founded scholarships for the same purpose.

On Monday evenings the course is on "Finance and Political Economy," by Prof. Alph. Courtois.

On Wednesday, "The History of Commerce," by M. L. Simonin.

On Friday, "Commercial Geography," by M. H. Pigeonneau.

Those who have attended the classes and desire to be examined, will, if they pass the ordeal successfully, receive a certificate of capacity. In addition the committee will distribute prizes amounting to 1,800 francs. Each course consists of twenty lessons.

The following is an outline of the programme. M. Courtois will treat:—1. Production; 2. Exchange and markets; 3. Distribution and consumption; 4. Book-keeping; 5 and 6. Association; 7 and 8. Share companies; 9. Money; 10. Exchange and arbitration, 11. Credit and crisis; 12 and 13. Banks; 14 and 15. The State and taxes; 16 and 17. Loans; 18. Commercial exchanges; 19. Foreign exchanges; 20. Resumé and conclusions.

M. Simonin has divided his course into three parts:—1st part, 3 lessons, Commerce in the Early and Middle Ages; 2nd part, 5 lessons, Commerce since the Discovery of America; 3rd part, 12 lessons, the Commerce of the Nineteenth Century.

M. Pigeonneau's course will be arranged according to the actual division of the surface of the globe, but France will be dealt with specially, and the last lesson will be devoted to the consideration of the great commercial powers—England, the United States of America, Germany, and France—with regard to their exchanges and the importance of their traffic.

The paragraph in last week's *Journal* referring to printed specifications of patents should have stated that it is only in the case of expired patents that the Commissioners will no longer undertake to keep the specifications in print. As long as a patent is still in force printed copies of it will be supplied in the ordinary manner, reprints being made as required at the cost of the office.

In Professor Archer's paper on the Philadelphia Exhibition, given in the *Journal* for Dec. 22 last, on p. 89, line 2 from top, Mr. J. H. Cundall's name is erroneously printed Cimdall.

The newly constituted Syndical Chamber of Ghent will organise an Exhibition of Industrial Art during the year 1877.

NOTICES.

PROCEEDINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday evenings, at 8 o'clock. The following arrangements have been made:—

January 17.—1. "The Cultivation of Common Fruits in England economically considered," by G. C. T. Bartley, Esq. 2. "Railway Wastes and Reclamation," by Hyde Clarke, Esq. Lord Alfred S. Churchill will preside.

January 24.—"Silkworm Grain," by B. Francis Cobb, Esq.

January 31.—"Ventilation of Rooms generally, and the way to make Workmen's Cottages comfortable, warm, and healthy," by Frank E. Thicke, Esq.

February 7. — "Street Tramways," by Captain Douglas Galton, C.B., R.E., F.R.S.

February 14.—"Zinc White as Paint, and the Treatment of Iron for the Prevention of Corrosion," by Professor Barff, M.A.

February 21.—

February 28.—Middle Class Education in Holland," by John Yeats, Esq., LL.D., F.R.G.S.

African Section.

Tuesday evenings, at 8 o'clock. The following arrangements have been made:—

January 23.—"The Trade of Central Africa, Present and Future," by Commander Cameron, R.N., C.B. Sir T. Fowell Buxton, Bart., will preside.

February 13.—"The Geographical and Commercial Character of the District between Mogador and Cape Juby, North-West Africa," by N. Giammal, Esq.

March 13.—

April 10.—"The Social State and Prospects of the South African Communities," by Robert Richards, Esq., of Grahamstown.

April 24.—"The Trade and Resources of Morocco," by Dr. Arthur Leared.

May 8.—

Indian Section.

Friday evenings, at 8 o'clock. The following arrangements have been made:—

February 2.—"Indian Tea Cultivation; its Origin, Progress, and Prospects," by A. Burrell, Esq.

February 16.—"Indian Railways," by Juland Danvers, Esq.

March 2.—"The Progress of Trade in Central Asia," by Sir T. Douglas Forsyth, C.B., K.C.S.I.

March 16.—"The Native Indian Press," by Dr. George Birdwood, C.S.I.

April 20.—"The Existing and Possible Commercial Communications between Persia and India," by Major-General Sir Frederick John Goldsmid, C.B., K.C.S.I.

May 4.—"The Wonderful Trees of India," by William Tayler, Esq.

Chemical Section.

Thursday evenings, at 8 o'clock. The following arrangements have been made:—

February 8.—"Some Processes of Nature's Hygiene," by C. T. Kingzett, Esq., F.C.S.

February 22.—"Spontaneous Combustion in Factories and Ships," by C. W. Vincent, Esq., F.R.S.E.

March 8.—"The Sizing of Cotton Goods," by W. Thompson, Esq., F.C.S., of Manchester.

April 12.—"The Cinchona Alkaloids; their Sources, Production, and Use," by Dr. B. H. Paul.

MEETINGS FOR THE ENSUING WEEK.

Mon. ...Charity Organisation (at the House of the Society of Arts), 4 p.m.

Institute of Surveyors, 12, Great George-street, S.W., 8 p.m. Mr. W. T. Marriott, "Riparian Rights."

Medical, 11, Chandos-street, W., 8.30 p.m.

Asiatic, 22, Albemarle-street, W., 3 p.m.

Victoria Institute, 10, Adelphi-terrace, W.C., 8 p.m. Professor Lias, "Christianity considered as a Moral Power."

London Institution, Finsbury-circus, E.C., 5 p.m. Dr. B. W. Richardson, "Health Improvements in Great Cities." (Lecture II.)

Social Science Association, 1, Adam-street, Adelphi, W.C., 8 p.m. Mr. Serjeant Cox, "Reform in the Procedure of Magistrates' Courts."

Tues....National Indian Association (at the House of the Society of Arts), 8 p.m. Mr. J. B. Phear, "The Employment of Native Indian Gentlemen in the Public Service of India."

Royal Institution, Albemarle-street, W., 3 p.m. Prof. Garrod, "The Human Form; its Structure in Relation to its Contour." (Lecture I.)

Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Mr. Alexander McDonnell, "Repairs and Renewals of Locomotives."

Statistical, Somerset House-terrace, W.C., 7¾ p.m. Mr. F. G. P. Neison, "Some Statistics of the Affiliated Orders of Friendly Societies." (Odd Fellows and Foresters.)

Pathological, 53, Berners-street, Oxford-street. W., 8 p.m.

Zoological, 11, Hanover-square, W., 8½ p.m. 1. Capt. Feilden, "To Exhibit some Arctic Birds, and make Remarks on their Distribution within the Polar Area." 2. Prof. A. H. Garrod, "Note on the Solid-hoofed Pigs in the Society's Collection." 3. Mr. Henry Durnford, "Notes on the Mammals of the Argentine Republic." 4. Mr. Gerard Krefft, "Notes on a Young Cassowary from North Australia."

Wed. ...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. 1. Mr. G. C. T. Bartley, "The Cultivation of Common Fruits in England Economically Considered." 2. Mr. Hyde Clarke, "Railway Wastes and Reclamation."

Meteorological, 25, Great George-street, S.W., 7 p.m. Annual Meeting.

Entomological, 11, Chandos-street, W., 5 p.m. Annual Meeting.

Archæological Association, 32, Sackville-street, W., 8 p.m.

Royal Horticultural, South Kensington, S. W., 1 p.m.

Thur....Royal, Burlington House, W., 8½ p.m.

Antiquaries, Burlington House, W., 8½ p.m.

Linnean, Burlington House, W., 8½ p.m.,

Chemical, Burlington House, W., 8 p.m. 1. Messrs. C. T. Kingzett and H. W. Hake, "Preliminary Account of some new Reactions in Organic Chemistry, and their Ultimate Bearings." 2. Mr. H. E. Armstrong, "Vekulé's and Ladenburgh's Benzene Symbols." 3. Messrs. J. Stenhouse and C. E. Groves, "Nitroso-orcin."

London Institution, Finsbury-circus, E.C., 7 p.m. Prof. Ella, First Musical Lecture.

Society for the Encouragement of the Fine Arts, 9, Conduit-street, W., 7½ p.m., a Special General Meeting 8 p.m., the First General Meeting.

Royal Institution, Albemarle-street, W., 3 p.m. Dr. Wright, "Metals and the Chief Industrial Uses of these Bodies and their Compounds." (Lecture I.)

Zoological, 11, Hanover-square, W., 4 p.m.

Numismatic, 4, St. Martin's-place, W.C., 7 p.m.

Psychological, 11, Chandos-street, W., 8 p.m.

Civil and Mechanical Engineers, 7, Westminster-chambers, S.W., 7 p.m. Mr W. J. Brain, "Teredo and Terebrans: their Ravages on Timber."

Fri.......Royal Institution, Albemarle-street, W., 8 p.m., Weekly Meeting; 9 p.m., Prof. Tyndall, "A Combat with an Infective Atmosphere."

Philological, University College, W.C., 8 p.m.

Sat.......Trades' Guild of Learning and National Health Society (at the House of the Society of Arts), 8.30 p.m. Prof. W. H. Corfield, "The Laws of Health." Part II. (Lecture VII.)

Physical Science Schools, South Kensington, S.W., 3 p.m.

Royal Botanic, Inner Circle, Regent's-park, N.W., 3¾ p.m.

Royal Institution, Albemarle-street, W., 3 p.m. Mr. Ernst Pauer, "The Nature of Music; the Italian, French, and German Schools" (with pianoforte illustrations).

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,261. Vol. XXV.

FRIDAY, JANUARY 19, 1877.

ROYAL SOCIETY OF EDINBURGH

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

PUBLIC MUSEUMS AND GALLERIES, AND NATIONAL EDUCATION.

The late meeting of municipal authorities at Birmingham, and future meetings which are about to take place at Manchester and elsewhere, render it desirable that the corporate authorities throughout the United Kingdom should be made fully acquainted with the steps which have been taken since 1873 by the Society of Arts, so that they may have an opportunity, if they see fit, of uniting with the influential Committee of the Society, which has been already constituted. It will be seen that the proposals of the Society not only embrace those objects discussed at the Birmingham conference, reported in the *Journal* of the 12th January (page 137), but also include other measures of great national importance.

In the year 1874 the Council passed the following resolutions:—

1. That the undermentioned persons be invited to serve on a Standing Committee, for the purpose of bringing under Parliamentary responsibility the National Museums and Galleries, so as to extend their benefits to Local Museums, and to make them bear on public Education. The following are the several objects in view for effecting this purpose:—

2. All Museums and Galleries supported or subsidised by Parliament to be made conducive to the advancement of Education and Technical Instruction to the fullest extent, and be made to extend their advantages to the promotion of original investigations and works in Science and Art.

3. To extend the benefits of National Museums and Galleries to Local Museums of Science and Art which may desire to be in connection, and to assist them with loans of objects.

4. To induce Parliament to grant sufficient funds to enable such objects to be systematically collected, especially in view of making such loans.

5. For carrying out these objects most efficiently, to cause all National Museums and Galleries to be placed under the authority of a Minister of the Crown, being a member of the Cabinet, with direct responsibility to Parliament; thereby rendering unnecessary, for the purposes of executive administration, all unpaid and irresponsible trustees, except those who are trustees under bequests or deeds, who might continue to have the full powers of their trusts, but should not be charged with the expenditure of Parliamentary votes.

6. To enter into correspondence with all existing Local Museums and the numerous Schools of Science and Art, including Music, now formed throughout the United Kingdom, and to publish suggestions for the establishment of Local Museums.

7. Also, to cause the Public Libraries and Museums Act (18 and 19 Vic. c. lxx.) to be enlarged, in order to give local authorities increased powers of acting.

The Executive Committee caused the foregoing resolutions to be submitted to Peers, Members of the House of Commons, Chairmen of Schools of Science and Art, and others, and answers were received from the following, who serve on the Standing Committee, whilst those marked * expressed their willingness to form the Executive Committee:—

Members of the House of Lords.

Lord Aberdare
Bishop of Bath and Wells
Bishop of Carlisle
Earl of Carnarvon
Lord Clinton
Earl of Darnley
Lord De Tabley
Lord Ebury
Earl Granville
Lord Hampton
Viscount Hardinge
Lord Kinnaird
*Earl of Lichfield
Earl of Longford
Duke of Portland
*Viscount Powerscourt
Duke of Sutherland
Lord Talbot de Malahide
Lord Vernon
Duke of Westminster
Archbishop of York

Members of the House of Commons.

Edmund Backhouse, M.P.	Darlington.
James W. Barclay, M.P.	Forfarshire.
*Major F. E. Beaumont, M.P.	Durham (S.)
I. Lowthian Bell, M.P.	Hartlepool.
Lord Charles Beresford, M.P.	Waterford County.
*Col. J. Bourne, M.P.	Evesham.
M. Brooks, M.P.	Dublin.
Colin Minton Campbell, M.P.	Staffordshire.
*Wm. T. Charley, D.C.L., M.P.	Salford.
*A. D. W. R. B. Cochrane, M.P.	Isle of Wight.
J. Corbett, M.P.	Droitwich.
J. Cowan, M.P.	Edinburgh.
Right Hon. Wm. Cowper-Temple, M.P.	Hants (S.)
Sir Charles W. Dilke, Bart., M.P.	Chelsea.
Joseph Dodds, M.P.	Stockton.

Thomas Earp, M.P.	Newark.
George Errington, M.P.	Longford County.
*Lord Elcho, M.P.	Haddingtonshire.
T. W. Evans, M.P.	Derbyshire.
P. Ellis Eyton, M.P.	Flint.
R. Ferguson, M.P.	Carlisle.
*Gabriel Goldney, M.P.	Chippenham.
W. Gordon, M.P.	Chelsea.
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Ion Trant Hamilton, M.P.	Dublin County.
John Hick, M.P.	Bolton.
T. Rowley Hill, M.P.	Worcester.
*Samuel Holland, M.P.	Merionethshire.
Captain D. M. Home, M.P.	Berwick.
*John Holms, M.P.	Hackney.
Saul Isaac, M.P.	Nottingham.
D. J. Jenkins, M.P.	Penryn.
*U. J. Kay-Shuttleworth, M.P.	Hastings.
S. S. Lloyd, M.P.	Plymouth.
*Sir John Lubbock, Bart., M.P.	Maidstone.
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Alderman Wm. McArthur, M.P.	Lambeth.
J. G. MacCarthy, M.P.	Mallow.
A. Macdonald, M.P.	Stafford.
*Peter McLagan, M.P.	Linlithgow.
*Samuel Morley, M.P.	Bristol.
*A. J. Mundella, M.P.	Sheffield.
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Right Hon. Lyon Playfair, C.B., M.P.	Edinburgh University.
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W. H. Smith, M.P.	Westminster.
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Edward Wells, M.P.	Wallingford.
*W. St. James Wheelhouse, M.P.	Leeds.
*John Whitwell, M.P.	Kendal.
Basil T. Woodd, M.P.	Knaresborough.
J. Yeaman, M.P.	Dundee.

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The Duke of Westminster, K.G., *Vice-Pres.*
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The Prime Warden for the time being of the Worshipful Company of Fishmongers.
The Master for the time being of the Worshipful Company of Clothworkers.

Notice.—Members who desire to join the General Committee are requested to send their names to the Secretary.

Also the following Art and Science Schools, represented by their Chairmen.

Aberdeen Mechanics' Inst.	James W. Barclay, M.P.
Andover Sch. of Art	Rev. H. B. Bousfield.
Banbury Sci. & Art Sch.	J. Griffin.
Bedford Sci. Classes	James Coombs, M.D.
Bedford Sci. Sch.	William Joseph Nash.
Bethnal-green Sci. and Art Classes	Rev. Septimus Hansard.
Bethnal-green, St. James the Less Sci. Sch.	Rev. George Moon.
Birkenhead Sch. of Art	John Williamson.
Birmingham Sch. of Design	C. R. Cope.
Birmingham Middle Class Sch.	Wm. Rolason.
Birmingham, St. George's Sci. and Art Sch.	Rev. S. Thornton.
Bolton Mech. Inst.	S. Winkworth.
Bolton Sci. and Art Sch.	Rev. Canon Powell.

Borough-road, Southwark, Sci. Sch.	John Corderoy.
Boston, Lincolnshire, Sch. of Art	Rev. Canon Blenkin.
Bradford Art Sch.	Charles Lemon.
Bridport, Dorset, Sch. of Art and Sci.	J. M. P., J.P. Montagu.
Brighton Sch. of Art	Frederic Merrifield.
Bristol Sch. of Art	Philip W. S. Miles.
Bristol, North-street, Sci. Sch.	Rev. W. T. Radcliffe.
Bristol, Langton-street Sci. Class	Francis Teal.
Bristol Sci. Sch.	Rev. Canon Girdleston.
Burnley Sci. & Art Sch.	J. Nance.
Cambridge Sch. of Art	Dr. J. B. Lightfoot.
Cardiff Sci. Sch.	Charles W. David (Alderman).
Cardiff Art Sch.	William T. Taylor, M.D.
Cheltenham Sch. of Sci.	William N. Skilicorne, J.P., D.L.
Cheltenham Sch. of Art	Rev. T. W. Jex-Blake.
Clonmel Sch. of Art	Gerald Fitzgerald.
Coalbrookdale Lit. and Sci. Inst.	H. Dickinson.
Cork Art Sch.	James Beale.
Corraclare Sci. Sch.	N. S. O'Gorman.
Coventry Sci. Sch.	Rev. Canon Baynes.
Croydon Sch. of Sci. & Art	Alfred Carpenter, M.D.
Devonport Sci. & Art Sch.	J. May.
Doncaster Sci. Sch.	Rev. J. Campion.
Dublin, Queen's Inst., Art Sch.	Lord Talbot de Malahide.
Dublin Sci. Sch., King's Hospital	Rev. L. C. Reichardt.
Dudley Sch. of Art	Rev. Dr. Cosens.
Dundalk Sci. & Art Sch.	Rev. Robert Black.
Dundee Sci. Sch.	Rev. J. R. McGavin.
Dundee Sci. Sch.	J. Yeaman, M.P.
Exeter Sch. of Art	Charles John Follett.
Galashiels Sci. & Art Sch.	W. Brown.
Glasgow Anderson Univ.	J. Young, F.R.S.
Halifax Sch. of Art	Henry C. McCrea.
Haverstock-hill, N.W., Sci. Sch.	Basil Woodd Smith.
Henley-on-Thames Art Sch.	Charles Lane.
Holywood Sci. & Art Sch.	J. Hunter, jun.
Huddersfield Mech. Inst.	J. Lowenthal.
Hull Sch. of Art	J. H. Gibson, M.D.
Inverness Sch. of Sci. and Art	Alexander Simpson.
Ipswich Sch. of Art	Rev. Charles H. Gaye.
Islington Sci. and Art Sch., Essex-road	Rev. H. J. Berguer.
Islington, N., Youths' Inst. Sci. Classes	
Keighley Sci. & Art Sch.	John Brigg.
Kendal Sch. of Sci. and Art	John Whitwell, M.P.
Kidderminster Sch. of Art	John Brinton.
Kilmarnock Sci. and Art Sch.	J. Dickie.
Lancaster Sch. of Sci. and Art	Henry Gregson.
Leamington Sch. of Art	P. O'Callaghan, LL.D.
Leeds Sci. and Art Sch., Y.M.C. Assoc.	John Barran.
Leeds Sci. and Art Sch.	Thomas Dawson.
Leicester Sci. Sch.	Rev. Canon Vaughan.
Leicester Sci. Sch.	Rev. C. C. Coe.
Leith Art Sch.	James Watt.
Lewes Sch. of Sci. and Art	Burwood Godlee, J.P.
Limerick Sch. of Art	William Spillane, J.P.
Liverpool South District Sch. of Art	P. H. Holt.
Liverpool Sch. of Art	Rev. George Butler.
Manchester, Peter-street, Sci. Schs.	John Hyde.
Marylebone West-London Sch. of Art	Peter Graham.
Merthyr Tydfil, Abermorlais Sch. Sci. Class	Charles H. James.
Mile-end New-town, E., Church-street Sci. and Art Sch.	Rev. William Tyler.
Newcastle-on-Tyne Sch. of Art	Joseph Watson.
Newcastle-on-Tyne, Elswick Mech. Inst.	Rev. William Maughan.
Newcastle-upon-Tyne Sci. and Art Sch.	John B. Falconar.
Newry Sci. and Art Sch.	Rev. J. Dodd.
Newtonwards Sci. Classes	Hugh Moore.
Nottingham Sci. Classes	E. Gripper.
Nottingham Art Sch.	W. G. Ward, (late Mayor).
Oldham Lyceum Inst.	William Richardson.
Oswaldtwistle Sci. Sch.	Rev. J. M. Wamsley.
Paisley Sch. of Art	David Murray.
Plymouth Sci. & Art Sch.	C. Spence Bate, F.R.S.
Plymouth Sci. Sch.	Rev. E. B. Hickman.
Portsmouth Sch. of Sci. and Art	Rev. Edward P. Grant.
Preston Art Sch.	Richard Allen.
Rathmore Sci. Sch.	Rev. E. Walsh.
Reading Sci. and Art Sch.	Rev. A. P. Cust.
Ryde Sch. of Art	Benjamin Barrow, J.P.
Salford Museum Library	T. Davies, J.P. (Alderman).
Salisbury School of Sci. and Art	Rev. H. P. Hamilton (Dean of Salisbury).
Shrewsbury Sch. of Art	Reginald Cholmondeley.
Southampton Hartley Inst.	W. Hickman.
Stamford Museum	Dr. W. Newman.
Stroud Sch. of Art	J. W. Hallewell, J.P.
Sunderland Sch. of Art	Rev. W. R. Burnet, M.A.
Swindon Sci. & Art Classes	Joseph Armstrong.
Torquay Sch. of Sci. and Art	Edward Vivian.
Trowbridge Sch. of Art	Thos. Clark.
Trim Sci. Sch.	H. Lightburne.
Truro Art Sch.	Charles Barham, M.D.
Walsall Sci. and Art Inst.	Rev. Alfred A. Cole.
Wellclose square, E., Sci. and Art Class	Rev. D. Greatorex.
Westminster, St. Stephen's, S.W., Sci. Class	Rev. William Tennant.
Winchester Col. Sch. of Art, Winchester	Dr. Ridding.
Woolwich, Presbyterian Church District Sch.	Rev. W. M. Thompson.
Woolwich Arsenal Sci. Classes	Rev. James White.
Wolverhampton Sch. of Art	H. Loveridge.
Wolverton Sci. and Art Classes	Richard Bore.
Worcester Sci. Classes	Ralph J. Coward.
York Sch. of Art	J. Spencer.

The following, though unable to join the Committee, expressed their sympathy with its objects:—

Earl Fortescue—"I must content myself with expressing my active concurrence in the object mentioned in your letter, and wishing the Council all success in their efforts for its promotion.

Earl Russell—"Quite agrees with the resolutions passed by the Council."

Viscount Sidmouth—"It appears to me that in the event of the direction of museums being assumed by the State, or indeed in any case, a thoroughly qualified staff ought to be available for the use of the public, whose duty it should be to give, when required, full explanations respecting the different objects exhibited. With such means at hand, the value of good collections is incalculable, but I am always struck with the great disproportion existing between the numbers of vague and unsatisfied visitors and those who leave a museum with a fresh supply of real, solid information. You can get this information in most museums, ruins, &c., abroad, by paying for it, but in London, where you must not pay, nine out of ten are afraid to make inquiry."

Thomas Ashton, J.P.—"The object has my full sympathy."

Dr. Hooker.—"I entirely sympathise."

Professor Huxley.—"I am unfeignedly rejoiced to see the movement set on foot by the Society of Arts."

J. D. Lewis, M.P.—"Sympathises with the object, &c."

J. G. Talbot, M.P.—"I beg to express my satisfaction that you are pressing this matter upon the Government."

The Council of the Hartley Institution, Southampton, has passed the following resolution:—"That the action of the Society of Arts, for the purpose of bringing under Parliamentary responsibility the National Museums and Galleries, so as to extend their benefits to Local Museums, is a movement deserving of the approval and support of the Hartley Council.

NATIONAL TRAINING SCHOOL FOR MUSIC.

The following is the report of the circumstances of this School during the first two terms of its existence:—

1.—Opening of the School.

The school was formally opened on the 17th May, 1876, by His Royal Highness the Duke of Edinburgh, K.G., who, accompanied by His Royal Highness the Duke of Connaught and Strathearne, K.G.; by representatives from the Musical Committee of the Society of Arts; by the members of the Committee of Management; by the Principal and board of professors; by the professional examiners, and by other officers of the school, inspected the building; the professors and students assembled in the various class-rooms, having the honour of being presented to His Royal Highness.

2.—The Committee of Management.

At a meeting of the committee, which subsequently took place, His Royal Highness the Duke of Edinburgh, chairman, formally announced his approaching departure from England on public duty, and appointed the Right Hon. the Viscount Newry, vice-chairman of the Committee of Management during the period of his absence. On the proposal of his Royal Highness, Mr. Alan S. Cole, who had, from the inception of the scheme to the opening of the school, discharged the duties of hon. secretary, and Mr. Thomas Chappell, were elected members of the Committee of Management. On the same occasion, there were also added to the committee Mr. John Bath, C.C., as representative of the Scholarships founded by the Corporation of the City of London, Mr. Charles Barry and Mr. Charles Morley, as representatives of the Scholarships raised by the City and Metropolitan Committee.

3.—Professional and Official Staffs, and Scholarships.

At the opening of the school the professional staff consisted of the Principal, Mr. Arthur Sullivan, now Mus. Doc. Cantab; a board of five Professors, of which the principal is chairman, embracing five members, and nine other professors. These have been since then augmented by two additional appointments. The official staff comprises a finance committee, a registrar, a clerk, a superintendent of scholarships, a lady superintendent and housekeeper, a financial officer, a collector, and an office-keeper. The body of scholars numbered fifty-one, and included five from the Society of Arts, one from Ashford, three from Birmingham, one from the Ward of Bishopsgate, one from Mr. T. Chappell, two from the Clothworkers' Company, one from the Ward of Cripplegate, two from the Fishmongers' Company, five from Mrs. Freake, two from Halifax, three from Liverpool, one from the Lord Mayor of London (Mr. Alderman Cotton, M.P.), one from the Sheriffs of London and Middlesex, two from the Mercers' Company, one from Mr. Charles Morley, one from Mr. Frank Morrison, one from Viscount Newry, one from Northampton, three from Northumberland, two from Nottingham, two from Messrs. de Rothschild, one from the Saddlers' Company, one from the executors of the late Mr. J. C. Sim, one from the Skinners' Company, five from the Merchant Taylors' Company, and one from the Vintners' Company. During the interval which has elapsed since the opening of the school the number of scholars has been increased to seventy-four, the additional scholars coming—four from the Queen and the Royal Family, one from members of the Society of Arts, one from Messrs. Barry and Causton, two from Bradford, two from the Cinque Ports (Sandwich), one from Mr. Barclay Field, one from the Rev. J. G. C. Fussell and Miss Dalrymple, ten from the Corporation of the City of London, one from Mr. Howard Morley, one from the Nottingham Sacred Harmonic Society, one from Mr. R. D. Sassoon, one from the Staffordshire Potteries, and one from Mrs. Stone (a former Lady Mayoress). Seventeen of the scholars are males and fifty-seven females.

4.—Attendance at the School.

The attendance of the scholars has been, with one, or perhaps two, exceptions, perfectly regular and punctual. Their general conduct has been, without exception, highly satisfactory.

5.—Studies.

With regard to the instruments and subjects studied by the students it may suffice to say here that forty-two scholars make the piano their principal subject of study; twenty-two, singing; nine, the violin; and one, the organ. With respect to second studies, the vocalists and violinists take the piano; the pianists take the organ, or singing, or the violin. Every scholar has, in addition to a principal and a second subject of study, two hours' instruction per week in solfeggio, and one hour in harmony; and eight of them have an extra hour's teaching in counterpoint and composition.

6.—Terms.

Since the opening of the school there have been two terms of study, viz., a Midsummer term, which ended on the 26th July, and a Michaelmas term, which commenced on the 29th September, and ended on the 23rd December. Both terms were brought to a close by an examination of the entire body of scholars, conducted by the Principal and the professors of the school, with the results hereafter alluded to in this report by the Principal. At the end of the Easter term the examinations will be conducted by the professional examiners.

7.—Competition for Royal Scholarships.

During the Michaelmas term a competition was held among the scholars of the school for the Scholarships which have been founded by the Queen and other members of the Royal Family. The examination, which was conducted by the Principal and the professors, embraced all the school subjects of study, except composition, and resulted in the election of Eugène d'Albert, Northumbrian scholar, to be the Queen's scholar; Minnie Eliza Webbe, Fishmongers' scholar, to be the Prince of Wales scholar; Eva P. Pidcock, Fishmongers' scholar, to be the Duke of Edinburgh's scholar; Hélène Heale, Society of Arts' scholar, to be the Duchess of Edinburgh's scholar.

The founders of the Scholarships which thus became vacant were communicated with, and have kindly sent up new scholars to fill the places previously held by those who have obtained the Royal Scholarships.

8.—Donations.

During the two past terms, the school has received valuable presents of furniture and an oil painting from Mrs. Freake; of music for the reference library from Messrs. Augener and Co., Messrs. Ashdown and Parry, Mr. Lamborn Cock, Mr. Ernst Pauer, Mr. Visetti, Mr. Welch, Mr. O'Leary, and Miss Ferrari; of music to furnish a students' lending library from Mr. T. Macco, of Bath, and Dr. Sullivan; of musical literature for the library from Sir Henry Cole, K.C.B., Mr. Hullah, and Dr. Stainer; and of a piano, from Sir Thomas Edwards Moss, Bart. A free loan of a grand piano for general use has also been most kindly made by each of the following firms, viz., Messrs. John Broadwood and Sons., Messrs. Collard and Collard, Messrs. Chappell and Sons, and Messrs. Kirkman and Co. The organ, recently built by Mr. Henry Jones, has also been enlarged at the cost of Sir William G. Anderson, K.C.B.

9.—Progress of the Scholars.

With respect to the progress of the scholars and the work of the professors, the Principal reports as follows:—I consider the condition and prospects of the school, from a musical point of view, to be in the highest degree satisfactory. Under the personal supervision and instruction of the principal and the staff of professors the pupils are making great progress, and whilst all are doing well, some of them bid fair to take the highest rank in the art—two or three indeed will, without doubt, achieve an European reputation. Great importance is attached to their becoming good, thoroughly well educated musicians, as well as to the necessity of their excelling in their principal studies. For this object every pupil goes through, or will go through, a complete course of harmony and counterpoint, and also attends the solfeggio class. In this latter, they become acquainted with the vocal works of the great masters, which are explained and analysed in the course of the lessons by the professor.

10.—Formation of Orchestra.

It is much to be desired that more pupils for stringed instruments should enter the school, as it is absolutely necessary that the nucleus, at least, of an orchestra should be formed; otherwise this important branch of the students' work will run some risk of being but imperfectly known, and the pupils will have but inadequate opportunity of learning and knowing those great orchestral works which form the very backbone of modern music. For this purpose the Principal has urged many of the students to take some stringed instrument for their second study; but even then, before they can obtain sufficient proficiency to take part in orchestral performance, a considerable time must elapse, so that it is highly desirable to encourage the admission of those who make these instruments their principal study as soon as possible. At present the greater proportion of the students devote themselves to either the pianoforte or singing.

11.—Professors and Scholars.

The Principal cannot speak in terms too high of the care and attention displayed by the whole staff of professors, and of the warm interest which they take in the welfare of their pupils. They have shewn it in a marked manner by the private reports which they send to the Principal every term, of the progress, the individual qualities, and the peculiarities of their pupils. This, combined with his own observations, gives the Principal an accurate insight into the abilities, the character, and the nature of each student, and enables him to form a clear judgment as to their individual and relative merits. On the other hand, it is a source of keen pleasure to all engaged in the work of instruction to note the delight and interest felt by all the pupils in their lessons, and the earnest desire they show to profit by all that is done for them. If this spirit continues on both sides there is no reason why this school of music should not earn an enviable reputation amongst similar institutions of Europe.

The foregoing report was adopted by the committee and ordered to be printed, under the direction of the Finance Committee, and distributed according to their discretion.

By Order of the Committee of Management.

SEVENTH ORDINARY MEETING.

Wednesday, January 17th, 1877; Lord Alfred S. Churchill, Chairman of Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Baggallay, Frank Thomas, Beckenham, Kent.
Bayly, John, Plymouth.
Brooke, George Edward, 18, King-street, Smithfield, E.C.
Crawshay, George, 6, Adelphi-terrace, Strand, W.C.
Duckham, Frederic Eliot, Millwall Docks, E., and Vanbrugh-fields, Blackheath, S.E.
Heaps, Arthur George Henry, Folly-hall, Beeston-hill, Holbeck, Leeds.
Hunt, Charles, Gas Works, Windon-street, Birmingham.
Hunter, Robert, Acres-lane, Stalybridge.
Knox, Arthur E. E., 52, Cadogan-place, S.W.
Maberly, George Henry, 35, Randolph-crescent, Maida-vale, W.
McDougall, John, F.C.S., 16, Croome's-hill, Greenwich, S.E.
Mactear, James, St. Rollox, Glasgow.
Morris, Edward Robert, Heathfield, Upper Hornsey-rise, N.
Perress, Robert Braxton, Newport, Isle of Wight.
Price, William H., 39, Albion-street, Broadstairs.
Stone, William, 22, Panton-street, Haymarket, S.W.
Unwin, William Cawthorne, Cooper's-hill College, Staines.
Watherston, Edward J., 12, Pall-mall East, S.W.
Wilson, Robert William Rankine, St. Stephen's Club, Westminster, S.W.; 234, St. Vincent-street, Glasgow; and Braidbar, Renfrewshire.

The following candidates were balloted for, and duly elected members of the Society:—

Abbey, John Henry, Huddersfield.
Barran, John, M.P., Chapel Allerton Hall, Leeds.
Berry, Thomas Hope Green, A.I.C.E., City-hall, Manchester.
Bovill, Frederick Anderson, 2, Vinery-villas, Park-road, Regent's-park, N.W.
Davis, George Edward, F.C.S., 10, Greenway-road, Runcorn.
Fletcher, W. R. B., 107, Cannon-street, E.C., and 34, Courtfield-gardens, South Kensington, S.W.
Josland, Thomas Pearse, 7, Falcon-square, E.C.
Kierzkowski, Charles Ferdinand de, 7, Collingham-road, Cromwell-road, S.W.
Kinch, William Hubert, Harewood-hill, Darlington.
McClelland, James, J.P., 32, Pembridge-square, W.
New, George Beazley, 62, George-street, Portman-square, W.

Rheims, Francis Henry de, 2, Caxton-villas, Granada-road, Southsea.
Smart, Mortimer Colebrook, Bolton-lodge, Belsize-park, Hampstead, N.W.
Zapata, His Excellency Don Felipe, 12, Weymouth-street, W.

The Papers read were—

THE CULTIVATION OF COMMON FRUITS, FROM AN ECONOMIC AND SOCIAL POINT OF VIEW.

By George C. T. Bartley.

Before I enter on the subject of my paper, perhaps I may be allowed to explain how it is that I am, so to speak, venturing on new ground, in taking up the subject of the cultivation of common fruits. My efforts have hitherto been chiefly devoted to the promotion of thrift, and the cultivation of fruit may not at first sight appear to be a kindred subject. However, I shall endeavour to show that what I have to bring before you this evening is essentially allied to thrift. I shall treat the national question of an ample supply of fresh fruit from the thrift point of view; for, had I not been strongly impressed with its importance from this standpoint, I should not have ventured to address you on the subject.

The question, then, that I am to bring before the Society this evening, namely, the cultivation of common fruits, though one necessarily involving important trade and large commercial interests, has also aspects of a social nature. As I have said, it is on these especially that I wish to dwell; and although I must refer somewhat to the other matters, for there is no separating commerce from practical questions of this character, yet I hope it will be understood throughout my remarks that I am discussing this question from a social rather than from a commercial standpoint.

The questions I shall briefly consider are these:—

1. Whether the supply of fruit is not far less than it should be?
2. The uses of fruits, and the consequences of an insufficient supply.
3. How a larger supply may be obtained.
4. The effects, direct and indirect, of the means I propose.
5. The action which the Society might take to promote an increased supply of common fruit.

I think I may safely assert, without fear of contradiction, that most of those whom I see before me have often wished that fruit was cheaper. What housekeeper has not regretted the great price of the commonest fruit in the summer season, and grumbled at the charges she has been compelled to pay? To go to a less opulent stratum of society, I am sure that many thousands of families will bear me out when I say that they are frequently obliged to forego the pleasure and benefit of even a small supply of fruit as an every-day article of diet. The very word fruit, indeed, is suggestive of luxury and of an expensive dish, and a basket of gooseberries, even, has but too often to be regarded as an exceptional treat.

In all classes of society this is an evil, but for the poor—or rather I prefer to call them the weekly-waged—this absence of vegetable food in the shape of fruit is a serious calamity. For children, fruit is not only a wholesome but, in certain seasons of the year, a highly-important form of nutriment, and its absence cannot fail to tell prejudicially on their development and ultimate physical power.

Looking at the matter also from a temperance point of view is important. Fruit is chiefly plentiful—or should be so—in the hot weather. For those engaged in manual labour at that time of year, an ample and cheap supply of fresh fruit would be invaluable, and thousands would patronise the fruit-stall rather than the publican's bar. Thirst must be quenched, and it would seem obvious that fruit is nature's provision for this very want.

No doubt, in London and other large towns, the supply of fruit is almost unlimited for those who have ample funds at their disposal. Strawberries may be eaten in February, and grapes all the year round adorn the tables of our rich citizens. Unfortunately few, comparatively, are in this happy condition, and the majority of householders, like myself, of limited means, feel the scarcity and dearness of fruit, not only when at home, but whenever they are away at any so-called out-of-town locality. I have almost universally met with the same and even a greater deficiency in the fruit-supply at these places. Indeed, I might almost say that at a distance from towns it is almost impossible to get fruit. I have had said to me repeatedly, in small country towns, that no fruit could be had nearer than such and such a large market town, some ten or twenty miles away.

The reason for this is, of course, easy to find. The supply of fruit is not at all adequate to the demand of even the large towns; high prices can be obtained for it in the richer centres of population; and, as the means of communication are now cheap and easy, everything is sent away from the country. In this way, what little is grown in villages can only be obtained in large towns.

In the suburbs of large cities again, and especially near London, market gardeners only supply the markets, and even the suburban shops are usually kept up by sending to the great markets in London for their main stock. Fruit, in fact, is obtained from London and the large towns, and as fish, even at the seaside, comes from Billingsgate, so suburban fruit comes from Covent-garden.

In saying this, I do not mean to suggest for a moment that this should not be so, or that this arrangement is commercially incorrect. I have no doubt it is necessary, and for the more costly and the best fruit this mode of disposal must always be maintained. The richest persons live in towns, they will pay the best price, and consequently they will command the very large gooseberries, the guinea pears, and the choice products, be they what they may. Further than that, the method adopted by large market gardeners, growing less choice fruit and vegetables, of sending all their produce to market must also be maintained. They simply deal in the largest wholesale, like the merchant in cargoes, and they could not be troubled—to say nothing of trade considerations—with supplying even a shop direct, even though it might be facing their very gardens.

Some of the largest consumers of fruit are the manufacturers of jams and preserves. Round London one or two well-known firms have regular travellers who look out for, and buy up at the best price, any crop of fruit which is really sound and good. This manufacture, though highly important, and, indeed, almost essential, in order to give palatable winter food, tends to reduce still further the supply of fresh fruit in the summer.

A good deal of fruit is imported from abroad, and, indeed, we owe many of our commoner fruits to the Continent. A great number of them were imported in the first instance as special luxuries, and then gradually became cultivated here. The annual value of the imports of fruit is about £6,000,000; and extensive preparations for an increased production and export is being constantly made in various parts of Europe, so good is the business and so profitable the results. For the imports, as far as they are good and wholesome, we should be most grateful to our neighbours for sparing for our use of their superfluity; at the same time, much fruit of foreign growth cannot be so good as the freshly picked fruit coming from close at hand. Some descriptions, such as pears, pine-apples, and plums, may, no doubt, be excellent, but much that is imported is apt to get damaged on the road, and to become stale, and even worse, before it reaches the consumer. However large the importation of foreign fruit may be, it never can meet the demand which must always exist for fresh common fruit.

The question then arises, How is this deficiency of good, wholesome, fresh fruit to be supplied? Can we hope to obtain very much more from abroad, or must we look to our own small island for what we want. Possibly, as means of communication become even more extended than they are at present—particularly if, by continuing to produce so little ourselves, the price is maintained—we may hope to obtain still more from abroad. Increased inter-communication, however, implies an increased population, and, consequently, a larger consumption, abroad as well as here, so that what is thus gained in one way may probably be lost in another. I think, therefore, that we must regard our own soil as the field for more increased production; and I feel convinced, as I hope I shall presently show, that this can be done, and that our own island can be made, without sacrificing any other important crop, to produce ample and abundant common fresh fruit, simply by the exercise of a little foresight, industry, and thrift.

The amount of land required to supply an ample quantity of fruit per head is difficult to ascertain. Of course, soil varies, and much land that would be good for many purposes is out of the way, and could only be cultivated at an unremunerative cost. The fact, however, that at the present time only about 40,000 acres (that is, 60 square miles—a piece of land less than 8 miles by 8 miles) is all that is set apart for tke market gardens of the country, shows, in spite of the large quantity of fruit that is imported, what an amount of fruit may be raised on a comparatively small piece of land. Now, every one must have noticed how many small pieces of waste land are to be seen in all directions. In all villages and country roads that I am acquainted with, there are such waste spots. Is it not possible, then, to rescue these for the cultivation of common fruit? It requires only to be gone into in a few villages to show how much land is thus, so to speak, useless, and these odd corners are to be met with in all parts of the country.

To begin with, there are the railway embankments, which must amount to many thousand acres. The railways of the country are 17,000 miles long, giving 34,000 miles of bank. Say these average only 10 yards wide, the land which this represents is about 200 square miles. Some of this land is admirably adapted for fruit culture, but, allowing that only a third is suitable in soil or situation for cultivation, it would be sufficient to double the area of our present gardens.

No one need think that the embankments, with care, will be unproductive, for every here and there along most lines, where a frugal stationmaster or porter who is fond of gardening is to be found, the banks, and even the stations, are made not only beautiful with flowers but highly productive of vegetables and fruit. These oases on the banks, too often desert of all cultivation but what springs up by an ever-bountiful nature, have always struck me as most pleasant. They, at all times of the year, look fresh and cared for, and must add not a little to the earnings of the not overpaid officials.

The small pieces of ground attached to cottages in the country form another great field for the cultivation of common fruit. No doubt, not a few are now utilised for vegetables and flowers, and the cultivation of vegetables is as important as that of fruit, and the production of flowers as highly desirable from its civilising and elevating tendency. At the same time, no one can visit among the cottagers in almost all parts without noticing, if attention is drawn to the fact, how many small pieces of a large proportion of the cottagers' little gardens are allowed to remain unprofitably employed. This neglect is not only wasteful, but it tends to destroy the beauty and comfortable appearance of the home.

Again, in most villages, and along roads in all directions, there is much land wasted. True, the sides of the road have to serve many purposes, such as the storing of stones and manure, and space for ditches for draining must also be provided. Apart, however, from all this, there is scarcely a mile in any country road where the waste land does not amount in the aggregate to a considerable area. The only appropriation of this at present is for stray cattle and for the feeding of those persons' animals which are allowed and too often encouraged to pick up a living in a somewhat irregular manner. These pieces of spare land belong, I believe, in most cases, to the lords of the manor, and they have power to part with them to the owners or occupiers of the lands adjacent. Why, then, should they not be allotted to the labourers, provided they are willing to turn them to account, by cultivating them in their evenings and spare time?

I have endeavoured so far to show, first, that a great deal more common fruit is required for the population of this island; and secondly that, without trenching on the land devoted to other purposes, ample space exists on which the fruit so much required might be grown. The last, and the most difficult question, however, remains, that is, how are we practically to promote the cultivation of these odd parcels of land, and make them produce an abundant supply of common fresh fruit for the people? That this is a subject for the Society of Arts, I think, is obvious. In its very early days, that is over a hundred years ago, the Society took in hand the problem of the planting of commons and waste lands with timber trees; and many parts of the country now have, indirectly, cause to be thankful to the then action of the Society, both for the wealth of timber which that action was the means of producing, and for the improved beauty of the present landscape. The cultivation of fruit, I think, is as important now as that movement was then; and I hope that, like so many useful movements of this Society, the increased cultivation of common fruits may be promoted by this meeting.

Corners of spare land, pieces of gardens, though only a few square yards in extent, are like fragments of all other materials—whether they are utilised or wasted depends almost entirely on the national character of the people. The subject of thrift, or the best appropriation of all small and apparently useless or insignificant trifles, is a subject in which I have always taken special interest, and the waste or incomplete use of a small piece of land is identically the same in principle as the waste or inadequate use of money, of time, or of any other opportunity or advantage which we possess. English people are not thrifty. They have many qualities that are fine and noble, but naturally thrift is not one; and in my opinion the question of the proper supply of fresh fruit has more to do with thrift than with any other quality.

Much has been written and said on the advantages of allotment gardens, and all that has been said cannot exaggerate the use and benefit which these allotments may produce. That they increase the production of the labourer is their least important benefit; they instil habits of care and thrift; they give him an occupation and an amusement out of the public-house; they elevate him intellectually and morally; and they tend in every way to make him a better man. The greater extension of allotment gardens is to be advocated by all who wish to improve the agricultural labourer. In some places, however, allotments cannot be obtained, and many a landlord may with some reason object to giving, or even letting, land for this purpose, when he sees so much land attached to cottages and at odd corners which is not yet made use of to the best advantage. Further than this, when a cottager makes the very best use of his own little garden, though it be but a few feet square in extent, he is the man above his neighbour who is the most promising tenant of an allotment garden.

To go, however, a step further. It is not only the agricultural labourer who often allows small pieces of land to remain waste, but in the suburbs of large towns I venture to assert that there are many thousands of acres of land which are not only unused, but absolutely void of ornament. It is true that, owing to the extent of the population, the gardens portioned out to semi-detached villas are not usually very extensive, but they are large enough, if properly cultivated, to produce, besides abundant flowers, a plentiful supply of some sort of common fruit. The fancy for gardening is, no doubt, extending, but there is great room for much more to be done in this direction; and I cannot see why persons of small means, who live so much in these suburban retreats, should not only supply themselves, but even take to sending their surplus to market. The great landed proprietor does not think it beneath him to do so, and why should not the man whose means are almost always too narrow for his actual wants.

There is another aspect also of this question, and that is the artistic one. I never could understand why fruit-trees were always banished from an ornamental garden. I remember, in the laying out of some grounds within a few miles of Charing-cross, that a most picturesque old mulberry tree stood on the lawn. The landscape gardener ordered this to be cut down, and a sapling forest tree to be put in its place. He did this as a matter of course, and took it quite as a personal affront when his orders were arrested by his employer. His argument was, that on an ornamental garden a mulberry tree was out of place; but I am glad to say that, unorthodox as it was, the old tree is still standing on this point. I was glad to read the following on "Use and Ornament" in the *Garden* of a week or two back. It so directly bears on this subject that I cannot help quoting it:—

> "A great deal more might be done in this direction [that is, combining use and ornament] than is at present the case. It is no more trouble to grow an apple-tree than it is an ash or a lime-tree, and the apple when in fruit is certainly far more attractive than either of these, and when in bloom it is not only ornamental, but useful and valuable and if it pays the Americans to grow apples for the English markets, it would pay Englishmen. The best varieties of apple-trees to plant in shrubberies for ornament are the Hawthornden, the Emperor Alexander, Lord Suffield, and Beauty of Kent. These are all trees of vigorous habit and fine foliage, and produce large clusters of bloom, and bear abundant crops of large, handsomely-coloured fruit, which is unsurpassed for culinary purposes."

If some persons in authority could be induced to set the example of planting fruit-trees instead of so many forest-trees, a very great deal of useful and wholesome diet for the people of this country would be the result. At the present time, we import annually nearly £2,000,000 worth of apples and other hardy fruits, and there would seem to be no reason why a great deal, if not all this, should not be grown in this country. No doubt the climate is better in the South of France, but excellent apples and hardy fruit are grown here; and if fruit can be sold at a profit, after payment of the heavy carriage from abroad, more extensive cultivation here would surely pay well. It would also, at the same time, I hold, not only be no disfigurement to country houses and picturesque landscapes, but, on the contrary, highly ornamental to both.

If a spirit of thrift, as regards the utilisation of waste corners and odd pieces of garden ground, can once be engendered universally, and the cultivation of fruit trees, &c., by those whose privilege it is to have gardens and grounds, become popular, then the scarcity of fruit will no longer exist. Many acres, which are now covered with rank grass, would be planted with useful and productive trees and shrubs; and the waste pieces of land, which, as I have said, usually are under the authority of the lords of the manor, would soon be in such a demand that it would be impossible for them to remain misappropriated. Wholesome, sound, fresh fruit, would become so plentiful that it would soon cease to be thought a luxury, but a common though always a pleasant article of food.

It may, indeed, be said that, with fruit growing in all directions, the temptations to steal would become so serious, that what we gained in food we should more than lose in the morality of the juveniles of the country. I think this would not be so in practice. No doubt, stealing fruit is, and always will be, one of the offences of youth, and perhaps of adults; but the cheaper and more plentiful any produce becomes, the less temptation to steal it. Smuggling was much more common when the duty was high than it is now. Further, I almost think that the excitement of climbing over a fence or wall, and the danger involved in an attack upon a fruit garden, is not unfrequently one of the inducements for stealing. If fruit grew in all parts, it would be little molested. Besides this, a large number of persons would be interested in the protection of fruit; so that people themselves, in fact, would learn to act as custodians of one another's property. I feel sure that the fear of loss by stealing would be greater than the reality.

The indirect benefits of encouraging cultivation of small waste lands by the people, besides those I have touched upon, are not unimportant. The very occupation itself is one of the most healthy, and persons residing in the suburbs of towns, and engaged all day in crowded districts, can hardly do better than devote some of their time to this pursuit. True, the country labourers, whom I also urge to grow fruit, see and smell the earth sufficiently for their bodily health, yet the amusement and interest they will take in their produce will be of immense benefit to them. It will remove many of the temptations to intemperance by giving occupation to leisure hours. It will add considerably to the productive power of each individual, and of the country at large, and it will supply a large amount of most useful food, and that of a description now perhaps more needed than any other.

In conclusion, I think that the promotion of an increased supply of fresh fruit is a subject well worthy of this Society, and further that it is one which is eminently practical. The supply of food for the people is a matter of vital importance in a country where the population is so large in proportion to the area it occupies. This Society has for years shown great interest in this question, and as one of its members, I am proud of the part it has taken towards solving the problem of bringing fresh meat from the colonies. This problem is not yet completely solved, but much that has been done has been promoted within these walls. I trust that the fruit supply will also now be taken up with energy, and a committed formed in order to consider what practical steps shall be taken in the matter. If this is done with energy, I have little doubt but that the benefits likely to be secured, both commercially and socially, to the country, will amply reward any trouble that may be involved in bringing about the necessary results.

RAILWAY WASTES AND RECLAMATION.

By Hyde Clarke.

Corresponding Member of the Society of Engineers of Vienna.

The construction of a railway, as a matter of necessity, diminishes the area of the arable land of a country, and the total so appropriated for railway purposes in these islands has annihilated the food production of many thousands of persons.

This loss is, however, more than compensated by increased production and better means of distribution for the country at large. Thus the railway has enabled lime, coprolites and other fertilisers to be distributed over a far wider area than was done by horse or water transport. It has also enabled town manure to be carried to the fields, but not to the extent that might have been effected by a judicious supervision of the Legislature. The railway has greatly contributed to the economical distribution of imported substances, such as guano and bones.

Another mode in which railways have increased the supply of food, has been by the conveyance of fat cattle or their carcases to market, instead of their being driven by road, at an enormous loss of the meat which had previously produced. The conveyance of lean stock to feeding grounds is another useful function of railways. So, too, the conveyance of harvest labourers in the evening from place to place, without waste of their strength, is a great economy of power.

The supply of coal for agricultural engines has done more than anything to promote the increase of these instruments of productive power throughout both islands.

As the railways also distribute great quantities of fish and other articles of food to the remotest places, they add to the supply of the population, and compensate for the displacement of land from tillage or pasture. Nevertheless, it is a matter of great importance that there should be no wasteful occupation of land even for railways, and wherever the course of the land or the supply of material can be directed over barren land, this should be provided for by the care of the community.

It is scarcely necessary to say that there is no such care and no such supervision, and that a railway engineer or contractor is allowed needlessly to spoil land or soil. For that matter so is anyone else, and so to diminish the national resources.

Holland alone has looked to the economy of her soil, and the provision of new soil by reclamation from lake or sea. In England and Ireland there is no such thought, and reclamation of commons or reclamation of shore is left to what is called private enterprise and hap-hazard action.

Forty years ago I computed that 60,000 acres of sea could be converted into good land on our north-west coast, but we were embarrassed by the Crown instead of assisted. In the case of my plan for the construction of the railway in Morecambe Bay, the Crown fought against us, and against itself, in its twofold capacity of Crown claimant, and of Duchy of Lancaster claimant, to the lands we should have recovered. In the end, those who carried out the works only succeeded in obtaining a small area in Morecambe Bay, the Duddon and the Solway—but which is still a permanent addition to the wealth of the country.

On the present occasion, although I refer to this subject of the extension of our national resources, I wish to urge the stoppage of waste of existing means in advance of the measures for extension which should certainly be kept in view.

In passing along any railway we can see square ponds, or tanks. In most cases these will be recognised as rank marshes, and in some instances such a marsh is established alongside the station-village, founded by the railway company or its group of workmen's cottages. Thus we find two evils in operation at once—a destruction of food-producing surface, and the institution of nuisances for lowering the vital energies of the people and for promoting disease. Good examples may be found in populous neighbourhoods in low-lying ground, in such places as Battersea, publicly illustrating our course of sanitary administration.

In the aggregate, these little malarious tanks constitute a considerable extent of swamp, and, unless prevented, their construction will proceed, and the amount of mischief will become still more appreciable. This mischief and this nuisance is, in general, without necessity and without excuse. At an early period of engineering, when it was not quite so easy to take land from proprietors, the cuttings and embankments were made to balance each other, and the stuff for the cuttings was brought from a distance. Contractors at length found out that if they were allowed to make up an embankment more or less from side-cutting, it effected a large saving to them in the lead or transport of material. A collateral result is that the stuff from a cutting is also deposited in a spoil-bank on other land, which is wasted, and not restored to cultivation. This, however, is not so great an evil as the other.

What we want is a Minister who will look after the national resources. Many a Spanish republic has such under the name of a Minister of Fromento. We have not even a Minister of Agriculture; and that anomalous department, the Board of Trade, has no adequate organisation in reference to the national wants. If, however, nothing better can be done, the Railway Department of the Board of Trade should be charged to ascertain the extent of the present evils, and to devise measures for their cure or prevention.

In making the present remarks, it is not necessary for me to suggest how or in what way the corporations who have created the mischief should be set to redress it. It is enough to point out that on the railways there is coarse soil to fill up the excavations, good soil to cover it with a cultivable top, and the mechanical power for its conveyance. There are many of these small preserves of malaria which could be filled up for a few pounds. It is a very common practice to take side-cuttings from a small depth, and that is the cheaper, leaving three or four foot only of excavation and for water gathering. In some cases the side-cutting could be drained under the line to the other side.

Such is a simple reference to common facts, open to everyone's inspection, but receiving very little attention. On further consideration, it will be found that the railways, besides distributed fertilisers, are capable of materially improving the soil of various districts, and of contributing much more than they even now do to the national advancement and prosperity.

DISCUSSION.

Mr. W. Botly said he had taken a deep interest for many years in the question brought forward by Mr. Bartley, and agreed with almost all he had said, as also with the observations of Mr. Hyde Clarke, particularly with regard to marshes near workmen's cottages. He desired, however, more particularly to show the profitable results of fruit cultivation, by reference to the experience of Mr. Richard Webb, of Calcot, near Reading. On a former occasion he had referred to the wonderful results obtained by this gentleman, but fearing that his memory might mislead him, he had obtained the following particulars with regard to the twelve acres of fruit garden cultivated by Mr. Webb. In 1854 it was a wheat-field, the produce of which obtained a prize medal at the Paris Exhibition of 1855; it had a south aspect; and since 1854 it had not been dressed with anything beyond the leaves which fell from the trees. There was a vine upon it, far exceeding in size that at Hampton-court, as it covered 1,600 square feet, and it was so arranged as to ripen its fruit at three different times; part being in open air, and the remainder in two separate greenhouses. The other fruit trees were planted 6 feet by 8 feet 3 inches apart, and every variety of fruit—apples, pears, plums, cherries, nectarines, peaches, &c.—were produced. One tree bore on one occasion 110 lbs. of cob nuts. The trees were never pruned or cut, and a produce of £320 per acre had been obtained for nuts alone. In one year the produce from the 12 acres was £12,000. He believed the soil in the neighbourhood of Reading was light and gravelly, and he would only add that Mr. Webb was always ready to show visitors his plantation and method of cultivation.

Mr. F. W. Burbidge said the advantage of fruit culture was no new thing, for he had in his possession a book published in 1653, in which it was strongly recommended. It might not be known to all that for the last 300 years England had imported fruit, and in 1815 Mr. Salisbury, of the Oxford Horticultural Society, saw 40,000 bushels of French apples in Covent-garden in one day. The 40,000 acres mentioned by Mr. Bartley referred to market gardens, and did not include orchards, which were about 150,000 acres. The quantity of fruit imported included also dried fruit and nuts used for edible purposes. There was no doubt that a large quantity of sound fruit was bought up for making jam, but it was an interesting question what became of all the waste fruit from Covent-garden market, and he feared that a great deal of it was used for this purpose. He was glad to hear that Mr. Bartley was in favour of mulberry trees, which were among the best of all trees for town growth, and many still existed in the City, having been introduced in the time of James II., who thought they would be useful in promoting the silk culture. There was no doubt corn could be imported more easily than fresh fruit, but animal food, he thought, must always be grown at home, though it involved considerable waste of vegetable produce. After meat, however, he considered fruit was of the greatest importance for home cultivation, and trusted it would receive more attention.

Dr. Hogg hoped the interesting paper which had been read would have the effect intended, of increasing the fruit-producing power of this country. The paper seemed to divide itself naturally into two parts, the utilisation of waste lands, and the extension of fruit cultivation. With regard to the first point, he did not think there was the same scope for it as there was years ago, when the Society took it up. As to the small strips of waste land by road sides, no doubt they might be utilised to a certain extent, but he doubted whether any material advantage with regard to fruit-culture would be gained, and probably they would be better utilised by being thrown into the adjoining pastures or cornfields. With regard to the slopes of railways, there might be some which might be so employed, but, generally speaking, embankments and cuttings were not places where one would expect to find fruit trees flourish. If, then, the cultivation of fruit was to be promoted, it should be done on an extensive scale, and there was every inducement for it, because as population increased, so the demand for fruit became greater and greater. Within his own recollection a great change had taken place in fruit-tree management, almost amounting to a revolution. The old orcharding system of Kent, Hereford, Devonshire, and other localities had been abandoned, and fruit was now grown in gardens, smaller and more bushy trees having taken the place of the old cankered and gnarled trees which formerly existed. In the Vale of Evesham, again, in Worcestershire, there had been a great development of fruit-growing of a peculiar kind, which might not be generally known. Great quantities of plums were grown, but they were gathered in the green state, and sent to Manchester for some purpose connected with the arts, he believed to be used as a mordant in dyeing. Large quantities of fruit were also sent from the southern parts of England to the north, where it did not ripen so soon, and where a higher price was obtained than in the London market, particularly in the early part of the season. That there was a large field still unoccupied was proved by the quantities imported, and if this could be grown at home it would save so much money going out of the country, and the consumers would be better satisfied; but it was necessary to know both how to plant and what to plant. It might be easily shown that fruit culture was profitable, and he might refer to a pamphlet published by the Rev. Canon Lee, of St. Mary's, near Droitwich, giving the results obtained on three acres of land, bought in 1864. One acre he devoted to specimen trees, in order to find which were best suited for cultivation, and another to experiments with vegetables. The third was planted with gooseberries, black currants, and plums. They were planted in rows, six feet apart, with the same distance between the rows; the plum trees being some 10 feet and others 12 feet apart. There were 800 gooseberries, 320 black currants, 400 plums, and, for the first three years, there were three rows of potatoes between. As the bushes increased in size, these had to be reduced, until, in the seventh year, there was only one row of potatoes, and ultimately these would have to be removed. The returns were as follows:—In the first year, £1 18s. 6d.; second, £3 6s. 6d.; third, £10 15s. 8d.; fourth, £10 16s. 9d.; fifth, £21 17s.; sixth, £28 6s.; seventh, £31 12s. 6d. from the acre. With such a climate as ours we could not expect to have a crop of fruit every year; but taking it on the average, it would be found that it could be produced with profit to the grower, and with benefit to the community. One way in which it could be extended would be by planting fruit trees in hedgerows, which would be far preferable to gnarled pollard ash and elm trees. Damsons and early plums would be particularly suitable for this purpose, apples shaded more, and cattle might get at them to do damage; but there was no reason why they should not be protected like other trees in parks and pastures. He knew Mr. Webb's fruit garden very well, having seen it, both when first planted and since. No doubt that was an exceptional case, and was very productive. It was well situated on a rich alluvial soil, in what might be called the Thames valley. The peaches, apricots, &c., were on the walls, where Mr. Webb also grew some beautiful roses, the blooms of which fetched him a good price in Covent-garden.

Mr. Danby Seymour asked if it were the fact that Mr. Webb never pruned his trees, because, if so, the place would soon get like a wilderness; also what kind of trees he planted and how far apart, and how was the ground underneath utilised? Mr. Botly said the soil was light and gravelly, whereas the last speaker described it as a rich alluvium. He had been informed in Kent that nut trees grew best on stone brash, and in the neighbourhood of Maidstone they were planted under the apple trees, but the latter were pruned and were not allowed to shade the ground too much.

Dr. Hogg said it was quite true that Mr. Webb's were not pruned, and formed quite a thicket. Nothing was cultivated under them but primroses and polyanthuses. The nut trees were the largest he had ever seen cultivated for fruit, but they were not under the apple trees, but were in rows, and grew 12 or 15 ft. high. When they became so thick that one injured the other, one row was cut about half way down, and in a couple of years another row was cut down, when the first was getting up again. He did not think the apples and pears were ever touched.

Mr. Botly thought the richness of the soil in Mr. Webb's ground must be accounted for by the leaves from the trees being allowed to accumulate. The soil in the neighbourhood of Reading was gravelly, and there was considerable ascent from the town to Mr. Webb's garden, so that it could hardly be considered in the valley of the Thames. He believed there had been only one failure in the nut crop in seven years.

Mr. Smartt said there was no doubt the fruit trees would do well if planted in suitable soil, but it was rather difficult to induce people who were not freeholders to go to the expense of preparing the ground and planting fruit trees, which might take several years before they returned enough to pay, not the original outlay, but the rent of the land. That there was a profit was shown by the fact that in some parts, such as at Enfield, where orchards had been planted, the rent, which was originally £2 or £3 per acre, was now £10 to £15. He thought, therefore, the only way to induce people to cultivate fruit trees was to alter the tenure of land. He had planted some trees on a small piece of land which he had purchased, on which the soil varied considerably, and he found that whilst one tree bore nearly a bushel of apples yearly, another almost touching it would not yield more than a fourth of the quantity. Mr. Webb's ground, he thought, must be very exceptional. If a thousand apple trees, each bearing a bushel of fruit annually, could be planted on an acre, they would yield an enormous return, even at 2s. a bushel. He knew a tree at Loughton which had borne 24 bushels in a year, and bore every other year. About 80 such trees could be planted on an acre, and at 2s. 6d. a bushel this would yield £240 per annum. He had also about 200 walnut trees planted in a bed about one foot apart; some were not more than 2 ft. high, whilst others were 8 ft., and he hoped in a few years to get a large crop from them. He was a great advocate for planting fruit trees in hedgerows, but he did not think it would do to put them on railway embankments, since boys might be tempted to go after the fruit, and accidents might arise.

Mr. Sowerby thought this was a matter rather for individuals than for the Society. He had often talked to cottagers about growing fruit, but they always replied that they got more by cultivating potatoes and carrots than they ever could out of strawberries or gooseberries, and until they were better educated he did not think they could be got to do much in this way. It appeared to him that the larger growth of fruit was like other commercial undertakings, the larger the factory the greater would be the profit. At the same time, anything which could be brought forward, such as the paper they had heard that evening, which drew public attention to the matter, was of advantage, and he hoped that good results would follow from it.

The Chairman, in proposing a vote of thanks to the readers of the papers, said it had been abundantly shown that large tracts of land did exist which were capable of growing fruit trees to advantage. The question then arose how it was that these were not more utilised, as they would be on the Continent. He believed Mr.

Bartley had hit the mark when he said that it was want of thrift in the people. Last autumn he spent some time in Brittany, which was a large fruit-growing country, sending large quantities both of fruit and vegetables to England; in fact the South-Western Railway Company constantly employed steam-boats, running three times a week, and oftener in the summer, in conveying this produce from St. Malo. The French people were much more thrifty than the English, sent everything to market, and saved their money; and if our own labourers could be induced to do the same, they would be much better off Very probably a large growth of fruit would to a certain extent mitigate the pilfering habits of the young; a plan must be adopted such as prevailed in vineyards abroad, that the passer by might eat as much as he liked, provided he did not carry any away; besides which everyone would have an interest in preserving his own property, and consequently that of his neighbour. Landlords might do a great deal in this matter by giving a few standard fruit trees to cottagers, which would in a few years go far to pay the rent. Some few years ago, a village he knew, in Oxfordshire, large numbers of apricots were grown, which almost entirely paid the rent of the cottagers; and the same thing might be carried out more extensively.

The vote of thanks having been passed unanimously,

Mr. Bartley, in responding on his own behalf and that of Mr. Hyde Clarke, said he should be well satisfied if the reading of his paper led to more attention being given to the subject, and to any practical results. He was quite sure that an enormous amount of wholesome fruit might be grown to very great advantage, but the question of thrift lay at the root of it all. They were doing all that they could, by the establishment of penny banks and otherwise, to promote this valuable quality, and he trusted that this question of fruit-growing would not be lost sight of.

CANTOR LECTURES.

THE HISTORY OF THE ART OF COACH-BUILDING.

By G. A. Thrupp, Esq.

Lecture IV.*

On Public Carriages.

I mentioned in an earlier lecture that the Romans, during the time of the Emperors Augustus and Tiberius, established a system of public vehicles for hire. These vehicles were stationed at inns or post-houses, at intervals of five or six miles, and there were twenty or more horses at each inn along the great main roads of Italy, and many of the dependent countries of Europe and Asia. The chief use of the post houses was to supply the public messengers, but they were found of such accommodation, that more horses and vehicles were required for the use of travellers. The *essedum*, or two-wheeled curricle; the *cisium*, or gig; and the *rhedum*, a four-wheeled waggon, drawn by four or six mules, were the chief vehicles kept at these stations.

Cesarius, a magistrate in the time of the Emperor Theodosius, went post from Antioch to Constantinople, 665 miles, in six days, with a speed, allowing for stoppages, of about six miles an hour.

Coaches, we have already seen, were introduced into England in the 16th century, stage coaches in the 17th, mail coaches in the 18th, and railways in the 19th centuries. Each of the four last centuries had added to and improved upon the systems of passenger and commercial transit. The internal modes of land travelling, prior to the introduction of coaches, were on horseback, and by cars, or charettes, vehicles without springs, as I have already described, by waggons, and by strings of pack-horses following each other laden with goods, upon which an occasional passenger was put. For the sick, and ladies who did not ride on saddle, the litter, carried by men on two poles, or strapped to mules or horses, was, as we have seen, adopted.

Persons were in the habit of collecting together and travelling in company with these conveyances, or in gangs by themselves, or on horses when they had them, for their mutual protection. Old men can still recollect strings of pack horses traversing Lancashire and Yorkshire, and advertisements for companions desired by gentlemen about to ride to London.

Laws for the improvement of old roads, and the making of new roads, were passed in the reign of Henry VIII., and special mention is made of the roads between St. Clements Danes in the Strand, and Charing-cross, Holborn, and Southwark, as being then noxious and very jeopardous. In the time of Queen Mary, in 1555, an Act of Parliament ordered the appointment of two surveyors for each parish, and that the roads should be repaired by their direction.

Towards the end of the 16th century the long broad wheeled waggons were introduced into England, and began to pass regularly between the great towns with goods and passengers. It was these long waggons which first received the name of stages. There are continual allusions in old books to the great convenience of these waggons, although the rate of their speed was small.

About one hundred and thirty years ago, there seems to have arisen an extraordinary contest between the owners of waggons and those who repaired the highways. It was asserted that the waggon wheels destroyed the road, by reason of the great weight of the vehicles and the narrowness of the tyres.

The question was carried before Parliament, and an endeavour was made to widen the tyres of the wheels to nine and even ten inches, with a view to reduce the crushing effect of the wheels on soft roads to a minimum. On soft roads it was said there were ruts more than a foot deep, cut by the narrow wheels. The Legislature endeavoured to promote the use of broad wheels by exemptions from turnpike tolls, by restrictions and fines upon narrow wheels, and they actually went on to tyres 16 inches wide, under the idea that they would roll the roads flat, just as the gravel walks of a garden are rolled.

In the British Museum may be seen a work by Daniel Bourne, dated 1763, with a design of a waggon with four wheels, in which the front axletree is very short, so that the track outside the front wheels is made to correspond with the outside of the hind wheels, and the wheels are made like four garden rollers, each 15 inches wide, so that as the waggon moved, 5 feet of the width of the road should be simultaneously rolled flat.

After a contest of many years, it was generally acknowledged that to oblige waggoners to carry burdensome wheels to roll the road for pleasure carriages was an obvious hardship. Every inch that was added to the really necessary width for strength to the tyre of the wheels was felt by the carrier as a grievance, and the evasion of the Government regulations was sympathised with by the common sense of mankind. It was left to the waggoner to keep the tyre of the wheel sufficiently narrow to run lightly, and sufficiently wide to prevent its sinking with a heavy load into the road's surface. It was admitted that the chief person interested in the matter was the waggoner, as, if his wheels turned heavily over the road by reason of sinking into the surface, then he would fine himself heavily by being obliged to use more horses, or by travelling very slowly.

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* Delivered December 11th, 1876.

During the whole of the 16th century, however, the improvement of English main and cross roads continued steadily advancing, by the system of turnpike tolls, on the security of which money was borrowed by the parishes in order to make the turnpike roads. Although for a long time there was great opposition, yet the system suited the time, and was probably, in our free country, the only way to obtain roads. In France, on the other hand, the nobility obtained their roads by the forced labour of the peasants within their territory—one of the instances of cruel oppression that led to the outbreak of the French Revolution of 1786, as the poor peasants were obliged, from time to time, to leave the cultivation of the fields, and turn out with carts and horses to labour for two or three weeks together at the repair of the roads, and this, too, without any payment whatever.

In 1617, an author named Fynes Morryson relates, that "there were post horses in England, at stations about ten miles apart, that could be hired by travellers on horseback, at the charge of 2½d. per mile to 3d.," but, he adds, "most travellers ride their own horses. In some parts of England a horse can be hired at 3d. per day, finding the food. Likewise, carriers let horses from city to city, bargaining that the passengers put up at their inns. They will lend a horse for five or six days thus, and provide its food at these inns, for about 20s. Lastly, these carriers have long covered waggons in which they carry passengers from city to city; but this kind of journeying is very tedious; so that none but women and people of inferior condition travel in this sort. Coaches are not to be hired anywhere (this was in 1617) but in London. For a day's journey, a coach with two horses is let for about 10s. a day, or 15s. with three horses, the coachman finding the horses feed."

Yet in 1610, a native of Stralsund, in Pomerania, obtained in Scotland a Royal patent, giving him the exclusive privilege of running coaches and waggons between Edinburgh and Leith.

The horses that were hired for travellers were called in France "hacqueneè," which term extended into England, and after was applied to hired coaches, thus named hackney coaches. Samuel Pepys, in his diary of about the year 1662, speaks of riding his hacqueneè to Woolwich, at a period when he did not keep any horse of his own.

I have already mentioned that long waggons were the first stages; their use commenced before the year 1600, but for the poorer classes there was no other conveyance for many years, and it was late in the 18th century before stage coaches were able to give any accommodation to persons with a small purse.

The stage coach began to be used in 1640, the same description of vehicle as that in use for private or hackney work, but of a larger size. The body would hold eight persons at times, but generally only six; the passengers were screened from the weather by leather curtains. It was not until the year 1680 that plate glass was sufficiently cheap to be used for windows. The coachman sat on a bar between the two standard posts from which the body was slung, with his feet upon the footboard fixed to the top of the perch. Behind, between the great wheels, was the basket for luggage, in which the outside passengers also sat up to their knees in straw. The body swung about upon heavy leather straps through the rough country roads.

In 1649, Chamberlayne, in a work entitled "The Present State of Great Britain" speaks up for coaches. "Besides the excellent arrangement of conveying men and letters on horseback, there is of late such an admirable commodiousness, both for men and women, to travel from London to the principal towns in the country, that the like hath not been known in the world; and that is by stage coaches, wherein any one may be transported to any place sheltered from foul weather and foul ways, free from endamaging of one's health and one's body by hard jogging or over violent motion on horseback; and this not only at the low price of about a shilling for every five miles, but with such velocity and speed in one hour as the foreign post can make but in one day."

In 1662, however, when there were but six stage coaches, another writer of the day condemned coaches. "For," he says, "these coaches make country gentlemen come to London on small occasions, which otherwise they would not do but on urgent necessity: nay, the conveniency of the passage makes their wives often come up, who, rather than make such long journeys on horseback, would stay at home. Here, when they come to town, they must be in the fashion, get fine clothes, go to plays and treats, and by this means get such a habit of idleness and love of pleasure, that they are uneasy ever after."

Another writer, in 1673, opposes stages. "Is it," he asks, "for a man's health to be laid fast in foul ways, and forced to wade up to the knees in mire; and afterwards sit in the cold till fresh teams of horses can be procured to drag the coach out of the foul ways? Is it for his health to travel in rotten coaches, and have their tackle, or perch, or axletree broken, and then to wait half the day before making good their stage?"

This gives us some idea of the badness of the roads, and the imperfection of the vehicles. These last, however, were not improved in the time of Hogarth, who, in 1730, painted a stage coach waiting in an inn-yard.

In the diary of Sir William Dugdale we find records of his journeys by stage coaches, between 1659 and 1680, to the towns of Norwich, Coventry, Chester, St. Albans, Bedford, and Birmingham, during the reign of Charles II.

Hackney coaches were first used in England in 1605. These were similar to the coaches used by the gentry, but at first they did not ply for hire in the streets, but remained at the hiring-yards until they were wanted. As, however, many more persons wished to hire than could afford to keep a coach of their own, the demand for them increased rapidly. In 1635, the number was restricted to 50. Still they increased in spite of the opposition of the court and king, who thought they would break up the roads, till, in 1630, there were as many as 300. In Paris they were introduced by Nicholas Sauvage, who lived in a street at the sign of St. Fiacre, and from this circumstance hackney coaches were called in France "fiacres," and they became very common and popular. In 1772, the hire of fiacres in Paris was a shilling the first hour, and tenpence the second. In London, in 1662, there were 400 hackney coaches, and the Government began then to levy a yearly duty upon them of £5 upon each coach. In 1694, however, the number had increased to 700, a substantial proof of their usefulness. Mr. Pepys, in his amusing diary, continually speaks of hiring coaches for use in London, and to go to Deptford and Woolwich on his journeys to the dockyards in his business for the Admiralty.

Many of these coaches were the old coaches of the nobility and gentry, and it is not until 1790 that we hear from Mr. Felton that the hackney coaches were generally built of a smaller size, and much shorter in the under carriage than those of the gentry. The hire of these coaches appears to have been very moderate, to judge by the records of Dean Swift, who resided in London for three years in the days of Queen Anne (1710 to 1713), and who made frequent use of hackney coaches, and on wet days did not venture out without a coach, or a sedan chair. It would seem he could ride from the City to the neighbourhood of St. Giles for one or two shillings.

To return to stage coaches, we are told that in 1673 there were coaches from London to York, Chester, and Exeter, having each 40 horses on the road, and carrying each six inside passengers. The coach occupied eight days in travelling to Exeter, but the fare was only forty shillings; this was in the summer and fine weather; but in winter the same coach was nearly ten days on the road, and the fare was increased to forty-five shillings. There were other stage coaches going daily to places within 20 or 30 miles of London, each with four horses, and others that went and returned the same day to places within ten miles.

In 1703, a stage coach went from London to Portsmouth, when the roads were good, in fourteen hours.

In 1706, a coach went from London to York every Monday, Wednesday, and Friday, which performed the journey in four days, allowing each passenger fourteen pounds of luggage free, and for above that weight the extra charge was threepence each pound.

In 1742, the Oxford stage used to leave London at seven in the morning and reach High Wycombe at five in the evening, and resting the night, proceeded to Oxford the next day.

In the same year there was a coach to Birmingham, starting on Monday from London and arriving on Wednesday, 40 miles a day, but the coach delayed half a day at Oxford on its way.

In 1751, a stage coach went to Dover, arriving at Canterbury the same night, and reaching Dover early the next day, and starting on its return to London the same afternoon. The advertisement states that there is a conveniency behind the coach for baggage and outside passengers. This advertisement implies that it was not, even at this late date, usual to carry passengers on the roof, and that the general structure of the vehicle was similar to the stage coach of 1640; but one change had been made, the driving box on the fast coaches was placed high above the horses on a narrow boot, something like what is called a Salisbury boot; this was placed upon the beds or timbers of the carriage with a tolerably comfortable seat for two persons upon it, but the jolting and shaking over rough bits in the road must have been very trying. In the hall of the Coachmakers' Company, in Noble-street, Cheapside, is a picture of Hyde-park-corner in 1796, painted by Dagaty, in which is an old stage coach; the hinder part has a boot and guard's seat attached to the body as in modern stage coaches, but the box is detached from the body and on the beds, as described above; the panels of the body are very deep, and on the upper quarters are painted two large stars, from which we may conjecture that it is a mail coach.

In 1754, a coach was started from Manchester called "the flying coach." The advertisement states, "However incredible it may appear, this coach will actually arrive in London in four days and a half after leaving Manchester." What sort of vehicles stage coaches usually were in those days will appear from the following :—

In 1755, stage coaches are described as covered with dull black leather, studded, by way of ornament, with broad-headed nails, with oval windows in the quarters, the frames painted red. On the panels were displayed, in large characters, the names of the places where the coach started and whither it went. The roof rose in a high curve, with an iron rail around it. The coachman and guard sat in front upon a high narrow boot, often garnished with a spreading hammer-cloth with a deep fringe. Behind was an immense basket, supported by iron bars, in which passengers were carried at lower fares. The wheels were painted red. The whole coach was usually drawn by three horses, on the first of which a postillion rode with a cocked hat and a long green and gold coat. The machine groaned and creaked as it went along with every tug the horses gave it, and the speed was frequently but four miles an hour.

The first post chaise built in England was only on two wheels, and was open in front. This corresponds with the description of the *chaise de poste* of France. In 1765, the stage coaches from Dover to London were drawn by six horses; the fare was a guinea. Servants paid half a guinea, riding either in the basket behind or on the box, which held three persons. In 1775, stage coaches are stated in the Annual Register to carry eight passengers inside and ten outside, and that there were (including vehicles called flys, machines, diligences, and stage coaches) four hundred altogether. In 1779, a license duty was first levied by Government on stage coaches. Increased accommodation was provided by seats on the top of the coach. It must have been at this time that the front and hind boots began to be framed to the coach body, or there would have been no rest for the feet of the roof passengers.

In 1798, a stage coach ran from Gosport to London, 86 miles, in 19 hours, 4½ miles per hour. It is not until 1754 that we have a reliable account of any stage coach being upon springs, but in that year, in the newspaper called the *Edinburgh Courant*, appears the following advertisement:—"The Edinburgh stage coach, for the better accommodation of passengers, will be altered to a new genteel two end glass coach machine, being upon steel springs, exceeding light and easy, to go in ten days to London in summer and twelve in winter, every other Tuesday." This coach rested all Sunday at Burrowbridge.

In 1757, a coach was started to run in three days from Liverpool to London, and Sheffield to Leeds, followed with speedy fly coaches, the examples of Manchester and Liverpool, and in 1784 coaches became universal at the speed of eight miles an hour.

In France, we learn from M. Roubo's work that in 1760 the diligences (their stage coaches) were constructed much as ours, with large bodies with three small windows on each side hung by leather braces on long perch carriages, with high hind wheels and low front wheels, without, however, any driving box, and fitted with large baskets both back and front for passengers or luggage; they were drawn by five horses, and driven by a postillion on the off wheeler instead of the near wheeler as in England. One of their diligences running to Lyons had springs, and it is noted by M. Roubo as the only diligence in France with springs, and also the speediest. It performed the journey to Lyons, about 320 miles, in five days during the summer and six in winter. As the diligence did not travel at night, and deducting the time of meals and changing horses, the speed appears to be between five and six miles an hour. M. Roubo also describes a large stage coach called a gondola, which held twelve persons inside, ten sitting sideways and one at each end; this vehicle may be considered as the grandfather of the omnibus which was first made at Paris. Another coach was called a coupè Berlin, and had four doors and three seats, the middle seat corresponding to the third inside seat of the so-called stage coaches used in America at the present time. There was, however, a backboard to lean against, but I believe that in the American stage coach the back of the middle seat is only a wide strap. The other travelling public carriage in France was the "chaise de poste" upon two wheels, which I have already described in a former lecture. I remember to have seen one of these at Amiens thirty years ago, painted yellow, like so many of the English post-chaises. There are probably many of these vehicles still in France. They were much like our gentlemen's cabriolets, but were larger and heavier, drawn by one stout horse in the shafts, with a second horse ridden by the postillion, attached to an outrigger-bar on one side of the shafts. The chaise de poste was first made in France in 1664.

To return to our own country. Stage coaches had increased so much in speed that in 1780 they were quicker than the post which carried the letters.

For a long time letters had been entrusted to the bags of the post-boys, who travelled on horseback, about 3½ miles an hour. Mr. John Palmer, the originator of mail coaches, in the year 1784 gave the following statement to the Government:—"The post at present, instead of being the swiftest, is almost the slowest conveyance in the country; and though, from the great improvement in our roads, other carriers have proportionably mended their speed, the post is as slow as ever. Rewards have been frequently offered by the Postmaster-General for the best constructed mail-cart, or some plan to prevent the frequent robbery of the mail, but without effect." Palmer, who resided at Bath, went on to state, "that the coach diligence, which left Bath at four o'clock on Monday afternoon, would deliver a letter in London about ten on Tuesday morning, whilst the post would not deliver a letter until Wednesday morning. The only advantage of the post was its greater cheapness. The post charged only 4d. from Bath to London for each letter, whilst one by the coach diligence cost two shillings. Nevertheless, many persons, both at Bath and Bristol, sent by the dearer and quicker mode, and all over the kingdom wherever diligences* were established they obtained the patronage of the public.

At first any improvement on the post was warmly opposed by the officials and committees of the House of Parliament, and it was declared impossible that letters could be brought from Bath to London, only 108 miles, in eighteen hours. *i.e*, 6 miles an hour. After some careful experiments, however, and a struggle of two years, Mr. Palmer's system was adopted, and his new-fashioned mail coaches were accepted to convey the mails. For some years, however, the mail coaches did not run at more than six miles an hour, they were built of too cumbrous a form, and to carry as many as six persons inside. It was in this same year that the Prince of Wales, afterwards George IV., began to erect the pavilion at Brighton, and bring fashionable company into the mere fishing hamlet which it then was. The effect, however, upon the traffic was very great, and led to the reform of the whole of the south and south-western roads, and thirty-five years later, viz., in 1820, no less than seventy coaches daily visited and left Brighton.

Mr. Thomas Pennant, the celebrated antiquarian, writing in 1782, says, "that in March, 1739, he travelled to London in the Chester stage, than no despicable vehicle for country gentlemen. The first day, with much labour, we got from Chester to Whitchurch, twenty miles; the second day, to the Welsh Harp; the third, to Coventry; the fourth, to Northampton; the fifth, to Dunstable; and, as a wondrous effort, on the last, to London before the commencement of night. The strain and labour of six good horses, sometimes eight, drew us through the sloughs of Mireden, and many other places. We were constantly out two hours before day, and late at night; and in the depth of winter proportionably later."

"Families who travelled in their own carriages contracted with Benson and Co., and were dragged up in the same number of days, by three sets of able horses."

"The single gentlemen, then a hardy race, equipped in jack-boots and trowsers up to their middle, rode post through thick and thin, and, guarded against the mire, defied the frequent stumble and fall; arose and pursued their journey with alacrity; while in these days their enervated posterity sleep away their rapid journies in easy chaises, fitted for the conveyance of the soft inhabitants of Sybaris."

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* Here we have the French name of diligence instead of stage coach.

In 1799, His Majesty's mails were paraded in procession past St. James's Palace to the General Post-office, and it is said that the custom was kept up for 36 years on the king's birthday. Each coach was new, or turned out to look like new, and was painted red with the Royal arms on the door panel, and on the smaller panel above the name of the town to which the coach went, on the boot the number of the mail, and on each upper quarter one of the stars of the four orders of the knighthood of the United Kingdom, the Garter, the Bath, the Thistle, and St. Patrick. The coaches were built just big enough to contain four inside and three or four outside, and coachman and guard. The body was hung upon a perch carriage and eight telegraph springs, the underworks being both solid and simple in construction. At first the number was about 80, but more were added as time went on, until there were at length 700 mail coaches in the year 1835. Only a small quantity, however, left London, the rest were dispersed all over Great Britain and Ireland.

These mail coaches were at first built by contract and kept in repair by contract in London. The experience gained by watching these vehicles was very advantageous to the coach trade; anything faulty in timber or iron, steel or paint, was soon discovered by the vigilant contractors and remedied, and their plans and devices spread through the trade to the benefit of masters and workmen.

The improvement of stage coaches and their multiplication kept pace with the mails. Turnpike roads also had been much improved by Mr. McAdam's system. He substituted on roads hitherto laid with gravel of all sizes, and round or carelessly broken stones of other qualities and materials, the improved surfaces of granite and other hard stones and flints, carefully broken into small angular pieces, which during the passage of heavy traffic dovetailed into one another, and made the surface firmer, whereas the round pebbles, under the old system, would slip from under the wheels and leave the surface of the road still uneven.

The factories for building stage coaches grew to be of large size and importance. Coach proprietors were often very successful, and their business increased until Mr. Chaplin had 2 hotels, 5 yards, and 1,300 horses at work. Messrs. Horne and Sherman had 700 horses each; and Mr. Nelson, of the "Bull Inn," Aldgate, rivalled these. Stage coaches, as they carried more luggage and more outside passengers, were necessarily built stronger and rather heavier than the mail coaches. The cross roads, however, became gradually filled up with old mails re-painted, and stage coaches were also built upon elliptical springs in front, and generally three springs behind.

Gentlemen took to driving coaches for amusement, and vehicles were built with high coach boxes and high hind servants' seat; of different forms, it is true, and upon different sorts of springs. Two coaching clubs were formed of noblemen and gentlemen, who took an interest in four-in-hand driving and in vehicles in general. Several clubs of this kind are now flourishing, to encourage a manly sport, and with the capacity to promote improvements in the build and form of the "drag," as it is now called.

In Ireland, Mr. Bianconi established a good system of travelling upon long four-wheeled cars of a light construction. The passengers sat back to back, and the luggage was piled between, and frequently so high that the traveller had only the opportunity of seeing one side of the road along which he passed. These vehicles would give more satisfaction now-a-days if better horses were used, and for shorter stages, on those routes where passengers are plentiful, but prefer to travel at more than five miles per hour.

In Switzerland and some parts of the Continent, the use of large diligences still continues. Some of the old shape recently performed the journey from Geneva towards Chamounix. The shape of modern diligences varies very much, many are like omnibuses; but almost all are without a perch and upon elliptical springs. In Continental travel may also be seen large family travelling carriages, as well as very light one-horse vehicles for mountain roads, and the further eastwards the traveller proceeds, the rougher and more simple the vehicle. In Russia may be found very rough, cheap, fast waggons, as well as the "tarantass," which is a very comfortable travelling carriage for the wealthy, and, with its numerous boxes and appliances, its bed and store cupboards for food, is almost a small house upon wheels. Thus, whilst in our history we have enumerated the various methods of travelling used by our forefathers, we may, in passing from England to Persia overland, still have personal experience of almost all of these methods. All travelling dependent upon the speed of a horse, has been. on good roads, almost the same in all ages. It is only since the introduction of locomotion by steam on railroads that we have attained any great advance upon ancient times. The years during which rapid stage coach and post chaise travelling seemed such a remarkable advance to Englishmen, only lasted from about 1810 to 1840. Since then the triumph of steam has in many places paralysed the improvement of stage coaches and posting upon ordinary roads, even where steam does not compete.

In France two-wheeled vehicles for public hire had been in use for some years previous to the commencement of the present century; but it was not until 1823 that London possessed a two-wheeled cab. In that year Mr. David Davies built twelve two-wheeled cabs. The body was a little like a hansom cab, but smaller; it had a head of which the hinder half was stiff and solid, the fore part would fold. This arrangement was probably an imitation of the gentleman's cabriolet, the hood of which was rarely put down altogether, as the groom had to hold on by it. Outside the head on one side was a seat for the driver of the cab, and the whole was hung upon stiff shafts. They were, I think, painted yellow, and stood for hire in a yard in Portland-street, close to Oxford-street. At this time the stands in the streets were occupied by hackney coaches, which certainly were all old coaches of the gentry; many still bore the arms of the former owners, and the drivers wore great coats with a large number of capes, one over the other, to keep in warmth and keep off the rain. It was not long before the two-wheeled cab became popular, and came on the ranks with the coaches. Mr. Davies' cab was copied, but with little variation from his pattern, and the total number of cabs in 1830 was 165. After this came Mr. Boulnois' patent one-horse cab with a door behind, the two passengers sitting face to face, like a slice of an omnibus, the driver sitting on the roof—this may be remembered by some here, but the shafts were too short, and the passengers always felt uneasy in case the horse should kick, and the vehicle, otherwise light and useful, fell out of fashion.

Mr. Boulnois' cab was followed by a larger sort invented by Mr. Harvey, and at last, about 1836, came the brougham cab to hold two persons; this was rather smaller than that afterwards built for Lord Brougham, and of plainer outline, with straight fore pillar. From this we derive our present clarence cab on four wheels, which we may pronounce as the lightest of all four-wheeled close cabs, but it is certainly anything but satisfactory. It carries, it is true, a large quantity of luggage on the roof, besides six persons, and runs along faster than the cabs of most other cities, but it is abominably noisy, and very rough in motion, uneasy, and uncomfortable. Whoever will produce an improved four-wheel cab will deserve the thanks of his countrymen. The first step to this, I consider, would be the authorisation by law of two classes of fares. Let the present cab remain at the present fare, but allow a first-class cab to charge a higher fare, and appoint a proper person or persons to inspect the cabs, and to license the first-class cabs to charge a higher fare. The second step would be to insist on the first-class cabs having patent or mail axles, and covered glass frames to lessen the rattle, and to adopt a regulating spring which would assist in carrying a heavy load. Regulating springs can easily be made; they are unsightly on a private carriage, but this would be no objection in a public conveyance. It might be the form of a buffer in the centre of the elliptical spring, or a second elliptic within the first, but the ingenuity of our spring makers would soon surmount the difficulty if the proper authority insisted upon the attempt.

The hansom patent safety cab is an immense improvement upon the old high two-wheeled cab. We owe the invention to a Mr. Hansom, the architect of the Birmingham Town-hall. The safety consisted in the arrangement of the framework at the nearest part to the ground, so as to prevent an upset if the cab tilted up or down. It has since been improved by Mr. Evans, of Liverpool; Mr. Marston, of Birmingham; and others, until the recently built hansoms are really convenient, easy, and comfortable conveyances, and receive the patronage of many ladies in preference to the four-wheelers.

Cabs of other towns of England and foreign countries have all their peculiar features. Other towns of England allow a higher charge per mile. In Plymouth, Southampton, Birmingham, Edinburgh, and some other towns, the cabs are light, easy, and quiet. In Bristol, they were recently heavy and slow, large and clumsy. In Paris, the cabs are chiefly old broughams of the gentry, with poor, slow horses; but during a great part of the year the stands have abundance of light, open victorias, some of which are satisfactory, being easy and light. In Rome, nearly all the cabs are open victorias, with hoods and a leather apron—that is, however, a poor protection in heavy rain; the drivers are generally civil and intelligent. In Naples, the cabs are also victorias of a smaller size, and hung higher from the ground, with little horses, generally of a very sorry description. Milan has very good cabs, and the best omnibuses I have ever ridden in, quite like our private omnibuses, and they are kept up in very good condition. The streets are paved at Milan very evenly, and have tracks, or tramways, for the wheels, of long blocks of granite, on a perfect level with the rest of the pavement. These were first laid down at the beginning of this century, and have probably contributed to the general excellence of the carriages built at Milan. This city was one of the first to make improved carriages, even before France and England.

In the year 1662 a remarkable attempt was made to furnish a method of transport which should be within the reach of all, a sort of omnibus carriage. It was originated and managed by Blaise Pascal, the well-known author of the *Lettres Provinciales*. He was assisted by several noblemen, who obtained a patent from the king for the privilege. The design was to run public coaches, carrying six persons each, along certain streets in Paris, each coach keeping to its own route, for the sum of five sous each passenger for the whole journey.

This was commenced in March, 1662, with seven coaches, the drivers in a blue uniform, with the king's and city's arms embroidered upon it. The coaches bore golden *fleur de lys* on the panels. At first they were a great success, and the sister of Pascal wrote to a friend, "I heard the blessings that were called down on the authors of an institution so advantageous and useful to the public." This was a general opinion. Two more lines of route were chosen, and the number of coaches increased. They were called "the carriages of the five soldi." It was found necessary, however, to raise the fare to six soldi, and this, with the increasing number of hackney coaches, the prohibition of the use of the omnibus by soldiers, servants, or any one in livery, and probably the death of Pascal himself, at the early age of 39, brought the enterprise to a premature end after the coaches had run nearly two years.

Stage coaches at the beginning of this century were used in London to bring men of business into the city, and the fare was ordinarily two shillings from Paddington or Clapham; they were slow and unpunctual, being usually an hour over the five miles. The first omnibuses were built at Paris, in 1820, and were drawn by three horses, and soon became much in vogue; they were never very fast, and still are slower than our omnibuses, not because they cannot be driven fast, for occasionally they keep up a good speed, but because our neighbours attach so much importance to the way-bill, and stop at certain stations to take up passengers, or exchange some for the branch lines, and tickets are given at these stations beforehand bearing numbers which entitle the bearers to be first served. These regulations detain the omnibuses very much; the same remarks apply also to the tramways, on which the progress is still slower than by the omnibuses. There is at Paris an excellent service of omnibuses for the conveyance of passengers and luggage from the hotels to the railway stations. They hold eight inside, and are quick and easy. All over the Continent the hotels have the best omnibuses; some of them are of full size, well stuffed, and lighted at night with good lamps. Sometimes each hotel has its own 'bus; sometimes one will serve several hotels.

The first omnibus was started in London, in July, 1829, by the enterprising Mr. Shillibeer, who had been for a short time a coachmaker at Paris. His first omnibuses were drawn by three horses, and carried twenty-two passengers, all inside. They ran in a shorter time to the City than the old stages; the fare was a shilling from the "Yorkshire Stingo," near the bottom of Lisson-grove, to the Bank.

We can imagine how unwieldy these carriages appeared even compared with the stage coaches and hackney coaches of the day, yet they soon proved a success; they followed the horses so easily that the drivers were astonished. The passengers were pleased by the speed, and the scheme should have been very profitable to Mr. Shillibeer. The first omnibuses, however, were thought too large for the streets of London, and they were superseded by a smaller pair-horse omnibus, carrying twelve passengers inside, and an extra one or two at the end of the omnibus, by the driver, but it was a very unpopular position.

In 1849, an outside seat was added along the centre of the roof, and by 1857 the omnibus had been improved nearly to what we now have, and this was chiefly done by Mr. Miller, of Hammersmith.

Our present omnibus is probably the lightest and strongest vehicle in the world for carrying twenty-eight persons, at a speed of nearly eight miles an hour. If tried with four horses on a country road they easily beat the old-fashioned stage coach, either in weight, capacity for carrying, durability, or safety.

Large omnibuses are in use in Glasgow and Manchester, and other towns where speed is not so much an object as it is in London, and they have been re-introduced in London between Charing-cross and Portland-road, and there are a few small one-horse omnibuses for short distances. It is not necessary to describe these vehicles at any length; it is sufficient to notice that they must be light and strong for the work they have to perform, and the peculiar shape enables the builder to secure this.

The London General Omnibus Company has contributed greatly to the improvement of system of public conveyance. It was founded in the year 1856, when it took over 580 omnibuses previously in use, and belonging to a large number of different owners. The company had 6,400 horses the first year. Although many of their omnibuses have been superseded by the Metropolitan and District Railways, and the establishment of tramway cars, they have still 560 omnibuses and 6,000 horses to work them. Each omnibus runs about 60 miles a day. The company builds its own 'buses, about 30 each year; the average weight of an omnibus is 24 cwt. Most of the vehicles are now provided with brake retarders, which are set in action by the foot of the driver, and check the speed down hill, or help to stop the omnibus to take up a passenger without so much strain upon the horses as formerly.

In Vienna the public omnibuses are longer, and are divided into two compartments, entered by separate doors; they carry 12 inside and 6 outside. The speed is rather slow and the appearance of most very shabby. In summer other omnibuses are also used, which are constructed without sides or windows, and in hot weather are agreeable from the free admission of air without draught.

American stage coaches began in 1786. As early as 1697 an innkeeper, named John Clapp, at the Bowery, New York, kept a hackney coach for the accommodation of the public; and in 1699 a law was made forbidding fast driving of "slees" through the streets of New York. The first private coach owned there appears to have been in 1745 by a Lady Murray. In 1786 there were but three coachmakers' factories in New York, Mr. Steel, in Pine-street, Mr. Jones, and James and Charles Warner, in Broadway. However, in 1789, six more factories had been opened in the coach trade, and five livery yards had begun to keep hackney coaches. In 1790, a coach was built in Philadelphia for 800 dollars, and there were eight coachbuilders in that city. But the usual vehicle used was a sort of wheel chair upon wooden springs, and from recent accounts it seems that gigs, hung upon long wooden springs, are still in use in the United States.

The *Historical Magazine* states that in 1805 the English chariot was copied in America, but that it was found cheaper to order these carriages from Europe, on account of the high price of material, and the excessive cost of wages. In 1810 there were 28 factories occupied by coachmakers in New York. In 1822 a New York coachmaker, named Miln Parker, had begun to make a name by building "volantes" for the Cuban and Mexican markets. These volantes are gigs, with hoods, perched upon two very high wheels, much used by the ladies of Spanish America.

I should have mentioned that the cabs of Vienna are of a superior description, consisting of victorias, broughams, and landaus, as well built and finished as those used by private persons. Many of these cabs are drawn by two horses, and are driven at a rapid rate. It would be a great benefit to London if we could procure such conveyances at a shilling, or even more, per mile.

MISCELLANEOUS.

THE SEWAGE OF BIRMINGHAM.

A report on the disposal of town sewage has been issued by the Local Government Board, which has long been in preparation by Mr. C. S. Read, M.P., and Mr. Robert Rawlinson. It quotes the report on the Conference held by the Society, and fully confirms the opinions therein expressed. The following facts relate to the sewage of Birmingham where the difficulties of water-carried sewage, and the extent and varieties of the dry system are remarkable and exceptional. The statistics and large cost imperative for the health of the people are well worth the study of all large towns in showing what they must be prepared to pay. The figures are those of 1875:—

Population (about)	350,000
Rateable value	£1,229,841
Houses	83,420
Water closets (about)	8,000
Privies, old system, *i.e.*, middens	35,000
Ditto, pail system (increasing daily)	7,000
Ashpits, for ashes only	25,000
Refuse removed in 1875 from privies and ashpits (tons)	128,512
Cost of removing contents	£35,180
Cost of cleansing privies and ashpits yearly, and amount received for refuse, £5,885; but this includes about £2,000 returned by sales of pails. Consequent loss on removal, or at the rate of 4s. 6¾d. per ton, or 1s. 8d. per head of the population, or 5½d. in the pound on the rateable value of the borough	£29,295

EXPENSES INCURRED TO DISPOSE OF THE WATER-CARRIED SEWAGE.

Purchase of land (farm)	£45,400
Levelling, draining, and laying out	11,250
Outlet works and tanks	58,880
Cost of promoting Bill in Parliament	10,644
Compensation to Sir C. B. Adderley, M.P.	6,000
	£132,174

YEARLY COST OF DISPOSING OF THE SEWAGE.

Capital, £132,174, at 6 per cent., to repay principal and interest. Yearly instalment	£7,930
Part of farm held on lease, yearly rent	855
Yearly expense of liming, cleansing tanks, removing and digging in 109,500 tons of sludge	12,778
Yearly cost of General Scott's cement process	382
Yearly working expenses of farm	2,547
	£24,442
Amount received for sale of farm produce, sale of sludge and cement	£2,511
Net cost	£21,930

The daily mean flow of the sewage is about 12,000,000 gallons = 53,571 tons, or 19,553,415 tons yearly. The annual cost to the Town Council in disposing of the sewage is £24,442 8s. 9½d., or at the rate of about nine thirty-seconds of a penny per ton. They receive for it £2,511 10s., an amount equal to about one thirty-second of a penny per ton of sewage, and consequently lose £21,930 18s. 9½d., or about one-fourth of a penny per ton; or at the rate of 1s. 3d. per head of the population. Loss per head of the population in cleansing privies, 1s. 8d.; *ditto, disposing of sewage*, 1s. 3d.; total loss, 2s. 11d.; or 4½d. in the pound on the rateable value of the borough. The yearly loss by cleansing the privies is £29,295, by disposing of the sewage, £21,931, total, £51,226; or about 2s. 11d. per head of the population, or about 10d. in the pound on the rateable value of the borough. The volume of sewage is at a rate of 34 gallons per head of the population, or about six persons contribute to every ton of sewage. The capital, £132,174 will be paid off, when the rates will be relieved to the extent of about 1½d. in the pound on the present rateable value.

The cost in 1876 will be found to have increased largely; it is still increasing, and will soon reach 1s. in the pound. The facts above stated are given in the official report. The calculations are quoted from the *Birmingham Daily Post*. Science may prove useful in promoting health and cleanliness, but after the facts and opinions stated in the report, it cannot be hoped that the cost of cleanliness can be much reduced.

OBITUARY.

Alexander Bain.—Mr. Bain, the inventor of the electro-chemical telegraph, died at Glasgow on the 2nd inst. In the early days of the electric telegraph he made many important inventions, and though his claim to having discovered the "earth circuit" is more than questionable, he at least deserves credit for the practical application of the principle. His telegraph or modifications of it is in use in America, but in this country it has not, until recently, been employed. In 1866 he read a paper before this Society on "Automatic Telegraphy." Notwithstanding the importance of his inventions, he died a poor man, subsisting on a pension from Government of £80 a year.

Alfred Smee, F.R.S., F.R.C.S., &c.—The death of Mr. Smee took place on the 11th inst. As the inventor of the Smee battery his name has long been a household word among electricians. His book, too, on electrometallurgy still remains a standard work on that subject. He was born in 1818 at Clerkenwell, and was the second son of Mr. W. Smee, the Accountant-General of the Bank of England. He was educated at St. Paul's School, and afterwards at King's College and St. Bartholomew's Hospital. At the early age of 21 he was elected a Fellow of the Royal Society. He held the appointment of surgeon to the Bank of England, and was also surgeon to the Central London Opthalmic Hospital. In conjunction with Mr. Hensman, the engineer, and Mr. Coe, the printer, he brought out the present form of the Bank of England note, and the forms of cheques now used in the Bank. On this subject he read a paper before the Society in 1854, entitled, "On the New Bank of England Note, and the Substitution of Surface Printing from Electrotypes for Copper-plate Printing." Another paper read here, in 1874, was on "Heads of Legislation for the Regulation of Sewage Grounds," a subject which he took up very warmly during the later years of his life. He was for some years a member of the Society, but retired in 1856.

GENERAL NOTES.

The Colouring of Ceramic Ware.—M. Avril effects the colouring of the clay of ceramic ware by means of ferric solutions, and especially the chlorates, perchlorates, and sulphates of iron. These solutions are applied to the clay, either during the mixing and tempering, or on the surface, by dipping the articles. The process may be applied in the dry or wet state, and with hot or cold solutions, the proportion varying with the colour desired. This invention may be applied to the colouring of bricks, tiles, and architectural blocks, as well as to the decoration of artistic objects in terra-cotta. All shades may be obtained, from rose and light yellow to bright red and dark brown.

Birkbeck Institution.—On Wednesday, the 10th inst., Dr. H. W. Hake, M.A., F.C.S., commenced a course of twenty lectures on "Health," intended as a preparation for the Society's examination on this subject. Among the matters dealt with are:—The causes tending to imperfect respiration in large centres of population, and their removal by the most approved measures of ventilation, drainage, and disinfection; the theoretical action of food on the animal system; water supply and its impurities; the influences of climate and temperature; the chemical identification of disease, and its possible prevention; and the sanitary laws and statistics of public health.

NOTICES.

PROCEEDINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday evenings, at 8 o'clock. The following arrangements have been made:—

January 24.—"Silkworm Grain," by B. Francis Cobb, Esq.

January 31.—"Ventilation of Rooms generally, and the way to make Workmen's Cottages comfortable, warm, and healthy," by Frank E. Thicke, Esq. Dr. B. W. Richardson, F.R.S., will preside.

February 7.—"Street Tramways," by Captain Douglas Galton, C.B., R.E., F.R.S.

February 14.—"Zinc White as Paint, and the Treatment of Iron for the Prevention of Corrosion," by Professor Barff, M.A.

February 21.—Lecture, by Sir John Lubbock, Bart., M.P., F.R.S., on "The Relations of Plants and Insects."

February 28.—Middle Class Education in Holland," by John Yeats, Esq., LL.D., F.R.G.S.

African Section.

Tuesday evenings, at 8 o'clock. The following arrangements have been made:—

January 23.—"The Trade of Central Africa, Present and Future," by Commander Cameron, R.N., C.B. Sir T. Fowell Buxton, Bart., will preside.

February 13.—"The Geographical and Commercial Character of the District between Mogador and Cape Juby, North-West Africa," by N. Giammal, Esq.

March 13.—

April 10.—"The Social State and Prospects of the South African Communities," by Robert Richards, Esq., of Grahamstown.

April 24.—"The Trade and Resources of Morocco," by Dr. Arthur Leared.

May 8.—

Indian Section.

Friday evenings, at 8 o'clock. The following arrangements have been made:—

February 2.—"Indian Tea Cultivation; its Origin, Progress, and Prospects," by A. Burrell, Esq. Dr. Forbes Watson will preside.

February 16.—"Indian Railways," by Juland Danvers, Esq.

March 2.—"The Progress of Trade in Central Asia," by Sir T. Douglas Forsyth, C.B., K.C.S.I.

March 16.—"The Native Indian Press," by Dr. George Birdwood, C.S.I.

April 20.—"The Existing and Possible Commercial Communications between Persia and India," by Major-General Sir Frederick John Goldsmid, C.B., K.C.S.I.

May 4.—"Thaumato-dendra, or the Wonders of Trees," with illustrations from life, by William Tayler, Esq.

Chemical Section.

Thursday evenings, at 8 o'clock. The following arrangements have been made:—

February 8.—"Some Processes of Nature's Hygiene," by C. T. Kingzett, Esq., F.C.S.

February 22.—"Spontaneous Combustion in Factories and Ships," by C. W. Vincent, Esq., F.R.S.E.

March 8.—"The Sizing of Cotton Goods," by W. Thompson, Esq., F.C.S., of Manchester.

April 12.—"The Cinchona Alkaloids; their Sources, Production, and Use," by Dr. B. H. Paul.

MEETINGS FOR THE ENSUING WEEK.

Mon. ...Royal Geographical, University of London, Burlington-gardens, W., 8½ p.m. Rev. J. Mullens, "Later Explorations in the Interior of Madagascar."
British Architects, 9, Conduit-street, W., 8 p.m. Mr. F. C. Penrose, "The Optical Refinements of Greek Architecture."
Medical, 11, Chandos-street, W., 8.30 p.m.
London Institution, Finsbury-circus, E.C., 5 p.m. Mr. E. B. Taylor, "The Philosophy of Language." (Lecture I.)

Tues.... **SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (African Section.) Commander Cameron, "The Trade of Central Africa, Present and Future."
Royal Institution, Albemarle-street, W., 3 p.m. Prof. Garrod, "The Human Form; its Structure in Relation to its Contour." (Lecture II.)
Medical and Chirurgical, 53, Berners-street, Oxford-street, W., 8½ p.m.
Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Discussion on "Repairs and Renewals of Locomotives."
Anthropological Institute, 4, St. Martin's-place, W.C. 8 p.m. 1. Colonel A. Lane Fox, "Report on Measurements for the Anthropometric Committee." 2. Mr. Sweet, "Development of Language." 3. Mr. Laws, "Kitchen Midden at Tenby." 4. Mr. Knowles, "Classification of Arrowheads." 5. Mr. Knowles, "Port Stuart Finds."
Royal Colonial, 15, Strand, W.C., 8 p.m. Hon. William Forster, "The Fallacies of Federation."

Wed.... **SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. Mr. B. Francis Cobb, "Silkworm Grain."
Geological, Burlington House, W., 8 p.m. 1. Mr. H. F. Blanford, "The Question of the Glacial or Volcanic Origin of the Talchir Boulder-bed of India, and the Karoo Boulder-bed of South Africa." 2. Mr. J. Starkie Gardner, "British Cretaceous Patelloid Mollusca." 3. Mr. A. Leith Adams, "Observations on Remains of Mammoth and other Mammals from Northern Spain."
Royal Society of Literature, 4, St. Martin's-place, W.C., 8 p.m. Mr. C. H. E. Carmichael, "Dante and the Thirteenth Century."

Thur. ...Royal, Burlington House, W., 8½ p.m.
Antiquaries, Burlington House, W., 8½ p.m.
London Institution, Finsbury-circus, E.C., 7 p.m. Prof. Colvin, "Giotto's Gospel of Labour."
Society for the Encouragement of the Fine Arts, 9, Conduit-street, W., 8 p.m. Lecture by Mr. H. Danby Seymour.
Royal Institution, Albemarle-street, W., 3 p.m. Dr. Wright, "Metals and the Chief Industrial Uses of these Bodies and their Compounds." (Lecture II.)
Inventors' Institute, 4, St. Martin's-place, W.C., 8 p.m.
Philosophical Club, Willis's-rooms, St. James's, S.W., 6½ p.m.

Fri.......Royal Institution, Albemarle-street, W., 8 p.m., Weekly Meeting; 9 p.m. Sir John Lubbock, Bart., "On Ants."
Quekett Club, University College, W.C., 8 p.m.
Clinical, 53, Berners-street, W., 8½ p.m.

Sat.......Trades' Guild of Learning and National Health Society (at the House of the Society of Arts), 8.30 p.m. Prof. W. H. Corfield, "The Laws of Health." Part II. (Lecture VIII.)
Royal Institution, Albemarle-street, W., 3 p.m. Mr. Ernst Pauer, "The Nature of Music; the Italian, French, and German Schools" (with pianoforte illustrations). Lecture II.

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FRIDAY, JANUARY 26, 1877.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

PUBLIC MUSEUMS AND GALLERIES, AND NATIONAL EDUCATION.

The Council have to request that corrections in the list of the Committee published last week may be sent to the Secretary.

PRIZE FOR IMPROVED SANITATION.

The following letter has been transmitted to the Society by command of H.R.H. the Prince of Wales, President of the Society.

The Council have much pleasure in laying it before the members.

A Son Altesse Royale Monseigneur le Prince de Galles, Président de la Société des Arts de Londres.

Bruxelles, 12 Décembre, 1876.

MONSEIGNEUR,—J'ai l'honneur d'adresser respecteusement à votre Altesse Royale, une copie de la lettre que S.M. le Roi des Belges a daigné me faire écrire, le 3 Octobre dernier, en ma qualité de Président du Congrès d'Hygiène et de Sauvetage de Bruxelles.

Il résulte de cette missive que S.M. met à la disposition du futur Congrès un prix, consistant en une Coupe d'Or de 5,000 francs, afin d'être décerné par ce Congrès à la ville, à l'autorité locale, à l'association ou au particulier qui, en améliorant les logements des classes nécessiteuses, sera parvenu à réduire, de la manière la plus notable, et au moins de frais, la moyenne de la mortalité dans ces mêmes classes.

L'intérêt qui s'attache à cette mesure sera double pour votre Altesse Royale. Elle est en quelque sorte le développement d'une idée de votre Auguste Père, Monseigneur, qui, à l'Exposition Universelle de Londres, organisée par ses soins, apporta comme contribution personnelle une habitation modèle d'ouvrier.

Je demande la permission de m'adresser à votre Altesse Royale, comme Président de la Société des Arts de Londres, d'une Société qui, sous la Présidence du Prince Consort d'abord et puis sous celle de votre Altesse Royale, a dirigé ses efforts vers les arts les plus profitables à l'amélioration de la condition des classes nécessiteuses, et j'ose recourir à la haute influence de votre Altesse Royale pour porter la fondation du Roi à la connaissance des nombreux membres et correspondants de la Société dans les États de Sa Majesté Britannique.

Je prie votre Altesse Royale de daigner me permettre d'ajouter à cette lettre mon discours d'inauguration du Congrès de Bruxelles. Il n'a d'autre mérite que d'indiquer la portée et la signification de ce Congrès, et de signaler à la reconnaissance du monde les souverains, les princes, les gouvernements, les savants, et les philantropes qui nous ont donné leur précieux concours.

J'ai l'honneur d'être, avec le plus profond respect, de votre Altesse Royale, Monseigneur, le très humble et très obéissant serviteur,

L. VERVOORT.

AFRICAN SECTION.

The opening meeting of this Section was held on Tuesday, January 23rd, Sir T. FOWELL BUXTON, Bart., in the chair.

The Chairman said, in commencing the proceedings, he must express to Commander Cameron his congratulations on having successfully accomplished so great a journey. All present would be anxious to acknowledge what they felt as to his pluck and courage in having prolonged his journey for 2¾ years in Africa, from one side to the other, traversing through lands never before visited by any European, amongst tribes who had never heard of Europeans, and in parts where there existed the most fearful suffering from disease. But still he urged on his way, till he reached the Atlantic coast; and all Englishmen must be proud of the courage and perseverance he showed. And he might further congratulate him on his belief that his journey was the beginning of what would be for the benefit not only of that country, but of the world. It was very remarkable, in regard to Africa, that there was so great and universal an interest taken in all that concerned the development and exploration of that country. A Church Congress could not assemble without making it one of their most prominent features. The Social Science Association also gave to it almost a separate department, and scientific men also could not meet without getting Commander Cameron to tell them his story. This was not only the case in England, but it extended to the Continent as well. He could not but allude to the great interest which was felt in Belgium—especially, perhaps, owing to the action of their excellent and learned King. No one could doubt the deep-rooted and sincere interest which the King of the Belgians took in this question. It might be that it was an interest in the scientific exploration; but, far beyond that, it was based on an earnest desire to see civilisation and Christianity extended, and reflecting their light over the continent. He was convinced that that monarch was desirous of using his high position for the purpose of civilising Africa, and aiding every effort for the good of that continent. They were assembled that evening specially to hear the subject discussed with reference to its commercial aspect; and there were many ways in which it would be for the benefit of the world if that long-neglected and lost continent were drawn into the community of nations. They were told long ago by Dr. Livingstone that a great deal of the trade of India was hampered by the want of those very grains and seeds which grew in profusion on the East Coast of Africa. It was capable of producing any amount of cotton, and they were told by travellers that there were vast masses of people only wanting a little stimulus to afford a great market for cotton goods, such as Manchester could produce. But all these were questions within the ken of their Society, and he could not but congratulate it at having an opportunity of hearing these topics discussed by one who had had such ample opportunities of proving the capacity of Africa for becoming useful to the civilised world.

An address was then delivered on

THE TRADE OF CENTRAL AFRICA, PRESENT AND FUTURE.

By Commander Cameron, R.N., C.B.

After what your Chairman has said, there is little for me to say about the general interest which is felt in Africa by all thinking people. That large continent has been, as far as history goes back, one of the great labour-producing countries of the world—but all that labour has been wrung from it by the cruellest oppression. The slave trade, as it goes on at present, is the curse of Africa; and the one thing which pleases me more than anything else about my journey is, that it seems to help people to take an additional interest in that question—not that interest was wanting before—and that the day may some time come when Africa may be free and happy. Before talking about the present trade of Africa, the first question to briefly consider is the geography of the continent. Africa, as everybody knows, is traversed in the middle by the equator. On each side of the equator lie first of all the tropical districts, which are marvellously fertile, and have great quantities of rain during the year. On the north there is the great desert of Sahara, and to the south the desert Kahlahari, which cannot be compared to that of Sahara, because a great portion of the year it has rain, but during the other part it is almost equally desert with Sahara. North and south of it we come to the more temperate regions. In the south, we as Englishmen, with our great colony, are more interested than in the north, but at the same time our intimate relation with Egypt—one of the granaries of Europe—also leads us to look to that part of Africa with an interest which is only second to that which we feel in the Cape.

Africa, as Captain Speke said, may be briefly considered as being like a great dish turned upside down. First, the rim of the dish represents the low-lying littoral; then the ascent to the centre by the mountains, and then coming on by a small descent to the great central plateau. This central plateau of course cannot be considered as a single great table-land; on the contrary, its surface is diversified by all sorts of countries it is possible to imagine. There are great ranges of mountains, great rivers, forests, plains, lakes—lakes, indeed, which are scarcely second, if indeed when we know all about them they are second, to that wonderful water system of lakes in North America. We have, then, this great continent lying there. This map of Africa on the wall has a few lakes marked on it, but when the map of Africa is properly drawn we shall find there are far more lakes than many of us have any idea of.

The great difficulty about travelling and trading in Africa lies in the unhealthiness of a great portion of the coast line and some parts of the interior. But at the same time, when we look to our great Indian possessions, we may rest assured that as we have been able to carry on our work as we have done in India, rendering the inhabitants of that country happier than they had ever been before, and have proved that Englishmen and English armies can exist there, we need have no hesitation in saying that, in time to come, Englishmen will be able to live in Africa as the Civil Service and the army live in India, if they cannot settle as colonists. The climate is not as a rule so bad as that of India, and half, or more than half, of the sickness, especially in the great missionary expedition under Bishop Mackenzie, has arisen from people travelling there not having the proper means of resisting the climate.

When we first left the coast, we travelled across the low-lying littoral, and then across a smaller line of hills, until we came to Usagarra mountains, which form the great dividing line on the eastern side between the coast line and the interior. These mountains at the north form part of the great chain of high elevation, which reaches down the coast at a varying distance from the seaboard, sometimes nearly close, and sometimes 200 or 300 miles inland, and which is connected with the great mountain of Kilmandjaro, one of the only two snow-covered mountains that we know in this region. Passing down from Lake Nyassa, and down on the western side to the Cape of Good Hope, it forms at its southern end a smaller range which, varying in height and distance from the coast, winds back with several breaks up both the Gold and Grain Coasts; although there is a great bank where the Sahara seems at one time to have joined the Atlantic, until we come to Mount Atlas in the north.

The rivers of this great continent are something marvellous. In the south we find the Orange River and others, which apparently, as far as our present means go, cannot be utilised for commerce. Coming a little farther north we find the Zambesi falls into the sea in the Mozambique Channel. It stretches nearly across the continent. Indeed, I found its affluents close to the mountains which separate it from the Congo basin, large rivers, one being about 80 yards wide, with a varying depth, in many places being 14 or 15 feet deep; a noble stream, and this was just at the beginning of the rainy season, before it could have been augmented by the rains which were then coming on. On the Congo, starting from its mouth at the West Coast, about 110 miles inland, are the great rapids of Illala, the meaning of that word being rapids, as Congo, in many African languages, simply means the great river. Above these falls, the only information we have about it is that gained by Captain Tuckey, R.N., who went above these falls in 1816, but owing to the way in which his expedition was fitted out, not knowing anything about quinine, which is the great safeguard against fever, and his men—mostly marines—being dressed in what we should now think a most absurd way, in strict uniform, with pigtails, long gaiters, stocks, and red coats, they succumbed to the climate. But Captain Tuckey talks of this vast river as being in many places three and four miles broad, and as a large navigable stream flowing with a placid current. This river, I firmly believe, is the same as the great River Lualaba, which I saw at Nyangwe. Away right in the heart of the continent I found it 1,080 yards wide, with a depth right across of over a fathom, and with channels of two or three fathoms in depth. That is the river which I heard had great affluents from the north, and which I believe, though this is simply a surmise, may very likely prove to be the same as the great river which was found by Dr. Schweinfurth at the furthest point of his famous journey. It also connects with the Tanganyika, and leads up by other branches towards the south, and comes to within 120 miles of the Zambesi, which was discovered by Livingstone to be navigable to within 120 or 130 miles of Lake Nyassa, which by the Cheri again communicates with the Zambesi. By various affluents the Congo also interlocks with the affluents of the Zambesi, so that, in many places where the country was quite level, the navigable affluents of the two rivers might be connected by canals of from 20 to 30 miles in length, or by portage. Of course the difficulty in all these unexplored rivers is for us to know how and by what means we are to get up and down them. On both these rivers—on the Zambesi especially—there are great rapids. We know there are the Illala rapids on the Congo, and I heard of small rapids a short distance below Nyangwe; but, looking to the fact that the River Ugarowwa was only 1,400 feet above the sea, and knowing that these small rapids had been shot by native canoes, and therefore could be passed by properly constructed steamers or boats, under the charge of men competent to manage them, there would be very little likelihood of any insuperable difficulties of this kind being found between Illala and the Nyassa; and, as the river between Illala and Lake Bangweolo passes through several lakes, this ought to show us that there can be scarcely any difficulty about navigation on the other branch of the river, reaching from Moero. Just north of that lake there are, no doubt, great rapids, and also between Moero and Lake Bangweolo. The rapids of the Zambesi we have heard all about, by the careful surveys made by the expedition under Dr. Livingstone and Dr. Kirk. We have heard of the great Victoria Falls, and the other rapids, but there seems to be no reason why steamers should not be sent out in sections, and transported past these various rapids, so as to allow each part of the river to have an independent system of steam navigation. The longest distance for portage would only be about thirty or forty miles, and tramways or roads might be made so that we should have uninterrupted communication with the interior by means of these rivers.

The other great river is the Nile, that famous historical river referred to by Herodotus, and of whose sources and geography we are now begining to learn something. Looking at the distance it comes from the Mediteranean towards the interior of Africa, there are 3,000 miles before it comes to the Albert Nyanza. We have heard of the difficulties experienced by Sir Samuel Baker, and his successor Colonel Gordon, in trying to get up that steamer which is now a monument of English pluck, and its successful navigation of the Albert Nyanza. We have also to look, in talking of the Nile, at the great distance and the great difficulties attending that route for a long distance through the Soudan; there are great difficulties on account of the deserts. The Khedive determined to have a railway built there, but although he is a very enterprising man, and undertakes many things, he often does so without counting the cost; and the railway now being built across Soudan by a great English engineer seems to be on far too great a scale for anything useful in Africa. Another great difficulty about the Nile route is that, notwithstanding what Englishmen have done there, there are adventurers of all kinds who have commissions under the Khedive, and also many Egyptian traders who have made their way into the interior, and who, the moment the back of the Englishman is turned—whoever he may be, whether Sir Samuel Baker or Colonel Gordon—occupy themselves in the slave trade. This route is practically barred to us by the slave trade and the way it is carried on. Tribe is set against tribe, people are robbed of their cattle in one place, in order that these cattle may be sold for ivory which may be used to obtain slaves in another, and the whole advance of the trader down the valley of the Nile is looked upon by the natives with suspicion and hatred. Indeed, when poor Mr. Lucas, whose death we heard of the other day, after spending an enormous sum of money, tried at Khartoom to force his way from the Nile to Nyangwe, he found he might as well put his head into a hornet's nest as to make his way where these traders had been. These people travel with such vast numbers of armed men that they are able to pay themselves for a short time; but although it pays a few of them, it is a short-sighted policy, because even now many of these men find that in countries where a few years ago they were able to find ample returns for their labour and capital, they have now to go very much farther a-field, and to get into the neighbourhood of tribes who are much more warlike, and offer more resistance to their aggressions. Indeed, unless we get some proper guarantees for the good government of the Nile route, it is so heavily handicapped by the way in which the trade is carried on at present, that it may be practically put out of the question.

There are other trade routes across the great Sahara, across from Jedda, and down by the Niger; and a short distance behind Sierra Leone we find Mahommedan populations, who have come across the Sahara and brought goods by that route. When I was at Lagos, on my way home, I heard there had been an Arab, a native of Fez, who had started from Suakim, half way up the Red Sea, and made his way across the continent to Lagos, and who went on to Sierra Leone, hoping to be assisted by our Government there in trying to open up a communication with the Soudan. A short distance behind Sierra Leone there are Mahommedan villages in an advanced state of civilisation; men called Hafiz are to be met there who know the Koran by heart; and it is not at all uncommon in these villages to find large libraries of Arabic literature, showing that the Arabs have forced themselves all across the great northern part of Africa; and one of these men who came to Lagos said he did not see any reason, if an Englishman would go with him, why he should not take him safely across the whole of that part of the continent.

The rivers are our great natural highways at present, but there are many parts of the continent which offer great facilities for constructing roads, or tramways, or light lines of railway. The Zambesi, unfortunately, has its mouths in the possession of the Portuguese. I do not want to animadvert on the conduct of the Portuguese; I believe their Government are acting for the best according to their lights, but their system of enormous protective duties, and of granting monopolies, and so on, has helped to stop the road to the interior by the Zambesi, and they are now attempting to annex the mouth of the Congo, and thus to practically seal up the water-ways to the interior. From Koilwe, in the ninth parallel of latitude to the north end of Nyassa, as at present known, is about 370 or 400 miles, and about 270 miles of that distance was surveyed by the Baron Van der Decken, who states that from the north end of the Nyanza, as at present laid down, to the south end of Tanganyika, is about 100 miles, and there seems, by the surveys which we have, to be no difficulty in running a road from Kilwe to the north of Lake Nyassa, and also joining Lake Nyassa where the Scotch missionaries at Livingstonia have already a road to the south end of Tanganyika, thus giving us a great line of water communication up and down the centre of the continent, right across the whole of the trade route to the interior.

The trade routes are the next thing to be considered. There is the Nile route, of which I have already spoken. There is a certain amount of trade from Berberi, opposite Aden, but it is small in extent, and there the Egyptians have seized the coast, and the King of Shoa has written to the Khedive, asking what he is doing in seizing the coast, saying that the people are desirous of having trade with Europeans, that they want the country civilised, and want commerce, and so on, but they are prevented by the Egyptian authorities. The envoy he sent was seized and plundered by the same official who behaved so infamously badly to the Italian expedition under the Marquis Antinori. Then we come south, along the coast, where we know absolutely nothing of the interior; in fact, the whole distance, right down to Brava, we know nothing of. The Soomalis come down, and bring a large amount of hides down to Brava, which forms the principal trade of a great German house at Zanzibar; but until we come to the Jube we know nothing. By the Jube river there is a certain amount of trade. Van der Decken, who surveyed this route after penetrating for some distance, was murdered, and nearly all his men, the only ones who escaped being a few half castes from Zanzibar, and all his valuable papers were lost. But the fact of his having penetrated some distance into the interior proves that by that river we may find another great route. From Bombessa there are many routes towards the Victoria Nyanza, where people go in search of ivory, and these people report that, besides ivory, they get into a country of a people who are, no doubt, treacherous and cruel, nomade in their habits, but who are possessors of enormous herds of cattle, and that the country, after the vast ranges of mountains are passed, is almost a perfect level; showing that there can be no great difficulty in travelling, as far as the country goes, but that the only difficulties to be expected are from the inhabitants. South of Bombessa, opposite Zanzibar, are the great routes to Tanganyika. First of all they travel up to Unanyembe, which is a sort of great centre of trade where many Arabs are settled permanently, and from there they branch out in all directions to Tanganyika and the Victoria Nyanza, and many other different places. A little south of Zanzibar they travel away into the interior along the south end of Tanganyika, until they find themselves in the country which is a feudatory of the great chief Ulunda, where many of their countrymen came across from Ujiji. Also as they come down from Kilwe, they march by numberless routes to the great Lake Nyassa to the territory south of Cape Delagoa. The consul at Mozambique has been trying to explore the route by land, but we know little or nothing of that, the Portuguese not being allowed to go into the interior, all the trade being brought down by the natives themselves.

On the west coast of Sierra Leone is a small local trade, but the great trade of the country is behind Sierra Leone, and also behind Ashantee, and is carried on right across the Sahara, or by means of different branches of the Niger. By that river, and the various oil rivers, we have got up some distance, and Bishop Crowther, a man who was once a slave, who was taken on board a ship when 12 years of age, liberated and educated, and is now one of our worthiest of missionary bishops, has got 500 miles up the Niger. He found there people who are highly educated, and in a very advanced state of civilisation, and these same people have come forward into Lagos. The Mahommedans of Lagos are now beating our missionaries out of the field in their efforts at proselytising. The mosques and Mahommedan population are constantly increasing, which shows that this people in the interior must have some real pith in them to do such a thing under the British flag. The oil rivers we simply know the mouths of. They are most probably connected in some way with the great delta of the Niger. Originally they were under one chief, but, by the ill-judged efforts of traders and the short-sighted policy pursued, they set up in place of the king George, who had been sovereign of all those tribes, Oko Jumbo, Ja Ja, and a man called Capt. Hart. King George still reigns in the Bonny, and is a Christian, but on the other rivers there are human sacrifices carried on, and emissaries of the different chiefs when they get into the interior quarrel with each other. A great quantity of oil is lost by the manner in which they go on fighting and squabbling amongst themselves.

At the Gaboon we meet a certain amount of jealousy on the part of the French. They possess the Gaboon, which is really at the mouth of a river, and, after passing a certain point in that river, the French make every merchant ship hoist French colours. There are a few English merchants there; they most bitterly complain that when they go 30 or 60 miles into the interior they cannot go under their own flag. Thither the trade is brought down from the interior by the natives. There is a French exploring expedition there now, and the Marquis de Compiegne, Du Chaillu, and others have given us some idea as to the interior of the country there and about the natives; but as to the state of things 150 or 260 miles from the coast we are practically ignorant. On the Congo we find some Dutch traders, and there have been some few small English houses at different times. The trade there is also all brought down from the interior by the natives. These natives have been contaminated ever since the time of Queen Elizabeth and John Hawkins, whom we are proud of as one of our pushing Englishmen, but whom we are ashamed of as the man who commenced the slave trade, and laid upon us the duty of doing away with the slave trade in every direction. Since that time they have been simply mixed up, as a general rule, with the very worst specimens of Europeans; with pirates and slave dealers, and they have not been slow to learn the lesson taught them by these off-scourings of Europe. South of the Congo the trade is carried on by native caravans, which come down occasionally, bringing large quantities of ivory, india-rubber, and other native produce, and they talk of having been to the great Lake Sankorro.

When we come further south we again meet the Portuguese, who, according to what our Government holds out, have no authority there, but practically their boundary is in latitude 7·50. South of that they are allowed to go about as they like, but north of that, if a Portuguese is seen by himself, the natives would kill him at once; but Englishmen and Frenchmen can walk about without any attempt at ill-usage. Then the Loando has a trade with the interior of Africa. The Scotch and English have a line of steamers on the Qwanza, which goes a considerable distance up that river, stopping at the first rapids. There is no reason they should stop there, because portages might be formed there. I crossed the river about 250 miles from the rapids, and there was still a fine navigable stream.

Then, coming down south of the Qwanza, there are small places which have a certain amount of trade; but the next great emporium is Benguela, which has the advantage of having beyond it, at the distance of 240 miles, the large city of Bihe. At this city of Bihe there are settled a few Portuguese, and its inhabitants form the greater number of the porters who carry the trade of the Portuguese right to the heart of the continent. Between Bihe and the coast the trade is carried on by the people of Benguela. The trade of Bihe consists principally in ivory, india-rubber, and bees-wax. The Bihe people go inland, and collect vast quantities of bees-wax, which they sell to the Bengulese, who take it to the the coast. Ivory and india-rubber are obtained from inland by men, some Portuguese, others half-caste, and others black men who call themselves Portuguese. They go with these people for very small pay, for the sake of being allowed to steal as many slaves as they choose. The slaves that are brought to Benguela are very few in number, but close to the coast, within the last 120 miles, over a rough and difficult country, I saw myself skeletons, slave forks, and slave clogs that were scarcely bleached or worn by the weather, and they could not have been more than two or three months old, proving that slaves are still driven down to Benguela. Where they go to is a question we have to find out; but when we look at Brazil, where there is slavery still going on, and seeing it was only the other day that there was a trouble about one of our own steamers having carried slaves from one part to another, which were sold after they left our steamers, and looking at the vast coast-line of Brazil, I think we need not be astonished if slaves are still imported there. I firmly believe such to be the case.

South of Benguela there is only one port where slaves are still exported; but on striking into the interior there is a considerable trade in ivory towards the Kaffir countries. Indeed, our consul at Fernando Po, Hartley, after some years' travelling, arrived within a few days of this port with a large stock of ivory, when he was robbed of everything, and turned up at Loando in only his shirt and trousers, having worked his way up in a coasting boat. South of that we come down again to our own colonies.

We have great hope of the future of Africa, because, whatever our troubles may be at present in the Transvaal with the Kaffirs, there is no shutting our eyes to the logical consequences which must ensue to our colony at the Cape. The logical consequences of the aggressions of these Boers—who, although they do a great deal of harm, push themselves forward—will be to render it necessary that some proper form of government be established, which will rest on the shoulders of the English to establish and carry out. Indeed, looking at the question impartially, it seems very necessary that, before long, the frontier of the Cape Colony shall be at the Zambesi. Livingstone, if you remember, when he walked up to Ngami, and across on his great journey to Loando, received great assistance from the natives; and they again helped him on his return from Loando to Ngami, when he was the first European that ever crossed tropical Africa from sea to sea. At that time Englishmen were perfectly unknown, but now all along that region Englishmen are well known. When I was there I heard the people say, "I known a man called Johnny, and another called George." These men were hunting with their waggons and with great armies of followers, for ivory; and I constantly got letters from men who have been to the Victoria Falls, and who seem to know the Zambesi just as well as most of us know the Strand. They are Englishmen who go out there to hunt; some go simply for sport, and some for the sake of the ivory; but there the Englishman is forcing is way forward, and it is there that the great hopes for the future of Africa lie. We are able to go up from our own colony at Natal, across the Drachensberg by a healthy road, right towards the great storehouse of the interior. We have there a road, where we can pass up without meeting any of those fever-stricken districts in the heart of Africa.

On Lake Nyassa the Scotch missionaries have now established a colony, where they are teaching the natives agriculture, and all the different arts of civilised life, and we also have a tentative trade party under Mr. Cotterell, son of the Bishop of Edinburgh. Bishop Cotterell himself was a missionary in these parts. His son is the head of this party, his daughter is married to a clergyman, who is also a missionary; so that we may be sure that with Mr. Cotterell, who was brought up amongst the Kaffirs, and knows what is necessary to be done, there is every hope that this effort will be successful. Again, Bishop Steer, the worthy successor of Bishop Mackenzie, is now forcing his way from Loando into the interior.

Then we come to the possessions of the Sultan of Zanzibar. Everybody here must have been glad to see the letter sent home by Dr. Kirk from the Sultan of Zanzibar. That Sultan, as long as he has Dr. Kirk to guide him, is sure to go right. Dr. Kirk is a man who will never speak anything about himself. He will do all his work, and never look for any other reward than the satisfaction of knowing he has done it. He will be the very last man for any one to ask what he has done. When we look at the vast interior slave trade which has been carried on, and when we now find the Sultan of Zanzibar saying, "I will give you every assistance I can to open up the routes to the interior," we may have some idea what the labours of Dr. Kirk have been. Dr. Kirk was, perhaps, overshadowed in Livingstone's Zambesi expedition, by being associated with one who had such a glorious name, but to Dr. Kirk a great deal of the accurate scientific results of that expedition are due. He is a clever, scientific man, a good observer, and a good botanist, and in every way he showed himself worthy of the task he had undertaken there. He is a personal friend of my own, and I am sure he is the same of every naval officer who has been at Zanzibar. We may be sure that while Dr. Kirk is our representative there, the name of England will always be in the ascendant. I always found in the interior that there were two great people in the world; there was the English Consul at Zanzibar, and the Sultan at Zanzibar. Those were the two greatest people, and if I told them I should report them to the Consul or to the Sultan, they instantly understood it was something serious. Well, the Sultan now is offering us assistance to open up the interior of Africa. True, his authority only extends along the coast line, but there are numerous ports there where, by his granting us a town or anything of that sort, we may establish a terminus to one of our great routes into the interior, and thus be able to frustrate the protectionist ideas of the Portuguese. The people on Lake Nyassa are already finding that the duties charged by the Portuguese at the mouth of the Zambesi render it very unlikely that their work ever will be able to pay; but directly we get a road to the coast, where, instead of paying 20 per cent. under the Portuguese flag, and 70 per cent. under a foreign flag, *ad valorem* duties, they can get to a place where they only have to pay to the Sultan of Zanzibar 5 per cent., we shall find that the Portuguese will bring down their duties, or they will get nothing at all; therefore, we shall be opening the Zambesi as well as opening the other routes. The Portuguese of course have a great historic right to the coast line they have in Africa. We all know what Prince John and Prince Henry of Portugal did, as well as Vasco-de-Gama, who first rounded the Cape, and how they established in a few short years a line of forts from Lisbon to China; but then comes the reverse of the story. After a short time, instead of being animated, as they all were under those great and worthy leaders, with the idea that the honour of the country was everything, they came to be simple traders, and not the best of traders, and that is the reason of the wreck of the vast Portuguese power, which was established in so short a time, but which existed a still shorter time.

The interior of Africa shows an immense produce, and we may look for a moment at the present state of trade. We want cotton, and cotton grows in many parts of Africa wild. On the Eastern shores of the Tanganyika, there is a large quantity of wild cotton, and there Dr. Livingstone, if I remember rightly, says the quality is very much the same as that of Pernambuco. Almost everywhere the people cultivate small patches of cotton; in some places they make their own cloth, but in others they simply make the yarn, and have not advanced to the weaving of it. But still, cotton growing wild, and being cultivated in so many places, proves the fact that there is a great future for Africa as a cotton-producing country. Our mills at Manchester are always complaining of having to work half-time, and we also hear of other regions being brought into competition with our mills at Manchester. Some of our capitalists find it cheaper to establish their spinning and weaving mills in India, and they are becoming able to undersell in India our own productions. Now, if we can only get Africa opened up, and use their cotton and manufacture it, in no long time we may expect to have mills built in Africa, and we shall find a market for the over-glut of manufactures we have.

I want now simply to say what the trade in Africa is at present. The first great article of commerce is slaves, the second ivory, and there is a small trade done in india-rubber and bees-wax. The india-rubber is rather a hopeful sign, because there was scarcely any exported from Zanzibar until recently, but since capital has been diverted from the slave trade by the action of Dr. Kirk and the Sultan of Zanzibar, last year £40,000 worth of india-rubber was exported from the Zanzibar coast, showing that some portion of the capital invested in the slave trade before has been diverted in a more legitimate direction. On the West Coast, of course by the efforts of our squadron, and by the development of the trade in palm oil, the slave trade has been very nearly stopped, but on the East Coast we still read accounts of her Majesty's vessels capturing many slavers, so that the trade is still going on. I had four years out there, and know pretty well what it was. Just to give you an idea, a dhow is about 120 tons burden, and stowed in that there are 230 or 240 slaves, many of them with small-pox. I have seen a dhow cleared out, and when everybody supposed that the slaves were all cleared out, and I was asked, as first lieutenant, whether she should be towed off and set on fire, I said "turn those sails over at the bottom," and they said they were too dirty to touch; I had them turned over, and I found four or five people—you could scarcely call them living skeletons, for they were nearly dead—who had been too weak to give any sign of existence. Down at the very bottom, under the lumber, these poor unfortunate wretches were stowed. That shows you something of the slave trade at sea. It has also been my misfortune to see the slave trade on land. In the first place there is a certain amount of domestic slavery, and a certain amount of internal slave trade, which is not a very great evil. In the domestic trade a slave is sold from one member of the tribe to another member of the tribe. But when these people come into the interior of Africa with guns and powder, to tribes who have never heard of a gun before, what they do is this—they make a present to one of the chiefs of a gun and some powder, and they say to him, "Now you give us leave, some forty or fifty of us, to go with guns and take what slaves we can. You say there is a village which has not paid tribute; we will punish it for you." Then they go out and destroy the village. It may be our statesmen, in allowing it, did not see the results, but the institution of polygamy being allowed amongst the Kaffirs, creates a great demand for women, and that institution is still allowed in our English; colonies and in the interior of Africa the Portuguese, and their fellows who came from Bihe principally, interest themselves in obtaining women. They surround a village, set it on fire, shoot down all the men, and carry the women off with the plunder of the village. I have seen a string of fifty wretched women brought in by one blackguard in one day.

There they were loaded with what had been their little property, which had now been appropriated by the men who had murdered their husbands, sons, and brothers. This is something of it. Then you see them driven along the road, all tied or chained together, or fastened with slave-forks, great heavy forked branches of trees, or with great clogs on their feet. They are driven along until they fall from hunger or thirst, and then they are thrashed until they get up again, or left to die on the roadside. When I got towards Bihe the people said they would not throw a woman away because she could not walk, but would carry her; but, after they got tired of carrying her, lashed to a pole, they chucked her down, so that she would become the prey of the first wild beast, without any chance of defending herself. And when I cut her loose, and gave her some water, I met with a great deal of abuse because I had attempted to interfere with their property. Just fancy any English village surrounded by a body of men armed with guns, artillery, and every new engine of warfare of which we had never heard, in the middle of the night, all the houses in flames, and when everybody tried to escape, the men all shot down and the women driven off. Imagine what our feelings would be. The feelings of black men must be the same as ours; perhaps not so acute in some respects, because civilisation, perhaps, enhances the keenness of the feelings, but that can be only a question of degree. There is no doubt they do feel this, and that they groan and writhe under it.

The other great trade of the interior is ivory. Ivory is taken by way of the Nile, and it is also taken to Zanzibar, whence the greater part of that for the Indian and Chinese markets is exported. It varies in quality, according to the different kinds of elephants, which vary in different districts. There are enormous quantities of ivory taken down, and there would be still more, for there is ivory lying about in places where it is utterly wasted for want of means of carriage. At present the only mode of carriage is human beings. Many of the Arab traders said to me, "Do you think we should be such fools as to employ slaves, if we could carry the ivory cheaper; but when I have 15 or 20 tons in the heart of Africa, do you think, when I have two or three hundred men with guns, and can go and take as many slaves as I like to carry it, that I am not going to do it? Do you think I am going to throw away ivory when I have to repay the £300 or £400 I borrowed at an enormous rate of interest, because I am too good-natured to employ the slaves which are ready to my hand?" This is the way that ivory interferes with the slave trade, but at the same time this gives us a hope, because it is already a recognised article of merchandise, and directly we have proper means of communication it would form a considerable item of goods to be conveyed. The india-rubber is only just beginning to be worked, but all through the continent this article is to be found in large quantities. On the East Coast copal is dug in considerable quantities; right in the interior I found the copal trees growing, and although I did not see the fossil gum myself, I was told by the Arabs that in digging pits they had come across considerable quantities of it, but it would not pay them to carry it to the coast so well as ivory. Bees-wax is exported in small quantities from places near the coast, and the Portuguese export a considerable amount from Benguela. But all through the continent there are places where people have hives in every tree, but only use the honey and throw the wax away.

All of us heard of the great famine in India—of the Orissa famine, with an enormous loss of life, and a cost of eight millions to the Indian Government, and we have now to look forward to paying six and a half millions for the famine which is threatening us there now. Why should we not get food for all these people from Africa. A great quantity of corn is now exported from the coast line to various parts in Arabia, and there is no reason why any amount of the corn even at present cultivated should not be exported to India. It wants roads; and then when the labour of the men at present employed as porters for the ivory trade is done away with, they might be employed in cultivating the ground, and more would be produced. Wheat has been grown successfully at Unyanyembi, Ujiji, and other places; and at Nyangwe there is a great fertile plain which no doubt could be practically cultivated in the same way.

Sugar has been made at Zanzibar, and the sugar-cane grows all through the continent wherever there is sufficient moisture. Of course, in a great continent like that, it is almost impossible to answer the questions which people often put to me—"What is the country and the climate?" You might as well ask what is the country and climate of Europe. But wherever there is sufficient water the sugar-cane grows most abundantly. Then, in regard to spices, Zanzibar is at present one of the great places for the production of cloves, and there is no reason why that cultivation should not be extended indefinitely on the shore opposite Zanzibar. Nutmegs I found growing close to the eastern shores of Lake Tanganyika; and after leaving the Nyanza, whilst walking up the valley of the Lomami, I went under great groves of nutmeg-trees; and for 200 or 300 yards walked over ground literally covered with nutmegs, nobody knowing their value. You could have gone and picked them up, and put them on board a boat on the river, and floated them down to the coast. There was untold wealth running to waste on the ground.

Coffee grows between Tanganyika and the Victoria Nyanza, and in many other places. This coffee I got a considerable amount of; it was the only coffee we had after leaving Tanganyika, and the bean was precisely like that I had bought at Mocha, on the

Red Sea—a small, greenish, semi-transparent bean, which you could not have distinguished from the best Mocha coffee. But the natives did not know what was the good of it. Again, different kinds of pepper grow there. Black pepper grows along the Nyangwe, and is brought from there into the market. As to the timber of the country, it is scarcely to be dreamed of what its natural wealth is in this direction. There are great forests to the eastward of Tanganyika, where you can go 300 or 400 miles without a break, except just the clearings round the villages. The trees of which the canoes are built are not very difficult to work, but supply a good, lasting timber. I have seen a canoe over sixty feet long—which I could just look into standing on tiptoe when she was hauled up, and standing inside her I could not stretch across her—hollowed out of one solid trunk of a tree. Then there are ebony, African oak, teak, blackwood, and many other woods of which we know nothing. Then there is another great question—oil. We know that from the oil rivers and from the Congo at present we get vast quantities of oil from the oil-palm; but right up the valley of the Lululaba, to 2,600 ft. above the sea, and in one or two instances to 2,800 ft.—and Livingstone even found it growing at 3,200 ft.—the oil-palm grows in most marvellous profusion. The attention paid to the oil-palm on the West Coast has done more to do away with the slave trade than all the squadrons ever sent there. But this oil-palm grows right up in the interior, and on the East Coast we have a trade in oil which is made from the semsem seed, of which the French take large quantities to Marseilles to make the very best olive oil from. The same plant grows right through the interior, and if we can only bring it down we shall have abundance of oil. Castor oil grows everywhere, as I found to my cost, for my cook used to be rather fond of using it for cooking. Different sorts of castor-oil trees are either cultivated or grow wild right across the continent. Ground nuts also grow everywhere; in fact, there is no limit apparently to the production of vegetable oils in Africa. Among vegetable products we must by no means omit tobacco. This is grown nearly everywhere; and I used to find, in the few places where it is not grown, it was so much valued that it quite repaid me to take a few loads to barter with the natives, instead of using the few stores I had. At Ujiji, the tobacco made will vie with the very best produce in the West Indies, and some day, perhaps, we shall have a great cigar manufactory in that place. There is no reason why we should not. The tobacco there is very good, and so is the climate, and it is a very comfortable place to live at.

Besides ivory, in animal products, there might be a great trade in the skins of the different wild animals we find. The hippopotamus and rhinoceros hides are now being used by mechanics for emery wheels, and they tell me one wheel will do the work of I do not know how many, at one-fifth the cost. Then there are the different monkey skins, leopard skins, and the skins of otters in the lakes, which might all be made a considerable article of traffic, though not to the same extent as the other things I have mentioned. Then there are hides for manufacturing purposes to be obtained in many parts, if we can only get communication with them. There the difficulty arises from the savage nature of the inhabitants; but there seems to be an almost illimitable supply of hides.

When we come to minerals, of course the first thing that Englishmen think about is iron. Now iron seems to be scattered broadcast over the whole continent, at least that part which I traversed, but in Manyuema, near Kyangwe, the iron was all very superior, a sort of black specular ore, and all the people seemed to be very great blacksmiths. Indeed, instead of the blacksmith being rather a rough, or outcast, as he is in many Eastern tribes, the chiefs of the villages were commonly working blacksmiths. In these villages they have great foundries, where large quantities of iron are worked, and this iron was exported and carried about for sale. And they were by no means bad smiths; indeed, I do not think an English smith, if he were to use their tools, could turn out such good work. They know the value of iron, and if we could instruct them in working it they would be most glad to accept that instruction, or if we sent them out models or patterns of better tools we might find a large market for our tools, and help them to manufacture their own iron better. Coal is found on the Tanganyika, and from a little to the south-west I had a piece of coal given to me. It had been exposed for a long time, and no proper judgment could be formed of its value; but it was described as a bright splintery coal, slightly bituminous. On the Zambesi there are great seams which are laid bare on the banks of the river, and Dr. Livingstone, in the *Pioneer*, used often to coal with native coal.

The next most common mineral production is copper, which over a large district around Katanga seems to be most marvellously plentiful, and is carried about by these natives in all sorts of directions, to buy things which they do not find in the country. In the malachite, from which this copper is produced, are often found great specks of gold; indeed, in reducing the copper, there is a certain amount of alloy of gold always found, and the people of Benguela were buying up this copper in order to get the gold from it, though this was kept rather a secret. In Katanga also, the gold seemed to be lying in the alluvial formation separate from anything else. An Arab showed me a calabash filled with small nuggets of gold, which he said one of his men had got from Katanya, to see if it would be any use to him for shot. I asked him why he did not go for more, and he said he did not know such little bits were good for anything. They were about the size of the top of one's little finger to about the size of No. 6 or 7 shot; and I believe if I had not told him it was valuable, he would have given it me. There is no doubt a large quantity of gold to be found there; and there is also silver about the same district, because I found the natives wore silver bracelets, which they told me they got from the same country. Cinnabar is also found in the country, the natives not using it for any manufacturing or scientific purposes, but simply making a red powder with which the better sort rub their faces when they approach the persons of the chiefs.

Another great hope for Africa, besides all these numerous products—although Sir Samuel Baker tells me it is not the same in the north—is the marvellous aptitude for trade and commerce the natives themselves show. The natives are always ready to get the best of you. Perhaps it may not be a very hopeful sign to say so, but they are very skilful in adulteration. At some some places you have to buy fish to pay your way a little further along. A basket of fish is brought to you, and when you open it, instead of finding it fish right through, in the middle, skilfully concealed, you find great fragments of pots, and stones, and earth, so as to make up both bulk and weight. If you buy a pot of honey, you find honey on the top, but if you put a stick right through, you find something put into the bottom. If they are selling butter, underneath the butter you find concealed a great mass of elephant's fat, or something of that sort. They go to their markets at Niangwe, and the country round about. There are numerous market places, and at each a market is held every three or four days. These people seem to make it their business to do nothing else but to attend markets and trade. They will attend one in the morning, and then go ten miles off to attend another in the afternoon, and sell what they have bought in the morning. At Ujiji, where there is a certain amount of rude civilisation, they have even advanced to the dignity of a sort of coinage. There is a kind of market there every morning, and a certain special sort of bead, in which everything brought to that market is priced. Before the market, you see regular money-changers going about with boxes of these beads, exchanging them for other beads, and, after the market is over they go and buy back these special beads with the beads that they have got from the buyers in the morning. Of course, they charge a considerable *agio* on the transaction, and make their living by it. It shows that in time coinage may be introduced instead of the present cumbrous system of barter, which now forms one great difficulty in all trading operations in Africa.

The great question which seems to arise now is, what are we to do with regard to opening Africa? The King of the Belgians, as Sir Fowell Buxton has told us, has set himself at the head of all those who wished to do good with Africa—that great, dark, and long-lost continent. Of course, there are difficulties of international jealousy; and whilst it behoved every one who has the good of Africa at heart to assist him loyally, at the same time we cannot conceal from ourselves that there are considerable difficulties in the scheme. Besides, his scheme is simply for exploration and civilisation, and thereby, if possible, of course he hopes to put an end to the slave trade. But what rests on us as Englishmen? We, as Englishmen, were the first Europeans to import slaves from the West Coast to the Americans. We have got the great duty now to do away with that great wrong we once did to that continent; and we have also a right, a far nobler right than that—I might mention the names of Livingstone and Mackenzie, but there is no need to go down the names of those who have travelled and died in the cause of Africa—but we have this right as Englishmen, that we are foremost amongst those who have explored Africa, foremost amongst those who have done the most to stop the slave trade, and therefore, as Englishmen, we should put our own shoulders to the wheel, and open up that country. People are constantly talking to me now—and I hope their talk means something—of perhaps being able to obtain a port from the Sultan of Zanzibar. From that letter which comes home from him that question seems to be answered. They talk of connecting Nyassa to the South Tanganyika by a line of railway. It seems a chimerical proposition, but where there is energy, perseverance, and money—and where can you find these if you cannot find them in England—the thing can be done. When we have that road to the interior, and we establish ourselves on the head waters of the Congo, and we have the steamers so nobly placed on the Nyassa by the Scotch missionaries, we shall have a line which, when joined by railway with Tanganyika, will go right across the whole of these slave routes, and right across the whole of these countries where the wonderful products of which I have spoken are to be found. Although, perhaps, people do not invest their money, they will, perhaps, subscribe a certain amount for philanthropic projects; but believe me when I say that will not be a bad investment commercially; that with all these products there laying waste, all our difficulties about employing our population at home, especially the difficulty of finding employment for a very numerous class, the sons of gentlemen—because the public offices are full, India is full—we shall want men to work there, and there is a great field open for numbers of educated men to find a way for themselves in Africa. It will be successful, I am sure, not only commercially, but morally, if we only put ourselves forward, and England will have the great glory, I hope, of putting a stop to the slave trade throughout Africa. If Africa become another jewel in the British empire, I believe it will be no less bright than that great jewel of India. We have a right to Africa—do not let us lose it.

DISCUSSION.

Captain Foot, R.N., said if any remarks of his could in any way endorse the sentiments which Commander Cameron had laid before the meeting, he could most certainly give them with all cordiality; and after a slight experience of African service—four years on the West Coast, and three years on the East—he was perhaps entitled to say that there was no nobler object before England at this moment than to put a stop to the slave trade. Commander Cameron had most graphically described the horrors of the slave trade in the dhows; and he had seen the same sort of thing, in a somewhat modified form, on the West Coast, before the Cuban slave trade was suppressed. There was only one point upon which he would endeavour to supplement the appeal which had been made on behalf of commerce, and that was to point out that, not far from the Juba river, there was another river called the Babooshi, or Port Durnford, on which, about a year and a half ago, he spent some time with the boats of his ship, the *Daphne*. That river was mentioned in Sir Bartle Frere's report, and if he was not mistaken it was the most healthy African river he had ever been in. It was a very convenient place for establishing a depôt for liberated slaves, and he might add in connection with it, now that so many English sportsmen were in the habit of visiting every quarter of the globe, that it would afford a very good opportunity for any gentleman who liked to fit up a yacht, and chose the right season of the year, when he could run down by the north-east monsoon, to go up and explore the river, where he would find a very fair amount of shooting. He believed that the opening up of commerce was the only way to stop the slave trade; and at the present time, when people were beginning to look with suspicion on Turkish and Russian bonds, he thought that they could not do better than put their money into something which would be of untold benefit to them in the end, and which at the same time would free these poor Africans, and prevent these horrors and cruelties being transacted. Now was the time when those who were willing and really meant to move in the matter should act; if we did not step to the front now, other nations would be going in. Now was the opportunity, when we had amongst us Commander Cameron, who had walked across Africa, and who could give valuable advice; and therefore he hoped capitalists would step forward and see if something of this sort could not be done. He hoped the Chairman would take a part in this good work, for which no one was better qualified.

Dr. Badger said he knew a great deal of the East Coast of Africa, having been connected with it since 1861, when he went out as co-commissioner with Sir Wm. Coghlan, to report to the Indian Government on the two African kingdoms, then only one, of Muscat and Zanzibar. From their report Zanzibar was made independent of Muscat, und his friend Dr. Kirk had often said that this was the best step ever made towards the civilisation of Africa. Col. Gordon had written a great deal with regard to the commerce of the interior, and had pointed out to the Khedive that there was a large field there for commercial enterprise, the only difficulty being the means of transit. The Nile was too far distant, and he, therefore, recommended to the Viceroy a position on the Eastern Coast of Africa. Had the Khedive taken proper measures to secure such a position, he would not probably have found any great difficulty; but he sent a filibustering expedition and seized a place which he knew was in the territory of the Sultan of Zanzibar. From that he was turned out, the Sultan of Zanzibar being supported by the British Government, and the consequence was that he was now ready to forward to the best of his ability any enterprise which British merchants might adopt in his territory. Only by the last mail he had received a letter from him, in reply to one he had sent, telling him of the efforts of the King of the Belgians, of the meeting at Glasgow, &c. The letter when translated was as follows:—"With regard to the meeting which assembled in Scotland, at which our beloved friend, Sir Bartle Frere, was present, we have understood all that you have written, and you are very kind indeed in having told us of it. What was said on that occasion pleased us very much; but we only wish that they had pointed out to us the locality from which they desire to make a road. Only let them point out to us the place which they deem to be the best starting point. We have expressed the same to our beloved friend, John Kirk; he was delighted, and advised us to write a letter to the Prime Minister, Derby, in order that we might make known this to him, and that we should ask him to point out to us the men who wish to make this road, in order that we may afford them every assistance in our power." Two or three parties had consulted him, as to whether he thought the Sultan would do this or that; but he could only advise them to formulate their scheme, and say what they wanted, because he was sure when the Sultan of Zanzibar once knew that Englishmen were desirous of extending British commerce and civilisation, he would give them every assistance in his power.

Mr. Hutchinson (Secretary to the Church Missionary Society) had listened to the lecture with extreme interest and satisfaction, and begged to say that his society quite endorsed the opinion which had been expressed as to the importance of opening up Africa, not by way of Egypt, but from the East Coast. Anyone looking at the map would see that that was the proper way to go to work, and the society which he represented was now sending a mission of some importance to the interior of Africa by that route, whilst the London Missionary Society was also sending a mission to Lake Tanganyika, and the Scotch had sent a mission, which was now established on Lake Nyassa, so that the religious and philanthropic portion of England was about to occupy, as far as it could, the lake region of Central Africa. What they were doing, and were about to do, would probably be more effectual in opening up Africa than anything else, for they were first going to try to make such a road as had been referred to as of prime necessity. The London Missionary Society, with their South African experience, said that bullock waggons and carts, when once placed on the spot, would be used in substitution for the present rude method of transport, viz., the head of a porter, and, as had been said, the question of transport was really the great difficulty in the way of the development of Central Africa. Mpopa was about 200 miles from the coast, and one of their young men had recently walked it in 11 days, though it took the expedition 35 to go up. He said in his journal that there was no more difficulty in the march than there was in crossing the wilder parts of Scotland or the North of England. They had already commenced making the road at Mpopa, where there were two men at work, and one engineer's contractor who had had considerable experience in the hilly country in the north. He had now started at Mpopa, his instructions being to work downwards, overcoming all the little difficulties in the way, smoothing a bit here, and occasionally making a bridge, so as to afford a rough and ready road for the passage of the bullock waggons, which they expected would be sent out in June or July by the London Missionary Society. What they had asked the Sultan of Zanzibar to do was to extend his protection along that road, and give the parties a certain amount of *prestige*. They did not want guards or protectors, for they had been kindly received by the natives, and though there were certain difficulties in obtaining food, they hoped they would be overcome, as they were on very good terms with the inhabitants. The Scotch, who had plenty of money, might make that road from Nyangwe to Nyassa if they liked, but he did not believe in a road from the north of Nyassa to the south of Tanganyika. He had had Jacob Wainwright stopping with him for some time; and his journal, in which he described that journey, showed they met with great hostility in that region. Nor again, further north, did he think there was much chance of water communication between Tanganyika and the Albert Nyanza. With regard to the suppression of the slave trade, he wished the meeting to know that again the Church Missionary Society had to represent the philanthropy of this country. At one time the Government was proud to come to the front, and do that which now they left voluntary agencies to do. These societies, with a few philanthropists who helped them, supported 470 slaves, the victims of the East African slave trade, and the Government had not given sixpence towards it. They were going to ask them to help, but they feared that whether from this Government or the last, they would find the answer would be the same, that they were glad the society was able to do it, and if it could not, some one else would. At this moment they had these slaves on their hands; and one great object was to see how they could utilise this raw material placed in their charge. Ivory, bees-wax, and india-rubber were the three staples to which they had directed their attention at their station at Mombassa, and they were also going in for cotton. The cocoa-nut was also found in profusion, and they intended to send out presses by which the raw material could be compressed and sent to England, where it would sell at a considerable profit. The same with the cotton seed, which was really more valuable than the cotton itself, the principal trade of Hull being now in these seeds from Egypt, of which was made the cake for feeding cattle. He believed the spare capital of this country could not find a better market than in developing these lines of traffic, and in helping the Sultan of Zanzibar to deal with the interior to a certain distance from the coast, so as to assist the people gradually to take advantage of that which lay at their doors. The best way of doing this was by imparting information, and working upon men's minds. The Sultan of Zanzibar was the last man to go into the English market and ask for capital, though there was no doubt that would be of great assistance to him. One great difficulty was, the question of the tribute which had to be paid by travellers going into the interior. On entering the territory of every fresh chief you were subjected to a delay of perhaps three days, and all kinds of extortion, before you were allowed to pass; and, therefore, one of the most important things was to extend the jurisdiction of the Sultan of Zanzibar, so that he might exercise a sort of protectorate over these tribes, whereby trading would be very much facilitated.

Mr. Whalley, M.P., having always taken an interest in African questions, desired to express his thanks to Commander Cameron for his interesting address. It appeared to him, from what information he could obtain, that the question stood thus: The slave traffic could only be stopped by means of trade; trade could only be promoted by means of capital; and capital never could reach the interior, or even the coast, unless such security were offered as persons who invested their money in trade commonly required. The next question was, how could that security be obtained, short of taking possession of the territory in the name of Great Britain, a step which he did not think it possible to induce any Government to undertake. It appeared to him that the best method of procedure would be to establish a company, which should apply to the Government for a charter, such as that of the old East India Company, and which, as it progressed in its operations and showed itself worthy of public confidence, might have further and further powers conferred upon it.

Sir Rutherford Alcock, K.C.B., was glad to have the opportunity of expressing to Commander Cameron his thanks to him, especially for the exertions he had made throughout the country to arouse interest and sympathy in the African races, and to put down the atrocious slave trade which he had so well described. One of the greatest glories attaching to his walk across Africa was that he never shed a drop of blood. He had thus given the world a striking example to show that violence was not necessary, when judgment and a true Christian spirit were exhibited. The subject of the civilisation of Africa was too large to enter upon at such a late hour, but he believed the time had arrived when it was the positive duty of Great Britain to step forward and represent the benefits of those heroic efforts which had been making for the last 20 years to explore and open up Africa. Dr. Livingstone, Dr. Speke, Grant, Burton, and lastly Commander Cameron had paved the way, some of them with the sacrifice of their blood, and now was the time to open these routes. The greatest civilisers of the world had always been the greatest road-makers; and the first step to be taken, therefore, was to facilitate the making of the road from the coast to the great lake region. This line of country was shown not to be infested by the *tsetse*, since bullocks could live there, and therefore there was every prospect of the road being successful. The power of the Sultan of Zanzibar was very great in that region; he claimed a sovereignty all the way to the lakes, and though he might not be able to enforce it at present, yet as the road was made, so would his authority extend with it. With regard to Mr. Whalley's proposal, he must say he thought the day had gone by when the British Government would grant a charter assuming to give rights in a territory that did not belong to it. But there was no reason why they should not, in harmony with the established usage in international matters, pursue the course now being taken by the Missionary Society, and establish a road; and he believed that in two or three years, with no more funds than could be obtained by an appeal to the public for these great objects, in which humanity, Christianity, and civilisation would be the principal motives put forward, it would be accomplished, and commerce would soon follow. The influence of commerce alone, independently of Christianity, would, he believed, be fatal to the slave trade. The Council of the Geographical Society had taken an important part in the exploration of Africa, and he trusted that before long a public appeal would be made, with the society at the head, showing that money was wanting, for money was the foundation of all work; and if the money was supplied, he believed that in a very few years we should reap a large and bountiful harvest for the sacrifices of the last twenty years.

The Chairman then tendered the thanks of the meeting to Commander Cameron, for the interesting discourse he had delivered.

Dr. Mann having pointed out on the map the route followed by Captain Cameron in his expedition,

Vice-Admiral Erasmus Ommanney, C.B., F.R.S., moved a vote of thanks to the Chairman, which terminated the proceedings.

EIGHTH ORDINARY MEETING.

Wednesday, January 24th, 1877; Sir Antonio Brady in the chair.

The following candidates were proposed for election as members of the Society:—

Colomb, Captain John Charles Ready, Droumquinna, Kenmare, Co. Kerry, Ireland.
Crawshaw, Edward, 15, Charterhouse-street, E.C.
Dempster, Robert, Gas Engineering office, Rose Mount, Elland, near Halifax.
Forbes, James Staats, junr., Engineer's office, Great Northern Railway, Derby.
Hepworth, Joseph, Carlisle.
Hudson, Robert S., 58, West-end, Redruth.
Lovell, Miss Matilda, Calke Abbey, near Derby.
Sachs, Christian Philips, 53, St. Paul's-road, N.

The following candidates were balloted for, and duly elected members of the Society:—

Binyon, Charles, 44, Bedford-row, W.C.
Danks, John Ryan, Tettenhall, near Wolverhampton.
Fearon, Francis, 21, Great George-street, Westminster, S.W., and 8, Clydesdale-road, W.
Lester, Colonel John F., Sawunt Warree, Bombay Presidency, East Indies.
Walker, Samuel, St. Stephen's-chambers, Telegraph-street, E.C.

The paper read was—

ON THE REARING OF "GRAIN," OR SILK-WORMS' EGGS, IN THIS COUNTRY.

By B. Francis Cobb.

In the opening address of the Chairman of this Society, his Lordship said—

"The disease which for some years has attacked the silk-worm, and brought deep anxiety to the silk producers in Italy and France, is too well known for me to dwell upon here. Science has sought in vain for a satisfactory antidote; and, although the labours and researches of Pasteur have done somewhat to mitigate the extent of the evil, and perhaps postpone for a time the full development of its ravages, the growers both in France and Italy have sought to introduce

> from time to time a sound stock, which should be free from this disease, and large importations are made yearly of the eggs, or "grain," as it is termed, from Japan and China.
>
> "The heavy losses sustained this year by cultivators, especially in France, combined with the high price of good grain, makes it extremely improbable that the quantity of grain set for rearing next year will be much more than half the average quantity of the last ten years, and a golden opportunity is now given for our colonies to take part in this valuable industry. The unsold stock of silk in the warehouses on the 1st October, 1876, was 2,495 bales, as against 14,884 bales in 1875. Thus we find a scarcity of silk and a want of good grain at the same time, conditions which could not possibly be more favourable to the development of this industry in our southern colonies, almost all of which have been proved to be admirably adapted to silk rearing, as already shown in the pages of the *Journal* of the Society. It behoves those in the silk manufacture, both in this country and in Italy and in France, to turn their attention to new sources of supply; and some of our colonies, we have seen, appear to present peculiar facilities for aiding in this great industry, though, of course, time is needed for its development. What is needed, in the first instance, is a good supply of sound grain.
>
> "M. Roland, a Swiss gentleman, by a series of investigations and experiments extending over many years, has discovered a treatment of the worm by which a sound stock can be produced. A detailed account of M. Roland's labours is given in the *Journal*, Vol. xxi., p. 414. The main feature of the plan is, to use the words of M. Roland, that the silkworm is hatched, lives, and cocoons in the cool climate of Switzerland; produces its chrysalis and moth, laying its eggs on the tree, in open air, where, in the coming spring, they are hatched. The grain remains there during the winter, exposed to all the changes and chances of the climate. In spring the grain is hatched perfectly, and vigorous silkworms are the result. Mrs. Neill secured some of this grain, took it with her to Australia, and, returning here, has shown that she has succeeded in raising sound grain and also a good quality of silk. She has lately returned to Australia, and is full of hope that by next season she will be able to furnish a supply of sound grain, and also export to us some good silk. The Society will watch with much interest the results of her endeavours."

It may not be generally known, but there can be no doubt of the fact, that the rearing silkworms, for seed or grain, can be made both safe and profitable in this country, and this has been confirmed by many competent judges, notably by Mons. Taurigna, an eminent French sericiculturist, who was so convinced of the practicability of rearing healthy grain in England, that he offered to take charge of any magnanerie on a large scale which might be erected for him.

The experiments of Capt. Mason at Yateley also prove that not only will the young mulberry thrive, but that at three years old it will bear having its leaves gathered. The report on the cocoons and silk exhibited by Captain Mason at the Exhibition of 1873, all reared and made from reproductions in this country, left nothing to be desired. Dr. Wallace at Colchester has also been successful in producing fine specimens of both cocoons and grain. But the experiment which Londoners will be most familiar with is, that conducted by Sir Daniel Cooper, lately a member of the Council and Silk Committee of this Society, during the Exhibition of 1873. The cocoons made by the worms reared at South Kensington were reeled in the Exhibition, and the silk produced admitted to rank with the best Italians.

At Sir Daniel's request the silk was submitted for examination to the eminent firm of Messrs. Dufour Brothers, who reported as follows:—

> "The silk you have submitted to us we find to be of the best Italian class, and it would be used for the same purposes as Italian silks. It is of good nerve, clean, and fairly reeled, and we have no hesitation in saying, that had greater care been bestowed on the reeling, so as to have had the thread of ten diniers, it might have been made to rank with the choicest silk in the world. As regards consumption of this class of silk, there is no limit. We should experience no difficulty in disposing of any quantity at current market prices, and taking the average of the last six years as a guide, the value would be about 43s. per lb. If, as you lead us to suppose, this silk can be produced in the colonies, either in this form or as dried cocoons, we do not hesitate to say that a ready market can be found at Lyons or Marseilles, provided the article can be sent in sufficient quantities."

The grain from which this silk was produced was, I believe, procured from the M. Roland, of Orbe, in Switzerland, mentioned by the Chairman, and I draw attention to this fact, because it comes from a colder climate than that of this country, and it is this grain which Mrs. Neill has imported into Australia, and from which we hope she will reap the reward of her indomitable perseverance and industry.

But my task to-night is not with the rearing of silkworms for the purpose of making silk, but the easier and more profitable education for grain; and the object of the paper is rather to show that, as an aid to thrift, and as a means of adding to small incomes, it is available where, as in many cases, we find female intelligence of a high order without the means of making that intelligence available as a source of income. I have shown that silkworms can be reared in this country, and, with the recent failure of the Continental crops, it is certain that good grain that can be guaranteed free from disease will for some years to come be eagerly sought for, and command high remunerative prices.

The labour required to produce such grain is peculiarly adapted to females, but while leaf-stripping and sorting may be done by young, inexperienced girls, intelligence of a high order is required in the magnaneries, and where this had been successfully applied, and the cards of grain bearing a certain signature or registered trademark had been found by foreign cultivators year after year to be free from disease, the demand for that grain would become so constant that the cultivation would prove equal to an annuity to the proprietors.

How then can this be accomplished? Of course the first difficulty would be in the supply of food. At present there are no mulberry plantations in this country, but there are plenty of mulberry trees from whence to obtain cuttings, and thousands of acres of waste lands and commons, which would be improved and beautified by mulberry trees being judiciously planted about in groups and rows. The light labour necessary for planting and watering the slips could be supplied from poor houses or otherwise, as most convenient, and the same labour would be available in due time to gather the leaves, when they might be sold to the proprietors of the magnanerie. Once let it be known that the leaf of the mulberry tree has a money value which can be obtained with little trouble, and many a cottager will plant the tree, in the hope of reaping a future benefit from the disposal of its leaves. There are already many more of these trees existing in this country than are suspected, for in 1869 the number then standing in a radius of ten miles round Charing-cross was carefully estimated by competent authorities at 30,000. No difficulty need, therefore, be experienced in obtaining cuttings for forming plantations.

In Capt. Mason's report upon his experiments at Yateley he speaks of having gathered 1,466 lbs. of leaves from trees standing in 16 rods, or one-tenth of an acre of his land; therefore, as Capt. Mason's trees were young trees planted by himself, and not stripped too closely, and 1,600 lbs. weight the quantity required to educate 1 oz. of grain, it may be accepted that in this country, with young trees, one-eighth of an acre will produce sufficient leaf to rear 1 oz. of grain and that, when the trees are more matured, one-tenth of an acre will do the same. This is important to bear in mind, as it follows that one acre of land will produce sufficient leaf to rear 8 to 10 ozs. of grain.

As regards the original grain suitable to be introduced for the purpose we are discussing, it is obvious that the greatest care must be exercised in the selection of the races from which to rear a healthy stock. Two sources, I believe, are only available, the one, M. Roland's best stock, where the survival of the fittest has proved the race free from disease, the other, from the races at the foot of the Ho-chow hills in China, from the cocoons of which the best white silks of China are made. It may be objected here that the persons who it has been suggested should be benefited by this new industry have neither the means nor the facilities for obtaining supplies of grain to start with from either of these sources; quite true, but if it can be satisfactorily demonstrated that such an industry is practicable, and that its introduction would be a boon to a struggling but deserving class, there will not be wanted generously disposed individuals who will come forward and devote some portion of their time or money to inaugurate so desirable a scheme.

There are already in this country many manuals giving all the requisite information as regards the feeding, moulting, and treatment at the different ages, and necessary rules and requirements for rearing silkworms, notably one in the pamphlet form written by Thomas Dickins, Esq., in 1869, when president of the Silk Supply Association, and again in the *Journal* of this Society, under the head of "Hints to Colonists on the Cultivation of the Silkworm," information was given which could be equally well applied to rearing in this country.

As to the diseases of the silkworm, M. Pasteur, the distinguished French chemist, has recently published an exhaustive treatise on the subject, being the results of his investigations conducted in the heart of the French district, and under the auspices of the French Government. The enormous mortality which has happened among the silkworms M. Pasteur ascribes to two diseases, each perfectly distinct. The first he terms *pébrine*, and it is characterised by the presence, in all the organs of the worm or moth, of small ovoid corpuscles, invisible except when magnified four or five hundred times. The other disease, called *flacherie*, is an enfeeblement of the vital force of the worm, and is recognised by the presence of a particular ferment in the digestive tube or stomach. The malady first mentioned attacks the worm of all ages, and is eminently hereditary and contagious. Its progress is very slow. The worm, born healthy, but subsequently contracting the germ, generally has time to make its cocoon before falling a victim. The disease is, however transmitted to the offspring, which perish prematurely. The way to avoid the trouble is to raise only such worms as come from eggs deposited by healthy moth. M. Pasteur gives the following instructions for obtaining eggs which are almost sure to yield a remunerative harvest. In selecting the cocoons, preference should be given to those from a healthy stock, which are or appear to be the finest. After the moths emerge, those which seem at all diseased should be carefully eliminated, and the others coupled and deposited on little squares of linen or calico suspended so that the insects cannot crawl from one to the other. As soon as the fecundation is terminated, the male is imprisoned by closing with a pin either one corner of the cloth or a little tuck previously made at the lower edge. After the deposition of the eggs, the female should be shut up in like manner, and the whole should be kept in a dry, well-ventilated place, submitted to all the variations of the exterior temperature. Nothing remains further than to examine the moths for corpuscles, a proceeding to which the entire winter may be devoted, as it can be done just as well when the moths are dried. The examination is accomplished by grinding one or both of the insects on a cloth, in a mortar, with the quantity of water necessary to obtain a thick paste. A minute drop of this is placed beneath the microscope and examined rigidly. If any corpuscles characteristic of *pébrine* are recognised, the whole batch of eggs on that cloth are at once destroyed, and so on through all, keeping only such eggs as are entirely free from infection.

Flacherie is a disease more alarming than *pébrine*, because it attacks at the end of the fourth age, after the rearing is accomplished, and when the cultivator expects soon to realise the fruits of his outlay of time and money. Within a few days every worm dies, leaving at the foot of the shrubs, which it had been hoped would be covered with cocoons, nothing but a mass of infected bodies. The malady is either accidental or hereditary, and may be caused by careless sanitary measures, in the conservation of the eggs, during the rearing, or more frequently by feeding on a leaf of bad quality. The hereditary transmission is only to be guarded against by careful selection of the moths which are to furnish the eggs for the crop of the following year; and those attainted, after a little experience, can easily be recognised by their lack of vigour and the slowness of their movements. *Flacherie* might almost be described as silkworm cholera. It is dreadfully infectious, and the discharges of a diseased worm having dried upon a net or tray will communicate the infection to a batch of healthy worms, if that net or tray be again used in the feeding. The only method to be adopted when the disease has once made its appearance is to stamp it out, by destroying at once all the worms in the infected or suspected tray, and burn trays, nets, and everything that such worms have even touched.

This *flacherie* is the disease most to be dreaded in this country, for many of the causes of it are such as may happen here. Damp air and insufficient ventilation in the magnanerie, improper food (that is to say, mulberry leaves that have become heated, or have been given to the worms wet) electrical disturbances in the atmosphere, such as sudden thunderstorms; but the cause most likely to produce the disease in this country will in all probability arise from over-crowding the worms, for inexperienced rearers are apt to forget that, although in the second age, 16 square feet are sufficient space for the worms from one ounce of grain; at the last age, before mounting, 200 feet are required for the same number of worms, and the growers hesitate about destroying healthy young worms for no other reason than to thin out and make room. But with care, and in magnaneries prepared for rearing to produce grain only, there is no reason that the disease should ever obtain a footing in this country.

Little need be said about the magnanerie; an equable temperature, thorough ventilation, and a complete command of light and draughts, are the necessities, a cool dry cellar or out-house to keep the leaves in, and the requisite number of trays and nets complete the absolute requirements. A room in a house, an out-house, or a barn can be easily adapted to do service; costly magnaneries are not required for rearing grain only, and a small beginning would, in this country, be more desirable than a large expenditure for plant. A single individual introduced this industry into California, and the account of it is reported by Mr. Baldwin, United States' Commissioner. To the efforts of the late Mr. Prevost, a gentleman residing near San Josè in California that State is mainly, if not entirely, indebted for the introduction of this great industry. He was its earliest pioneer, and a perfect enthusiast in its cause, not sparing himself, his time, or his money, in promoting its advancement. Like all new undertakings, this, too, had many difficulties to contend against, and many prejudices to overcome. "When I want to hatch my eggs," writes Mr. Prevost, "I simply take the papers on which my eggs are from my cellar to my garret, and there the heat caused by the sun through the roof makes them hatch promptly, which they generally begin to do on the third or fourth day." Then commences the real business of the silk-grower, the feeding and careful management of the worms.

When it is ready for spinning the cocoon the worm ceases eating, and is observed to move about uneasily, and trying to ascend to carry on its spinning; its neck, too, becomes wrinkled, and its body soft. It is now necessary to prepare some place to which the cocoon can be fastened. Boughs of willows or other small bushy twigs are used for this purpose, as is also straw. The cocoon is generally spun in four or five days; and in six or seven days after this—that is to say, in about six weeks from the time of hatching—the cocoons are gathered, and such of them as are not required for hatching purposes are exposed to the rays of the sun for four or five days, until the chrysalis inside is killed.

Whatever eggs are required for use the following year or for sale, must be produced from the moths which emerge from the cocoons. Before destroying the chrysalis, it therefore becomes necessary to calculate what quantity of eggs will be required, and, as a basis for doing so, it is said the female moth lays 400 eggs; there are 40,000 eggs to the ounce, which will therefore require 100 pairs of moths for production. The best cocoons are always selected for this purpose—such cocoons as are large, firm, and bright in colour. They are selected, too, in equal numbers, male and female—the former being easily known by their smallness, length, narrowness, and sharp-pointedness at both ends—the female being larger, rounder, and more like an egg in shape. Having been first stripped of the outside floss, the cocoons are next laid, in single layers, in open paper boxes or baskets, and then put away in some dark, warm, but airy place. About the twelfth day after the cocoon has been formed, the moth emerges from it; the male generally appearing first, and being known by its smaller size and the fluttering of wings; the female is larger and seldom moves. If the eggs be of the annual variety, the papers on which they are laid are deposited in tin boxes perforated with holes; the lids are carefully fastened, and the boxes put into some dry, cool place, and there kept until the following May. This is the plan adopted in California.

We have yet to learn how this rearing promises to be an aid to thrift. Let us suppose that the mulberry leaf is to be procured in sufficient quantity:—

The cost of one ounce of the best grain, would be (say)	£2	0	0
16 cwt. of leaves at 10s. per cwt.	8	0	0
Labour, other than that of the educators for 6 weeks (say)	8	0	0
Sundry petty expenses	2	0	0
	£20	0	0
An ounce of grain is 38,000 eggs; therefore 19,000 couples of moths, or with 5 per cent. off for failures or loss, 18,000 couples, should produce 7,200,000 eggs or 190 ounces, which at 20s. per ounce =	£190	0	0

The difference between £20 and £190 has to remunerate the management and educators for capital, expenditure, and services, and would prove the aid to thrift already referred to.

It may be argued that this profit is enormous, and if it could be ensured that everything would go exactly right, no doubt it would be enormous, but there are many casualties that happen, that are in themselves preventible, but which still do happen, and materially alter the figures given; rats, mice, birds, spiders, ants, wasps, and even cats destroy the worms when they get the chance. Again, the neglect of attendants will often produce serious and irremediable mischief, and unless constant and careful supervision be exercised indefatigably, the figures will alter their proportions so seriously as to be no longer an aid to thrift. But the figure which governs everything is the price at which an ounce of English grain can be sold. I have taken it at 20s. At the present time that of the old Italian races would readily, if free from disease, command 30s. or more. Mrs. Neill stated that orders were to be had for quantities of 3,000 ozs. at 25s. two years ago, that is before the late failure. Messrs. Arles Dufour and Co., write from Lyons with reference to next season:—"Holders are firm, and base to a certain extent their confidence on the unfavourable prospects of the next European crops. Native seeds are indeed scarce, and their quality doubtful after this season's failure."

It must be remembered that the class of rearers

I have alluded to would probably be able to educate from ¼ to ½ an oz. only, not having the accommodation for more. I cannot do better than give in this paper an extract from the *Daily Telegraph* of 11th January, viz:—

> "Yesterday the South-Eastern Railway Company conveyed from London *via* Folkestone and Boulogne, *en route* for Milan, 948 cases of silkworms' eggs, weighing 26 tons, 11 cwt. The eggs were imported at Liverpool from Japan."

And the last report from Yokohama gives the settlements of grain to date at one million cards, with a remaining unsold stock of 150,000 cards, almost entirely held by a Japanese bank. The price was firm, at 1·50 dols. per card.

DISCUSSION.

Mr. David Chadwick, M.P., said he felt great interest in this subject, having been connected for many years with the Silk Supply Association, and having worked with Mr. Cobb in his investigations into silkworm culture. He made a very interesting but in no way exaggerated statement, which embodied facts which the industrial classes in our country districts ought very seriously to consider. It was no doubt a fact that silkworms' eggs could be produced in all districts where the leaves for their food could be produced. He had recently returned from America, where he saw the eggs and silk produced in California; and two years ago, when visiting that country, he saw many varieties of the silk produced there. Some samples he had brought to his constituents in Macclesfield, and they were stated to be of a most excellent kind. There was no doubt that California could produce silk to almost any extent; but the rush of prosperity there was so great as to drown the plodding, untiring industry required in its cultivation. You could not have acres of leaves produced with a few years' cultivation, and you could not bring to the cultivation of the silkworm that care and manipulation which was required; consequently, although the soil and climate were exceedingly suitable, there had been many failures, though, at the same time, many successes. The facts now brought forward, however, were meant to encourage the propagation of silkworms' eggs in this country; and on making inquiries in California, he found that, from various causes, it was not considered advantageous to produce the silk; and where the cocoons were produced, it was difficult to get labour sufficiently cheap to reel and prepare the silk for the American or European markets. But Mr. Cobb had thrown a new light upon this question, which coincided with what he had heard in California, where he found the people had directed their attention to the production of eggs, and were exporting them to Italy, and even Japan. It occurred to him that the labours of the Silk Supply Association during many years might be briefly epitomised by saying, "Do not attempt in England to reel silk, but produce the eggs. Put them on cards, keep them healthy, and you will have a profitable result." The paper, therefore, was calculated to do great good if disseminated in country districts, especially in the south, In Cheshire there were thousands of mulberry trees, and if it only encouraged the cottagers to utilise these trees for silkworm cultivation, it would do a large amount of good, and he believed would be the most practicable step towards extending the cultivation of silk throughout the world. He feared that all efforts to produce silk in this country would be financially unsuccessful, but he had a firm belief that if the plan suggested by Mr. Cobb were carried out, it would be attended with profitable results.

Mr. Freeland remarked that, on the last occasion when this matter was brought forward in that room by Mrs. Neill, he had recommended the production of silkworms' eggs, and planting of mulberry trees by cottagers in order to supply food. Even in his own family he had seen a certain number of eggs produced every year, as a matter of amusement; and they occasionally had the silk reeled; and he had seen very beautiful samples obtained by some young ladies in his neighbourhood. A year or two ago, when about to repeat a lecture he had formerly delivered on the silkworm, he heard from Mr. Mason that he should shortly be in a position to state decidedly whether or no he considered that silk could be profitably produced in this country. His own impression had always been that healthy eggs could be produced for the purposes of export, and that they could be produced profitably, and, in the case of cottagers, with very little expense. In this way he believed a good deal could be done to keep up a supply of eggs from healthy parents. When this was last discussed, he read an interesting letter from the late Lord Lytton, which would be found in the *Journal* of the Society. The calculations he made as to the profit which could be made by rearing silkworms showed a very large profit, being about £15 an acre; but he stated that he had taken up the subject in order to amuse his daughter, and on her death his interest in the experiment died out. He was happy to say, however, that he had recently heard of the trees imported by Lord Lytton having been handed over to some ladies, who were going to carry on the experiments as far as possible.

The Chairman, having drawn attention to some articles produced from Australian silk, and to cocoons and eggs reared in this country of a very fine description, said he had devoted a great deal of attention to this subject for many years, and had watched the progress of the Silk Supply Association, and the work done in Australia and California, with the deepest interest. Not less than £2,000,000 per annum was paid to China and Japan for silkworms' eggs. It was well known that the diseases, to which reference had been made, had destroyed nearly the entire crop in France and Italy, and the whole world was now looking for a fresh race of worms from other sources. M. Roland had taken a leaf out of the book of nature. It was believed, from the researches of Pasteur and others, that the disease had been generated very much by the filthy homes that these silkworms had been reared in, and by in-and-in breeding. M. Roland, who was an emminent chemist and philosopher, had gone back to nature, and his silkworms, instead of being reared in unhealthy homes were reared on trees in the Alps, where they were subject to the alterations of an Alpine winter. This was following out the rules of the Spartans, by which the weakly children died off and left the healthy ones. M. Roland had educated these silkworms for many years, and only bred from the healthiest and strongest race, submitting them again to the elements, and the consequence was he had produced a healthy and splendid race of silkworms. These had been exported to Australia, where the silkworm flourished to a degree he could hardly venture to describe. The climate was very favourable to the growth of the mulberry tree, which produced an amount of food of such a healthy character, that finer worms had been produced there than anywhere else. These had now been introduced into this country, and several persons had been engaged in rearing them. On the previous day he had received a letter from his brother in Australia, acknowledging the receipt of some silkworms' eggs he had sent out, reared from Australian eggs in this country, and he pronounced them equal to any he had ever seen. This was more encouraging, because it was quite clear from all experience that it was not practicable to grow silk in this country to commercial advantage. But they had heard, from figures which could not be contradicted, that a large industry might be made with very little trouble, which would enrich many of the cottagers and poor gentlefolks, by rearing silkworms' eggs for export to the silk-growing countries. They imported fresh eggs every year, and it was immensely important to them to get a pure healthy race, rather than be subject to the destruction which had taken place of late years. Now it was quite possible that England could produce a large quantity of the eggs necessary for this trade, and it would be an industry which would materially enhance the wealth of this country, for the benefit of the poorer people. School children might earn much more than the cost of their schooling, and it was only for about 30 or 40 days that the worms required close attention. Owing to improved methods, instead of only having one race every year, his brother was able to have as many crops of silkworms' eggs a year as the climate would produce food for; the eggs being hatched by artificial heat at any time of the year. There had been great difficulties in bringing eggs from tropical to temperate climates, and the climate at the Antipodes being the reverse of that in England, Christmas falling in Midsummer, if the worms were sent over here to be reared, it would be necessary to keep them in ice, which was very prejudicial to them. By the means now adopted, however, the eggs could be sent here, and other eggs sent back without fail. It was not four months since he had sent out cocoons and eggs to his brother, and he had now heard of their safe arrival, and that many of the eggs had been hatched and were doing well. It was quite clear that it was better to send the eggs to France and Italy than to attempt to grow silk, and he hoped, therefore, that Mr. Cobb's paper would be circulated through the rural districts, and lead to a general utilisation of such mulberry trees as there were, and the cultivation of others. He thought Mr. Cobb had rather understated the amount of profit, because the expense was put at the highest point, and only 20s. per ounce was allowed for the grain, when he believed orders could be got for any amount at 30s. to 40s., or even more. Mrs. Neill's young ladies had been utilising some of the Australian cocoons, which Mr. Brocklehurst had been kind enough to spin and reel, and on the table might be seen some of the products of the establishment in Charles-street. He concluded by moving a cordial vote of thanks to Mr. Cobb, which was carried unanimously.

Mr. Lawrence asked if the spoiled cocoons produced by the 18,000 couples of moths were not of some value. He should think they were worth some £3 or £4.

The Chairman said they were worth 2s. to 3s. a pound.

The Secretary said he believed the specimens on the table were produced from these very spoiled cocoons. It was obvious that the cocoon from which the moth had come was spoilt for reeling, and the object of this association was to make use of these pierced cocoons by having them carded after the manner of cotton, and spun into thread, which was worked up by these ladies into the various beautiful fabrics on the table.

The Chairman said if the cocoons were only grown for silk, the moth was killed, but if the moth ate its way out it spoiled the cocoon, but they were now macerated, carded, and made spun silk of. If parties only wished to produce eggs, they might send the waste cocoons to Charles-street, where they would be purchased at the market price of the day.

Mr. Cobb, in acknowledging the vote of thanks, said he had not taken the waste cocoons into account, because his figures were already so large, that he feared he might create some doubt as to their accuracy. The specimens on the table were produced from these spoiled cocoons, and that was one of Mrs. Neill's objects, viz., that ladies might by means of small machines at their own homes produce these useful articles from the Australian cocoons. He did not know whether the meeting understood that the seed which the Chairman had sent to Australia had been reared by himself in England, and having been sent to Australia and reported upon immediately, must have been of an extremely strong and healthy growth to have borne the voyage so well. It was reared here one season, and was sent out the reverse season, and was hatched by artificial heat out there. It certainly had not hybernated from the time it was reared, and none but an extremely healthy race could possibly produce such a result. It was quite true that two millions sterling were paid to Japan for seed sent to France and Italy, and there was no doubt if they could supply the grain that could be reared in this country, there would be no market on the Continent for Japanese grain at all, because it was infinitely inferior to what could be reared in England. It would require at least three Japanese cocoons to equal one of those on the table in the weight of silk. Messrs. Arles Dufour, in their last report, said the Japanese cards arrived later than usual, and the warm weather might considerably compromise their success. There was always a risk attaching to the importation of Japanese cards, and the reason this large amount was reported now was, that in order to decrease the risk they were sending the grain for Japan across California, in order that it might come in a cold climate all the time, instead of risking the voyage by the Red Sea. Mrs. Neill had spoken as to the importation of Australian grain to this country, but he confessed he had serious doubts about it, for the reasons mentioned by the Chairman with regard to the seasons. When the worms became acclimatised there they were hatched in the spring, and although artificial means might be used to prevent that still there was always a danger of failure attending such methods. He thought the duty of the colonists was to rear cocoons, and the experiment of Mr. Brady, showing that he could rear them at all times of the year, was an additional reason why they should do so, and not attempt to rear seed for Europe. If they could rear cocoons all through the year, they had the germ of an industry which might rival that of wool growing, for there was no limit to the consumption of cocoons in Europe provided the price was sufficiently low. The estimate of an acre of land was this. There were in the world ten times as many acres available for mulberry cultivation as for cotton, and an acre of suitable land would grow 500 or 600 trees, and each of these in the colonies, when three years old would yield 20 lbs. of leaves, which would produce one pound of cocoons. The agricultural bureau of the United States gave the highest yield of clean cotton per acre in Louisiana, at 300 lbs., which, at 1s. a pound, amounted to £15; but 500 lbs. of cocoons at 1s. 6d., which was a very low price, amounted to £37 10s. Thus it appeared that it only required the knowledge of sericiculture to be more widely spread to enable silk to compete successfully in quantity as well as quality to all other fibres.

CANTOR LECTURES.

THE HISTORY OF THE ART OF COACH-BUILDING.

By G. A. Thrupp, Esq.

Lecture V.*

There are not many books upon the art of coach-building. There is a small book in the French language by F. A. Garsault of the year 1761, which contains designs of the first improvements of the century in carts and carriages.

There is Monsieur Roubo's work entitled "The Carpenter's, Cabinetmaker's, and Coachmaker's Art," published by the French Academy of Arts and Sciences, which is a very carefully written work, with numerous illustrations; it is certainly a perfect history of the art of coach-building as it existed in the middle of the 18th century.

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* Delivered December 18th, 1876.

Nearly equal to that work is the article on carriages in the French Encyclopædia of 1770, by Diderot; both deserve study and examination, even by a modern coachbuilder. Mr. Felton's work of the year 1790 I have already mentioned; also the work on ancient Greek and Roman carriages by Herr von Johann Christian Ginzrot, of Munich; this is a charming work for an antiquarian, but contains no information useful to a coachbuilder of this time.

Dr. Richard Lovell Edgeworth published in 1817 a work upon "Public Road and Wheel Carriages," which contains much that is valuable and useful to coachbuilders, and his book should be studied carefully by every student in our art. There is in it an account of the experiments he made for the Government of Great Britain, at Dublin, to ascertain the necessary height of wheels, length of a carriage, and other important rules of coach-building.

Mr. T. H. Markland read an interesting paper on the origin of carriages to a learned society, which is published in the 20th volume of the "Archæologia," accompanied with several interesting copies of old pictures of carriages.

In the "History of Inventions," by Beckmann, is an interesting article on coaches, which has been taken as the best authority by all succeeding writers. The dates he gives are not, however, all accurate.

The next work published was, I believe, that by Mr. W. Bridges Adams, in 1837, by Messrs. C. Knight and Co., of Ludgate-street, entitled, "English Pleasure Carriages." This book should certainly be possessed by all coachbuilders who desire information as to the best method of forming and completing a good carriage. It is complete and accurate in the rules given, and the theories and mechanical principles expounded. It gives very full details as to materials to be used, and the manner of making the best use of them. Mr. Adams, who was for a time in the firm of Hobson and Co., has given a description of the different carriages used in his time, which will form a reference for future ages, as Mr. Roubo's descriptions serve for the previous century.

Since Mr. Adams' work we have a valuable contribution to the history of the art of coach-building in the treatise by the Count Giovanni Gozzadini, on "The Origin of Coaches," published in 1864, at Bologna. This work is in the Italian language; it is in the British Museum. We find in it a spirited defence of Italy from the charge of deriving their knowledge of carriage-building from France; and the author proves, from the archives of different towns and noble families, that Italy was second only to Germany in its wealth and number of carriages during the 16th and 17th centuries. Besides these, we have had the *Carriage Builders' Art Journal*, which commenced in 1859 and lasted for four years, a journal which reflected great credit upon its editor, and is full of information still worthy of our study; the *Art du Carrossier*, published at Paris; two American periodicals; and the *Saddlers' and Coachbuilders' Gazette* in London.

The carriages of America are so different from our own, and from those of Europe, that they require special attention. It is possible that their style may influence in an important degree the carriages of future ages. We see in them, primarily, "lightness." That lightness in their larger carriages is carried to excess, most coachbuilders will agree. We are supported in this view by the fact that for some years these, such as landaus, broughams, and coaches, have been materially modified by European types. The Americans have adopted some of the shapes of Europe, and the mode of constructing the under carriages, retaining their own methods of making the pole and splinters, or whipple trees, as giving greater freedom to the horses. I think this principle of allowing the horse greater scope for exertion is particularly worth the attention of coachbuilders. The manner in which our horses are confined by tight heavy strapping and traces, by tight pole chains, by bearing reins, and the indiscriminate use of blinkers to the bridles, has been much overdone in England. If a horse, with a heavy load, and driven fast over slippery roads, should stumble, it is most difficult for him to recover himself—he falls, and is sometimes pushed along by the impetus of the carriage, and is more or less injured in his limbs or nerves by the accident, whilst it is difficult for him to rise again, until the harness is unstrapped, and the carriage is removed from above him. We also harness our horses too closely to their work in the two-wheeled carriages. We have thought only of the ease of turning and moving the whole vehicle in crowded or narrow ways, without observing the advantage of the long shafts over short shafts. If the shafts are considered as levers, by which the horse supports and moves the weight behind him in a two-wheeled cart, it will be at once obvious, that although (whilst those levers are parallel with the road) it does not so much signify whether they are long or short; yet the moment they point upwards, and especially when they point downwards, the difference between long and short levers is felt severely by the horse. We can all of us lift a weight or support a weight more easily with a long lever than with a short one, and it is the same with a horse. Those who have travelled abroad must have noticed the great weights placed upon two-wheeled carts in France and Belgium, and the greater comparative distance at which the horse is placed from the wheels, and yet how little the horse is distressed. He manages his load more easily because he does not feel the weight so heavily upon his back. Many drivers in England seem to have observed this, and try to ease the horse and lessen his chance of stumbling by tipping the shafts up in front, but in this way the horse is made to feel a pressure on the under part of the body which is neither natural nor healthy. I think, therefore, that in future years the growth of public opinion will be in favour of longer shafts and poles. This will also tend to preserve good carriages from the damage they at present suffer from the heat of the horses, and the quantity of mud which is thrown by their heels upon the front of the vehicle. The reins will of course have to be longer, but this cannot be of much consequence; the driver of a brougham is further from the horse than the driver of a mail phaeton, but we do not consider that the brougham is more difficult to drive than the mail phaeton on that account.

Another fashion prevalent in this country, and some others, may prove, in the opinion of the drivers of the future, to be a fallacy; I mean the supposed necessity for the driver to sit nearly upright, which necessitates a deep boot and a clumsy, thick coachman's cushion. In America, Russia, and in parts of Germany, the driver sits low, but places his feet against a bar in front of the footboard, which in their carriages is longer than in ours. I have seen four horses driven very well and easily in a low landau, and very powerful, fast-trotting, pulling horses held in with apparent ease. It has seemed to me that our coachmen are often in danger of being pulled over by their horses; and certainly, when an accident happens in a collision, they are easily thrown from their boxes. They do not have the purchase and security that the Russian drivers especially seem to possess.

Perhaps we shall learn from the American carriages a few useful hints in this respect.

The American carriage, called, I believe, a "rockaway," has a projection over the driver's seat, to shield him from sun and rain. Some of the Asiatic carriages have an awning for the same purpose. In Italy travelling carriages often had a hood over the driver. In instances where the master of the household likes to drive his own family carriage, it would certainly add to his comfort, and that of any one sitting by him, to have some useful addition of this nature.

The greatest novelty introduced by the Americans of the United States is the light waggon, called also "buggy," a name first given in England a hundred years ago to a light two-wheeled cart carrying one person only, and which we call a "sulky." These American waggons were modelled from the old German waggon, but they have been so much improved as to be scarcely recognised. The distinctive feature of the German waggon was a light shallow tray, suspended above a slight perch carriage on two grasshopper springs, placed horizontally and parallel with and above the front and hind axletree; on the tray one or two seats were placed, the whole was light and inexpensive, and well adapted to a new rough country without good roads. These waggons may still be found in Germany and Switzerland. They were doubtless formed as a development of the V-shaped agricultural waggon already described in the second lecture.

The American ingenuity was lavished upon these waggons, and they have arrived at a marvel of perfection in lightness; the two grasshopper springs have been replaced with two elliptical springs. The perch, axletrees, and carriage timber have been reduced to thin sticks. The four wheels are made so slender as to resemble a spider's web; in their construction of the wheels the principle of the patent rim used in England in 1790 has been adopted. Instead of five, six, or seven felloes to each wheel, there are only two, of oak or of hickory wood, bent to the shape by steam. The iron work of the American buggy is very slender, and yet composed of many pieces, and, in order to reduce the cost, these pieces of iron are mostly cast, not forged, of a sort of iron less brittle than our cast iron. The bodies are of light work, like what we call cabinet work. The weight of the whole waggon is so small that one man can lift it upon its wheels again if accidentally upset, and two persons of ordinary strength can raise it easily from the ground. The four wheels are of nearly the same height, and the body is suspended centrally between them. There are no futchels; the shafts or pole are attached to the front axletree bed, and the front of the pole is carried by the horses just as they also carry the shafts; the splinter-bar and whipple-trees are attached to the pole on swivels. Some are made without hoods and some with hoods. The hoods are made so that the leather of the sides can be taken off and rolled up, and the back leather removed, rolled, or fixed at the bottom, a few inches away from the back, the roof remaining as a sunshade. The leather work is very thin and of beautifully supple enamelled leather.

The perfection to which the American buggy or waggon has been carried, and every part likely to give way carefully strengthened, is marvellous. Those made by the best builders will last a long time without repair. The whole is so slender and elastic that it "gives"—to use a trade term—and recovers itself at any obstacle. The defect in English eyes of these carriages consists in the difficulty of getting in or out by reason of the height of the front wheel, and its proximity to the hind wheel—it is often necessary to partly lock round the wheel to allow of easy entrance. There is also a tremulous motion on a hard road which is not always agreeable. It is not surprising, however, that with the great advantages of extreme lightness, ease, and durability, and with lofty wheels, the American waggons travel with facility over very rough roads, so there is a great demand for them in our colonies. It must be remembered that the price is small, less than the price of our gigs and four-wheeled dog-carts. This cheapness is attained by making large numbers to the same pattern, by using cast-iron clips and couplings and stays, by the use of machinery in sawing and shaping, grooving and mortising, the timbers, and by the educated dexterity of the American workman, always ready to adopt any improvement. An educated man will make a nimble workman, just as an educated man learns his drill from the military instructor more quickly than a clown. And an educated man finds out the value of machinery and desires to use and improve it. Instead of fearing its rivalry he welcomes it; he remembers that all tools, even the saw and the hammer, are machines, and that the hand, the human hand that guides those tools, is but a perfect machine obeying the guidance of the brain more quickly and in a more varied manner than any man-made machine. The American workman therefore uses machines more and more.

In England, machinery for wood-shaping is used at Derby, Newcastle, Nottingham, Worcester, and other towns; and in Paris some beautiful machinery is at work in coach factories. In London, I believe, it is chiefly confined to patent-wheel factories. We use also a few steam-driven saws, some paint-grinding mills worked by hand, and drilling and punching machines. But until the use of machinery is adopted more generally in London, it is probable that the trade of building carriages for export will drift more and more to the provinces and to the Continent. The saving of machinery in omnibus and cab building would be great, because the patterns vary so little, and all other parts of one carriage could correspond with another, and counterchange when repairs were needed.

The coachbuilders of the future will look to steam and hand machinery as their great assistance in cheapening the cost of first-rate carriages, in multiplying them for the probable increased demand, and also to build carriages more speedily. It now takes from two to three months in building a brougham, of which at least five weeks is consumed simply in the wood and iron work, a period which by machinery might easily be shortened.

With regard to the American waggons, they are so completely a carriage of themselves, there is so little to work upon, that we do not look for great beauty; that each of its parts should be gracefully shaped must be sufficient. The shape is conventional, there is no great opportunity for style.

The larger carriages of America, however, in which there is plenty of room for style and grace, are, to an European eye, deficient in both. The extremely ugly straight and abrupt lines of the upper parts of the bodies, the wriggling, uncomfortable sweeps of the lower parts, the want of proportion, the scanty room for the legs of the passengers, must astonish all who have seen the carriages of other countries. American wheeled carriages seem to say, "We are made for lightness, and nothing else." On the sledges, however, grace, comfort, and elegance seem to have been lavished, and, to use an American term, "pleasing lines" and sweeps abound in the sleigh.

In all carriages the proportions of the different parts, to please permanently, must harmonise. If at one time the fashion of the day is for deep quarters, and deep rockers, and very shallow panels, it is certain that the eye of the man of taste will sooner or later correct this, and return to the proper depths of each. If at one time the wheels are too high, a Hobson will arise and cut them lower. If the curves grow too rampant, and the scrolls and foliage too abundant, a more cultivated taste will modify all this sooner or later. It is certain that our American cousins will alter the shapes of their larger carriages, and continue to improve them. In Australia—where the admiration for American and English carriages is nearly equal—there are native carriages built which, we are told, combine the lightness and durability of American carriages with the grace and comfort of English carriages. It may not be so yet, but it is cheering, at any rate, to hear of the attempt, and all true lovers of the craft must rejoice if it succeeds.

In America the principles of draught have been carefully considered and discussed in a magazine specially published for coachmakers, and which magazine does the greatest credit to its able editor, Mr. Ezra N. Stratton, of New York; it is beautifully illustrated, and is full of information for all branches of the craft. There is another magazine in the same city called the "Hub," edited by Mr. George Houghton, who visited Europe to see the recent display of carriages at the Exhibition at Vienna and London in 1873.

The principles of draught are in these works first set out with reference to the sledge. We are told that, from long experience, it is found that if the traces are attached to the sledge so high that the trace is horizontal or parallel with the ground, and the sledge meets with any obstacle in a rough track, that the runners will bite into the obstruction, so as almost to stop the team, but that if the traces are fastened lower, so as to form a straight line from the horse's collar to the hind end of the runners of the sledge, that they will lift, as it were, at the obstacle, and glide easily over it. This theory appears quite correct. It is more readily discovered in a sledge than in a carriage upon wheels, but the principle is the same in each. Again, if the runners project in advance of the sledge, it follows easier than if they begin to turn upwards beneath the weight of the sledge. This in wheel carriages is the same as if the weight of the carriage is mostly on the low front wheel, instead of upon the higher hind wheels.

In the New York magazine we are asked, "Why will a team haul a load on a vehicle of four wheels easier than the same load upon two wheels?" and "Why will a team haul a load in a circle, which they cannot move straightforward?" The obvious answer is, that the same load presses on the ground in two places heavier than it does upon four places, and secondly, that when moving in a circle, the obstacles are less felt by the inner wheels than by the outer. But the magazine gives further ingenious reasons. When a load is resting upon a two-wheeled vehicle, it is very seldom placed so as to balance just right. If correct for level ground, as soon as it ascends a hill, or descends, the balance is unsettled. When the wheels come to a hole, or a big stone, all the load must be raised with two wheels and only half when on four wheels. Again, an uneven road twists the horse that is between the shafts from side to side, when the load is on two wheels, more than when, on four wheels, the fore-carriage rotates on the perch-box. Again, on an incline the four-wheeler moves by its own gravity, whilst the two-wheel gives additional weight at once on the horse's back. To the second question the magazine writer remarks that an experienced driver takes his load up hill zigzag, and not straight, and what is lost in time is gained in power. On the question of the height of the splinter-bar and whipple-trees, he gives his experience of twenty years that they should be, as a rule, a foot below the point of traction at the horse's collar. He explains the advantage of splinters (like our leading-bars) for all the horses of a team, and not only the leaders, to be this—that if one horse is lazy, then the others draw their bars forward, and, consequently, his bar going back brings his traces tight again.

With reference to the method of attaching the horses close to their work in England, and some distance from their work on the Continent, I wish to have it understood that I do not consider the Continental custom absolutely superior to the English custom, but I consider we might adopt a middle course with great advantage to the horses and passengers. It is certain that on the Continent the horses have, in many instances, their traces too long, as it is that we have them often too short.

There has been much controversy about the difference in the length of the front and hind axletrees. It has been usual to make no greater difference than will allow the higher wheel to follow in the same track as the lower wheel. In France, however, it has been the practice, from the year 1846, to make the front axletree of broughams six inches shorter. The object has been to allow the front wheel to be placed nearer to the body. As the front wheel of a brougham must turn entirely in front of the body, the additional gain of three inches was very desirable. Some English coachbuilders have followed the example of the French. There is a decided gain. The eye is pleased with the proportions. The horse is eased, and upon hard roads the difference of trade is of no consequence. On the other hand, in country roads, the well-worn ruts make the running of the carriage uneasy, whilst in town the driver often forgets that the curbstones will strike his hind wheels sooner than the front wheels, and lastly more mud is thrown upon the panels. It is probable that the French style will not find favour.

In coaches built in 1750 it was customary to lower the hind part of the inside seats about two inches, by degrees this was changed to a level seat; recently the seat has been again lowered behind, and the back squabs made more upright than formerly. The height of the top of the cushion to the bottom of the body has varied during the same period from 14 to 18 inches. These slight changes belong more to the taste of the individual who uses the carriage. It is useless to lay down any general rule on these subjects.

If carriages had always to move along perfectly smooth roads, such as a tramway of wood, iron, or stone, the use of wheels in overcoming friction would be their sole utility, and the height of the wheels would be of small consequence. But as carriages are drawn along roads with loose stones and uneven surfaces, wheels are further useful in mounting over these obstacles, and it is plain that a high wheel does this more easily than a low wheel. To demonstrate this, let us suppose a shallow ditch or gulley of a foot wide and 2 inches deep, a wheel 2 foot high would sink into this and touch the bottom, but a wheel 3 ft. high would only sink an inch, and a wheel 4 ft. 6 in. high would sink only half an inch, on account of their greater diameters. Consequently, whilst the large wheel would have to be lifted by force of pulling only half an inch, the smallest wheel must be lifted two inches, and with the wheel must also be lifted a portion of the load of the entire carriage. Again, the long spoke acts as a longer lever, the point of draught being the axle, which is higher from the ground in the higher wheel, and again assists in overcoming the obstacle, as the angle of incidence is so much less.

That the leverage power of a high wheel is very great, we need only consider the advantages gained by a large wheel in locomotives and in bicycles. In practice, however, we find wheels from 4 ft. to 5 ft. sufficient for large carriages, from 3 ft. for ordinary vehicles.

The present method of constructing all wheels which have to carry considerable weight will doubtless continue to prevail. The timbers of which they are composed, viz., elm for the stocks, ash and hickory for the rims, and oak or acacia for the spokes in Europe and America, have been found the best for many years. Wheels of the present make must also be dished. The tendency of a wheel is always to become upright, and when it so becomes by the gradual hammering out of the tyre to a greater length, and the gradual sinking of the spokes further into the nave and rim by wear and tear, then the wheel goes to pieces. If any one will watch the manner in which the materials of a mop become straight as it is twirled round he will understand that the same centrifugal force compels wheels to become upright. Secondly, as a wheel runs along a road it is forced from side to side by the uneven surface, the uneven draught of the horses, and the rapid motion, which latter frequently causes the wheel to jump over the road instead of pressing equally over all its circumference. Then we dish our wheels, not only to keep the tyre tight as long as possible, but also to resist the lateral thrust, which in a perfectly upright wheel would soon force the spokes out of the naves. There is one exception to this rule in the American spider wheel; in this the spokes are not larger than a man's finger, and being of elastic wood, bend like a reed under the lateral thrust, and recovering themselves again will endure, whilst the unbending oaken spoke would be unrooted.

The late Lord Palmerston, whose vigorous common sense grappled many a problem which would be supposed quite out of his line, was fond of talking about carriages. He considered that wheels should have the spokes dished, but that the arm of an axletree should be nearly straight, so that the outside rim of the wheel should be upright; and would illustrate the soundness of his views by quoting the wheels of artillery waggons and pony phaetons. It became necessary to remind his Lordship that we pitch the arms of the axles for two reasons; first, in order to keep the box of the axle pressing against the strong shoulder instead of against the weak linch-pin; and secondly, because the wheels, when they are wider at the top of the tyres than at the bottom on the road, will throw the mud away from instead of into the carriage or on the panels.

There is no absolute rule for the dish of the wheel or the pitch of the arm of an axle. Experience and custom point out to a builder what is best for different carriages and different countries. It is sufficient to say that a spoke two feet in length will last longest when not dished more than its own width in its length, and that the pitch of the axle arms, to ensure, chiefly, the duration of the wheels, should not be more than will leave the spokes pointing towards the ground not upright, but narrower at the naves than at the rims by three-quarters of an inch if the spokes are two feet long. This rule is simply for the duration of the wheel as long as possible, without reference to any other consideration, which the coachbuilder, however, may find over-rule what I have said. If the axles of a carriage are rather stronger than is necessary—having regard to their length between the shoulders, and the weight they have to carry —it will be found to have a considerable influence upon the carriage, which will follow more steadily and quietly for the additional strength.

I do not propose to enter in this series of lectures at any length upon the subject of springs. I think we are far from having attained perfection either in the manufacture or shape of springs for carriages.

It may have been remarked that the first springs were all elbow springs, placed in different positions however for different carriages. A double elbow or horizontal spring of a length of four feet seems to give the most easy play of any shape, and if made nearly straight at first, wears little in the course of time, if compared with the elliptical shape.

In perch carriages we have abandoned the nearly upright spring, for the C spring, chiefly because the C spring is of a more elegant shape, and also resists wear better than the elbow or whip spring, which was found to break away from its supports.

In elliptical springs, the action of the steel plates is precisely contrary to the action in the C spring; in both, the back plates is similar in shape, but the shorter plates in the C spring are on the inner side of the curve, and in the elliptical they are on the outer side of the curve. A careful consideration of the effects of this variation may lead to a new combination which will be more satisfactory in its results. The elliptical springs made by Hobson were doubly compassed, and the same shape may be seen on some of the public omnibuses. A carriage may be hung to be very easy, by using double horizontal springs, one under the other. At the Exhibition at Brussels this year, the most easy hand ambulances on wheels were constructed in this manner.

In one elliptical spring you do not have the advantage of two horizontal springs, because the ends are in the elliptical spring united, and if a coupling is substituted at the hind end, it is found in practice difficult to keep it upright.

Mr. Adams in his work on "Pleasure Carriages," considers it a mistake to hollow out each steel plate of a spring. I am quite of his opinion that this process of hammering leaves the inner surface of a steel plate very uneven, thereby harbouring moisture and dirt, and rendering the plate liable to fracture. I should recommend, on the contrary, that each plate should be ground or filed quite smooth on both sides. If careful tempering were generally the rule among coachbuilders, I am convinced that there would be fewer broken springs, and less complaint of rust accumulating between the plates.

The use of brake retarders to the hind wheels has now for some years superseded the use of dragshoes. It is evident that the action upon two wheels is better than on one only; the brake can be applied or removed without stopping the carriage, which had to be done with the dragshoe; and the brake can be relaxed in its hold in an undulating country, and the horses can proceed at speed up the next hill, without the check formerly necessary, whilst the drag-shoe was removed.

The brake was invented very early, and was in use in the coal trucks upon the first tramways in Northumberland, long before steam was used to draw them, Brakes are now of two sorts, screw brakes, which are used on railways in England and all sorts of carriages on the Continent, and the old lever brake, which was the original form, and which is still the favourite among English coachmen. In Scotland the lever handle is often superseded by the treadle, or foot-brake, which has been selected by the General Omnibus Company.

In deciding upon the exact size and shape of the details of the brake, a coachbuilder is necessarily guided by the shape of the vehicle to which it is to be applied. It is necessary, however, to attend to the following points; the lever arm that presses upon the rim of the wheel should be short, both for quick action and also for strength. The handle should be long, that the coachman may have greater power in applying the brake. The whole of the handle and the connecting-rod irons should be made somewhat weak to allow a little spring in them. If they are made too strong they will be rigid, and not fit with and favour the motion of the carriage and play of the springs. If a quick action is desired, the inner half of the levers on the wheels should be short, or long if a slow action is preferred. The blocks which press upon the wheels have been variously made of cast-iron, wrought-iron, brass, wood, and india-rubber, and leather. The wood is the best for hold on the iron tyre and absence of noise and smell, but it wears out fast. India-rubber, especially for light carriages, seems most satisfactory.

The use of the brake is very much overdone on the Continent, especially in Germany, and it is put on for such slight declines that the unfortunate horses are always kept up to their collars, and never get the ease that we give them going down hill.

There is an error which is deeply rooted among coachbuilders and the public in general who use carriages, which consists in the idea that the draught is diminished by placing the front part of the carriage as far back as possible. Intelligent men who have thought on the subject, and watched the actual working of this idea, have long been convinced of the error, but much remains to be done to convince everyone of its fallacy. We have already seen that with large wheels the draught is less. If, therefore, a load has to be placed on a four-wheel vehicle, it should be placed in relation to the front and hind wheels, so as to place the heavier part of the weight upon the higher wheels. To obtain this result, it is sufficient to bring the hind carriage part as far under the body as it will work with comfort and safety, in order that as little weight as possible rests on the fore carriage part. English coachmakers have been working at this for thirty years, but for the most part blindly. They have copied well-known builders in construction as well as shape; they hear that these well-known firms' carriages run and follow very lightly, and if they would copy accurately they would obtain the same reputation. One firm should be specially mentioned as having for years been careful to build carriages to run lightly. As long ago as 1846, Messrs. Laurie and Marner brought the hind wheel of their carriages well forward, and advanced the position and raised the height of the fore wheel, thus balancing the weight properly, or rather as properly as the shape of the landau and barouche will allow.

There are many carriages, however, such as stanhope and mail phaetons, omnibuses, waggonettes, and pony phaetons, in which it is easy to advance the hind wheel, so as to carry the principal part of the whole weight of the body. This has been done, but then many persons have erroneously imagined that the carriage followed the horse easily, not because the weight was on the higher wheel, but because the wheels were so near together, and they have pressed the coachbuilder to keep the front wheels backwarder, instead of rather placing them forwarder, as they should have done. In the stage coach we see a conspicuous example of this great error, and some of the drags more recently built are the worst. If the roads round London were not so good as they are, or if the roofs of drags were loaded with luggage, we should hear of more accidents to the summer amateur coaches than we do at present. Most of the weight of the stage coach, or drag, is upon the front wheel, which is much the lowest, and it is so far back under the body that if the horses gallop the coach begins to swing, and a very small obstruction is sufficient to upset the whole. Compare this with a similar load upon an omnibus, with four horses at a rapid pace on a bad road. The comparative security and safety of the latter vehicle is at once apparent. If a coach and omnibus could be fairly tried together, it would be found that the omnibus with three horses could beat the coach with four horses, besides doing its work with much greater safety, and turning in a much narrower road. It is right to mention that the idea, or a great part of the above, has been contributed by a foreign coachbuilder, in whose views I entirely concur. It would be easy to make a stage coach as safe and nearly as light running as an omnibus, by making it with much higher front wheels and carrying them forwarder. If it is considered essential to be able to turn in a narrower road, it would be easy to cut a small arch in the boot, which would allow the wheel to turn as far as the perch.

You are, some of you no doubt, aware that drag coaches are made with the front wheel so far back in order to bring the horses close to their work, to use the phrase that has been much misapplied, and also to bring them under the driver's hands, who prefers the reins short, but it would be quite possible to build a coach in which the driver might be over the horses, and yet have the advantage of higher front wheels, and properly placed for carrying the load.

The coachmaker may often gather a useful hint by studying the construction of carts, which have to carry heavier loads than carriages, often at an equal speed, and certainly not with better horses.

If the wheels of a vehicle are of equal height, the load should rest in the midde of the wheels. When the front wheels meet with an obstacle in the road, the horse will only have to lift half the weight of the load, the other half being on the hind wheels. When the hind wheels come to the same obstruction, again only half the load will have to be lifted, the other half being on the front wheels. But, as in English carriages, the wheels are very rarely of equal height, we should proportion the load more upon the higher wheels than upon the lower. As long ago as 1770, a coachmaker named Joseph Jacob, of St. Mary-axe, wrote thus, "A load should always be placed in a waggon over the highest wheels, and as low as possible." This was the Mr. Jacob who assisted at some experiments made at that time in the Strand, by direction of the Society of Arts, for the purpose of ascertaining the proper height of wheels. Mr. Cuthbert Clarke was rewarded with a fifteen guinea medal. Mr. Jacob had also received a twenty guinea medal for improved carriage springs.

I will now call your attention to the drawings of carriages on these walls made by M. Dupont, of Paris, to show how completely a coachbuilder at a distance may be guided in building carriages by these designs. These drawings are quite works of art, and by means of them M. Dupont is educating the artistic taste of every manufactory which procures his aid. How much better our carriages would be if we worked from drawings as carefully planned out and executed as these. Many of our artisans could, with a little instruction, draw quite as well, and by degrees would learn to draw with as much artistic taste and sense of the beautiful. Some of our artisans are now being instructed in the art of design, and I trust the day is not far distant when every workman will see that his son learns drawing as part of his education, and as the essential preliminary to any technical education which is to follow. The power of producing on paper the images figured on the brain is an important part and factor in all the arrangements of our social life, whether those images and imaginations, and reasons and problems, are traced with the pen in writing, or with the pencil as a drawing, in both we record, we discipline, and we clear up more or less the busy thoughts that nature or surrounding circumstances have gifted and endowed us with. On the Continent, and especially in Paris, this has long been understood, and workmen have been carefully educated for this work. And, thanks to the department of the Science and Art of South Kensington, thousands of students have past through the schools of design scattered all over England. If the artisans of the coach trade would follow the example of those engaged in the china and pottery trades, they would meet with the same success, and restore their fame for coach-building to its former greatness.

Last year, in November, Mr. Gladstone gave an address at Greenwich upon the study of science and art. I may be permitted to remind you how in that address he eloquently pressed upon his hearers that:—

"Beauty could and should be combined with economy and utility in all our industrial products; beauty was indeed a great element of utility; the trade of France was founded upon the beauty of that which it produces, and the economical application of means to ends, and that is due to the long culture and traditional application of the national mind to beauty in their products. The human nature in which we are cast was not endowed with all its marvellous faculties for nothing, and it is the due development of those faculties that constitutes the true and full idea of the duty of man in this world. It has been too much the habit in this country to regard beauty of production as something quite apart from usefulness of production, and at the same time to look upon the beauty which may result from human labour as a luxury reserved for the rich alone. But beauty has a commercial value, and its multiplication should form part of human education. We are all still at school, both young and old. We should then endeavour to work all things into beautiful forms, as did the ancient Greeks, so that artistic skill and love of the beautiful became an inheritance with them, formed part of their nature, accompanied their daily life, and entered into every kind of production. This is a time when all who feel concerned in the welfare of the country feel it to be desirable that efforts should be made to give instruction, so as to improve the knowledge of the British artistic workman, and enable him to hold his position in the markets of the world. I confess," said Mr. Gladstone, "I should like to see a great deal of this work done by the London Companies. That they should strive to make themselves illustrious in the country, by fulfilling the purpose for which they were founded, namely, developing the crafts, trades, and mysteries of this great country—as the Society of Arts has laboured to do for so many long years—to promote beauty and economy in the production of works of industry. But I believe," Mr. Gladstone continues, "that it is really in the individual that the secret of the whole matter lies. It is not as a body that you fill the benches of this room; you are here as individuals, and it is your thoughts and convictions, your own resolute efforts to improve, and energetically to direct your labours to the attainment of the highest end, that constitutes the real resource to which we have to look. No auxiliaries can supplant, they can only aid individual exertion. Each individual worker may have a notion of doing his work in the way which is most useful, but he ought also to have a sense of the difference between what is more useful and less useful, and what is more beautiful and the less beautiful. Now the sense of beauty is not, under natural circumstances, the favoured inheritance of a few only, it is meant to be, should be, and may be tho universal inheritance of civilised mankind. It ought, therefore, to be the aim of the humblest artisan to acquire by study and thought such a sense of beauty as may elevate the character of the work he performs. And it will at the same time be found that as he developes beauty in his work he will raise his self-respect, he will raise himself, his family, and his class infinitely more than by any effort to get out of his position, either for himself or his children."

I trust I shall be excused for making this long extract from Mr. Gladstone's speech, but it expresses so much in such true and kindly language that I felt I ought not to omit his well-considered words from my lectures.

I have been asked to mention that the fine series of photographs of State and other carriages, and valuable library of the Coach and Coach-harness Makers' Company are open to coach artisans every Saturday afternoon. Tickets of admission may be obtained at the principal coachbuilders of London.

NOTES ON BOOKS.

A Treatise on Lathes and Turning.—By W. H. Northcott. Second Edition. London: Longmans, Green, and Co., 1876.

The first edition of this work was reviewed in the *Journal* on its publication, in 1868. Since that time it cannot be said that any very great improvements have been made in the appliances for hand-turning; consequently but little change has really been required to bring the book down to the present date. Comparing the two editions together, the latter one seems to have been revised throughout, and in part re-written. There are some additions to the texts and plates. Some illustrations, for instance, are given of the now well-known self-centring American chucks, which, in the first edition, are only mentioned, and not very favourably. Again, there are eleven pages giving examples of the different classes of figures which can be generated by the geometric chuck, that, to some turners, fascinating, but not specially useful apparatus. Some plates of examples of finished turnery, exhibited at the recent exhibition of turned works held by the Turners' Company, are also given, and these appear to be the chief additions to the illustrations. The most important addition to the text is a short paper by Mr. J. Nasmyth, on "Hardening and Tempering Steel Tools." It is certain that the greatest loss the literature of turning has sustained was the non-completion of Holtzapfel's important work. The promise so long held out that the wished-for fourth volume of "Turning and Mechanical Manipulation" should eventually appear, prevented the attempt on the part of other writers to supply the want. For many years past, however, it has been evident that the field would be left open, and hence there is abundance of room for Mr. Northcott and his works, both this one and the second volume which he promises, "Examples of Plain and Ornamental Turning."

OBITUARY.

Thomas Page.—Mr. Thomas Page, C.E., died at Paris on the 11th inst., in the 74th year of his age. He was the acting-engineer of the Thames Tunnel, under Sir Isambard Brunel. In 1842 he designed a plan for the Thames Embankment from Westminster-bridge to Blackfriars, which was selected by the Commissioners and recommended to the Queen for adoption. A difficulty about the coal duties, however, prevented the work from being executed. Westminster new bridge was his principal work; it was built in two divisions to obviate the necessity for a temporary structure. It was constructed without cofferdams or centres, and its building caused no interruption to the traffic. His plan for Blackfriars-bridge was approved and recommended for adoption by the committee of the Bridge House Lands; but by a vote in the Common Council Mr. Cubitt's design for the present bridge was adopted. Mr. Page became a member of the Society in 1848. In 1870 he read a paper on "Submarine Channel Communication," and on various other occasions he took part in the discussions.

GENERAL NOTES.

The Patent-office.—A correspondent writes to the *Daily News* of Thursday last:—"Some of the recent arrangements at this office have given great dissatisfaction to those of the public who are concerned with it. An attempt at economy in printing the specifications and drawings of patents has caused a good deal of complaint, which culminated the other day in an appeal from Mr. Aston, Q.C., to the Master of the Rolls, the learned gentleman stating that by the new method of printing the drawings were rendered almost unintelligible. Still graver fault is likely to be found when it is known that the authorities at the office are now busy destroying the old stock of printed specifications; these are being carted away by the ton from the Patent-office stores to be 'pulped,' it being found easier to do this than to provide storage room for them. The loss that these documents will be to patentees, patent agents, and patent lawyers is most serious, and the public inconvenience will be considerable. A few years ago the Patent-office obtained and deserved great credit for the rapidity with which it printed and published all its documents, but it is evident that its present administration is of a very different character to that which then was in power. I understand that attention will be drawn to these matters when Parliament meets, and it is intended to make an effort to obtain a Select Committee to inquire into the Patent-office administration."

In the discussion on Mr. Bartley's paper on "The Cultivation of Common Fruits," *Journal*, January, 16th, page 150, Mr. Botly is made to say that the produce of 12 acres of ground amounted in one year to £12,000. The sum should have been £4,000.

NOTICES.

PROCEEDINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday evenings, at 8 o'clock. The following arrangements have been made:—

January 31.—"Ventilation of Rooms generally, and the way to make Workmen's Cottages comfortable, warm, and healthy," by Frank E. Thicke, Esq. Dr. B. W. Richardson, F.R.S., will preside.

February 7. — "Street Tramways," by Captain Douglas Galton, C.B., R.E., F.R.S.

February 14.—"Zinc White as Paint, and the Treatment of Iron for the Prevention of Corrosion," by Professor Barff, M.A.

February 21.—Lecture, by Sir John Lubbock, Bart., M.P., F.R.S., on "The Relations of Plants and Insects."

February 28.—Middle Class Education in Holland," by John Yeats, Esq., LL.D., F.R.G.S.

African Section.

Tuesday evenings, at 8 o'clock. The following arrangements have been made:—

February 13.—"Recent Explorations of the Lake Systems of Central Africa," by Robert James Mann, M.D., F.R.G.S., &c.

March 13.——"Tho Geographical and Commercial Character of the District between Mogador and Cape Juby, North-West Africa," by N. Giammal, Esq.

April 10.—"The Social State and Prospects of the South African Communities," by Robert Richards, Esq., of Grahamstown.

April 24.—"The Trade and Resources of Morocco," by Dr. Arthur Leared.

May 8.—

Indian Section.

Friday evenings, at 8 o'clock. The following arrangements have been made:—

February 2.—"Indian Tea Cultivation; its Origin, Progress, and Prospects," by A. Burrell, Esq. Dr. Forbes Watson will preside.

February 16.—"Indian Railways," by Juland Danvers, Esq.

March 2.—"Tho Progress of Trade in Central Asia," by Sir T. Douglas Forsyth, C.B., K.C.S.I.

March 16.—"The Native Indian Press," by Dr. George Birdwood, C.S.I.

April 20.—"The Existing and Possible Commercial Communications between Persia and India," by Major-General Sir Frederick John Goldsmid, C.B., K.C.S.I.

May 4.—"Thaumato-dendra, or the Wonders of Trees," with illustrations from life, by William Tayler, Esq.

Chemical Section.

Thursday evenings, at 8 o'clock. The following arrangements have been made:—

February 8.—"Some Processes of Nature's Hygiene (Improvements in the Production of Antiseptics, Disinfectants, and Blood Albumen)," by C. T. Kingzett, Esq., F.C.S. Dr. B. W. Richardson, F.R.S., will preside.

February 22.—"Spontaneous Combustion in Factories and Ships," by C. W. Vincent, Esq., F.R.S.E.

March 8.—"The Sizing of Cotton Goods," by W. Thompson, Esq., F.C.S., of Manchester.

April 12.—"The Cinchona Alkaloids; their Sources, Production, and Use," by Dr. B. H. Paul.

MEETINGS FOR THE ENSUING WEEK.

Mon. ...Institute of Surveyors, 12, Great George-street, S.W., 8 p.m. Adjourned Discussion on Mr. W. T. Marriott's Paper, "Riparian Rights."

Institute of Actuaries, The Quadrangle, King's College, W.C., 7 p.m.

Medical, 11, Chandos-street, W., 8.30 p m.

London Institution, Finsbury-circus, E.C., 5 p.m. Mr. E. B. Tylor, "The Philosophy of Language." (Lecture II.)

Social Science Association, 1, Adam-street, Adelphi, W.C., 8 p.m. Mr. Adolphe Smith, "The Decay of the City Guilds."

Tues. ..Royal Institution, Albemarle-street, W., 3 p.m. Prof. Garrod, "The Human Form; its Structure in Relation to its Contour." (Lecture III.)

Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Mr. John Head, "The Combustion of Refuse Vegetable Substances in Steam Boilers."

Statistical, Somerset House-terrace, Strand, W.C., 7¾ p.m. Mr. Archibald Hamilton, "The Economic Progess of New Zealand."

Anthropological Institute, 4, St. Martin's-place, W.C., 8 p.m. Annual Meeting.

Wed....**SOCIETY OF ARTS**, John-street, Adelpbi, W.C., 8 p.m. Mr. Frank E. Thicke, "Ventilation of Rooms Generally, and the Way to Make Workmen's Cottages Comfortable, Warm, and Healthy."

Thur. ...Royal, Burlington House, W., 8½ p.m.

Antiquaries, Burlington House, W., 8½ p.m.

Linnean, Burlington House, W., 8 p m. 1. Mr. I. Bailey Balfour, "Aspect of the Vegetation of Rodrinez" 2. Sir John Lubbock, "The Habits of Ants." 3. Mr. John Buchanan, "The Rootstock of Marattia fraxinea." 4. Prof. Harrington (U.S.), "Steeres' Collection of Tropical Ferns."

Trades' Guild of Learning and National Health Society (at the House of the Society of Arts), 8.30 p m. Prof. W. H. Corfield, "The Laws of Health." Part II. (Lecture IX.)

Chemical, Burlington House, W., 8 p m. 1. Dr. H. E. Armstrong, "Kekule's and Ladenburg's Benzene Symbols." 2. Mr. W. H. Perkin, "The Formation of Coumarine, and of Cinnamic and other Analogous Acids, from the Aromatic Aldehydes."

London Institution, Finsbury-circus, E.C., 7 p.m. Mr. G. Meredith, "The Idea of Comedy."

South London Photographic (at the House of the Society of Arts), 8 p.m.

Royal Institution, Albemarle-street, W., 3 p.m. Dr. Wright, "Metals and tbe Chief Industrial Uses of these Bodies and their Compounds." (Lecture III.)

Royal Society Club, Willis's Rooms, St. James's, S.W., 6 p m.

Psychological, 11, Chandos-street, W., 8½ p.m.

Civil and Mechanical Engineers, 7, Westminster-chambers, S W., 7 p.m. Mr. C. Kingsford, "Mechanical Automata for Sporting Purposes."

Fri.......**SOCIETY OF ARTS**, John-street, Adelpbi, W.C., 8 p.m. (Indian Section.) Mr. A. Burrell, "Indian Tea Cultivation; its Origin, Progress, and Prospects."

Royal Institution, Albemarle-street, W., 8 p.m., Weekly Meeting; 9 p.m. Prof. Osborne Reynolds, "Vortex Motion."

Geologists' Association, University College, W.C., 7½ p.m. Annual Meeting.

Philological, University College, W.C., 8 p.m.

Sat.......Foremen Engineers (at the House of the Society of Arts), 8 p.m.

Physical Science Schools, Sonth Kensington, S.W., 3 p.m.

Royal Institution, Alhemarle-street, W., 3 p.m. Mr. J. A. Symonds, "Florence and the Medici." (Lecture I.)

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JOURNAL OF THE SOCIETY OF ARTS.

No. 1,263. Vol. XXV.

FRIDAY, FEBRUARY 2, 1877.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

NATIONAL TRAINING SCHOOL FOR COOKERY.

The competition for Scholarships in this School having excited so much general interest among the members, and the scholars having been trained successfully and obtained employment, the Council have resolved to hold a second competition for more Scholarships, which will take place at the School of Cookery, according to the same rules which governed the first, namely:—

There will be five Scholarships, entitling the holders to free instruction in this School. These will be competed for at an early date at the School at South Kensington.

Qualified teachers are now urgently wanted for schools, and when they have obtained their diploma, they may earn from £1 to £2 weekly.

Candidates must not be under 18 or above 35 years of age. They must be sufficiently educated to perform the duties of an instructor in cookery after special training.

The candidates, before entering into the competition, will be required to sign a declaration that they will hold themselves at the disposal of the Committee to accept service as teachers, if required, in London or elsewhere.

The examination questions are intended to test the above, as well as the candidates' knowledge of the first principles of cookery, and the reasons on which they are based; to prove their acquaintance with the essentials of good cookery; and to discover what the candidate can cook, and in what manner.

Every member of the Society of Arts is privileged to nominate one candidate, and members desirous of doing so are requested to send in their nominations, in the following form, to the Secretary of the Society of Arts on or before 23rd February next.

NATIONAL TRAINING SCHOOL FOR COOKERY.

I, the undersigned Member of the Society of Arts, hereby nominate

Name ....
Age ....
Address ....

As a Candidate to compete for a Scholarship.

Member's Signature..................
Address ....
Date ....

NINTH ORDINARY MEETING.

Wednesday, January 31st, 1877; Dr. B. W. Richardson, F.R.S., in the chair.

The following candidates were proposed for election as members of the Society:—

Besiker, William, 2, York-villas, Stroud-green-road, Finsbury-park, N.
Brittle, John Richard, A.I.C.E., 12, Queen Anne's-gate. Westminster, S.W.
Giles, Thomas, West Cowes, Isle of Wight.
Harrison, Robert William, 2, Grittleton-road, St. Peter's-park, W.
Hart, Ernest, 59, Queen Anne-street, W.
Kensington, Edward Thomas, Weston-super-Mare.
Livesey, James, 9, Victoria-chambers, Westminster, S.W.
Royle, Thomas, F.C.S., Greenford-green, Harrow, N.W.
Rylands, Thomas Glazebrook, Highfields, Thewall, near Warrington.
Samson, Louis, 48, Sussex-gardens, Hyde-park, W.

And as Honorary Corresponding Member:—

Morel, Dr. Jules, Ghent, Belgium.

The following candidates were balloted for, and duly elected members of the Society:—

Baggallay, Frank Thomas, Beckenham, Kent.
Bayly, John, Plymouth.
Brooke, Charles Edward, 18, King-street, Smithfield, E.C.
Crawshay, George, 6, Adelphi-terrace, Strand, W.C.
Duckham, Frederic Eliot, Millwall Docks, E., and Vanbrugh-fields, Blackheath, S.E.
Heaps, Arthur George Henry, Folly-hall, Beeston-hill, Holbeck, Leeds.
Hunt, Charles, Gas Works, Windon-street, Birmingham.
Hunter, Robert, Acres-lane, Stalybridge.
Knox, Arthur E. E., 52, Cadogan-place, S.W.
Maberly, George Henry, 35, Randolph-crescent, Maida-vale, W.
McDougall, John, F.C.S., 16, Croome's-hill, Greenwich, S.E.
Mactear, James, St. Rollox, Glasgow.
Morris, Edward Robert, Heathfield, Upper Hornsey-rise, N.
Perress, Robert Braxton, Newport, Isle of Wight.
Price, William H., 39, Albion-street, Broadstairs.
Stone, William, 22, Panton-street, Haymarket, S.W.
Unwin, William Cawthorne, Cooper's-hill College, Staines.
Watherston, Edward J., 12, Pall-mall East, S.W.
Wilson, Robert William Rankine, St. Stephen's Club, Westminster, S.W.; 234, St. Vincent-street, Glasgow; and Braidbar, Renfrewshire.

The paper read was—

VENTILATION OF ROOMS GENERALLY, AND THE WAY TO MAKE WORKMEN'S COTTAGES COMFORTABLE, WARM, AND HEALTHY.

By **Frank E. Thicke.**

Ladies and Gentlemen,—As several people have erroneously imagined that I am about to introduce something new and startling to the world this evening, in the way of ventilation, I think it only right, at the outset of my paper, to disclaim any such idea. The proper title of the paper, which it is my privilege to read to-night, should be "A chat upon the agreeable ventilation and economical warming of our future dwellings, together with a brief account of a new and cheap method of preparing the inside walls of cottages, by substituting an economical, clear, non-absorbing white or coloured surface, which can be washed like a common dinner-plate." "Health is the vital principle of bliss," and the more we think about, talk about, and act in sanitary matters the better, and therefore I make but few apologies for attempting to deal with what is acknowledged to be a complicated and difficult question in the crude manner I have, feeling sure there is always a possibility of good resulting when one or two are gathered together for purpose of discussion and debate on points affecting the welfare, morally or physically, of the community at large.

It is satisfactory to find that our educational government is fully alive to the importance of a sanitary education, as evidenced by an introduction of it in our School Boards, from whence it must extend to private schools, as a most necessary branch of an ordinary education, teaching a knowledge of the laws of health and of the causes of many avoidable diseases, such as a more complete ventilation, neglect of re-vaccination, typhoid or gastric fever from sewage-poisoned water, and dyspepsia from adulterated food and drinks, &c.

A man dies in every minute; and the late Dr. Lankester informed us that, in England and Wales alone, about 120,000 die yearly from avoidable causes. We are also told by Dr. Lyon Playfair that, in Great Britain alone, there are about 4,200,000 cases of avoidable sickness annually (out of a population of 31,857,338), and that the actual loss for medical attendance, wages, and other matters, is, according to Dr. L. Playfair, between twenty and twenty-five millions annually! It is also calculated by competent authorities that the death of a pauper husband, who is also a father, is valued at £666 13s., which has to be paid out of the poor-rates for the support of the family.

In St. Giles's, London, there are about 3,000 families which have but one ill-ventilated room for each family, and the average life-time of the poor in this over-crowded centre of civilisation is only twenty years, whereas among the Peabody tenants it amounts to sixty.

Other nations are not much better as regards their poor than we are. Dr. Strausmann, Berlin, says that in that city alone are 60,000 lodgings overcrowded; also 200,000 persons have to live in dwellings where there is only one room in each tenement which has a fireplace in it; and this is coupled with bad water-supply and defective open drainage.

London, our boasted metropolis of civilisation, contains official proof of the immorality and vice which reign in its over-crowded localities, and such a state of things leads not only to drunkenness but to crime, 120,000 criminals are actually known and registered yearly, amounting to a third of the whole crime committed in England. Criminals, of course, breed criminals, as is shown by the following fact:—

At a recent meeting of the State Charities Act Association of New York, Dr. Harris brought forward a remarkable career of crime and misery through six generations. It appears that, some 70 years ago, a girl named Margaret was left adrift in one of the villages in a county on the Upper Hudson. There was no almshouse in the place, but she was a subject of outdoor relief, probably receiving occasionally food and clothing from the officials, but never educated and never kindly sheltered in a home. She became the mother of a long race of criminals and paupers, and her progeny has cursed the county ever since. The county records show 200 of her descendants who have been criminals. In one single generation of her unhappy descendants there were twenty children, of these three died in infancy and seventeen survived to maturity; of the seventeen, nine served in the State prisons for high crimes an aggregate term of fifty years, while the others were frequent inmates of gaols, penitentiaries, and almshouses. Of the 900 descendants through six generations from this unhappy girl, who was left on the village streets and abandoned in her childhood, a great number have been idiots, imbeciles, drunkards, lunatics, paupers, and prostitutes, but 200 of the more vigorous are on record as criminals.

I will now proceed with the proper ventilation of our future dwellings, by remarking that there also should be a complete and agreeable ventilation in our present as well as new dwellings, since we know that many overcrowded, unventilated, dark abodes bleach or blanch the rosy cheeks of youth, as the want of light blanches our celery, by the heaped-up mould excluding light. As an excess of light, however, is injurious to the eye, so is too much ventilation injurious and disagreeable, as evidenced by the shrugging of the shoulders, &c., where the outer cold air is extravagantly admitted in the winter time by too large crevices both in doors and windows, to which there are two very great objections, viz., 1st, that the lower and more numerous classes will exclude this kind of ventilation altogether, because it is not only very disagreeable, by suddenly abstracting heat from not well-fed families, but because they know cold creates additional appetite. Many other good authorities will bear me out when I state that this is a matter of shillings and pence to a fine, strong labourer, who has a wife and a large family, for he, viz., the husband and father, well knows that the colder a person is the more food he requires to generate additional heat, consequently he rushes to the other extreme, by blocking every air-admitting hole on the score of economy. The other objection is, that even after all this intemperate admission of disagreeable outer air, there is no contrivance for the removal of the constantly generated impure air proceeding from the breath, perspiration, consumption of gas, lamps, candles, &c., so that this vitiated air is simply diluted by the disagreeable admission of the outer air.

Dr. Richardson very truly informs us, that our prisons are the best ventilated dwellings in the land, but the expense incurred in making them so cannot be applied to the cottages of the poor and similar abodes, which fact has induced me to devote attention to this subject. I consider the wife is even more interested in proper ventilation than her husband, who is, perhaps, breathing the country air all day, whilst she is inhaling an impure atmosphere at home, and then at night compelled to breathe a still impurer one in an overcrowded shut-up bedroom, the chimney throat, in nine cases out of ten, being blocked up.

Before giving a description and inspection of a ventilator invented by Dr. Ancell Ball, I will, with your permission, first define my views of ventilation, which aim at the ample and agreeable introduction of the outer air through muslin, wire-gauze, perforated zinc, or cotton wool, so that, in winter, the currents of cold air shall be so finely divided that they will all become sufficiently warmed before they reach one's neck, and thus produce no sudden abstraction of heat, which, in other words, is termed a draught.

This, however, is simply a mode of supplying the oxygen of the outer air for the inmates to breathe, which is only half the battle, for we well know every time we breath into a room we supply it with a poisonous gas at every expiration; and it is quite as necessary to convey this invisible poison out of the room as it is to admit pure air into it, the accomplishment of both of which I term proper and complete ventilation. Air, water, and food are all equally necessaries of life, as Sir R. Christison, at a late meeting in Edinburgh, boldly stated, adding "that no man had a right to adulterate or pollute them." I venture to say that a want of proper ventilation is as much an adulteration of the outer air with an injurious excess of carbonic acid from the breath, or sulphurous acid from gas, &c., as the addition of copper is to vinegar before mixing the latter with cauliflowers or cucumbers for pickling, or preserving peas, the landlord or paterfamilias being the offender in one instance, the tradesman or manufacturer in the other.

I will now invite your attention to a description of the mode of agreeably admitting the outer pure air into a room, and will show the manner by which the impure or vitiated air is carried off as rapidly as it escapes from the lips of the inmates as well as from the burning gas, lamps, and candles, &c.

The only thing to be done in reference to the admission of the outer air into an apartment is to regulate it in such manner that, when it reaches the sensitive part of the face or neck, no disagreeable current or draught shall be experienced, and this is easily accomplished by passing a current of cold air (no matter how powerful) through finely perforated zinc, wire-gauze, muslin, or cotton wool, which will divide the cold air into such fine streams that they will all become warmed by the air in the room before reaching the sensitive face or neck. Having decided upon the admission of this air, let us now inquire the proper places for such influx. Some recommend the upper, some the lower part of a room; I myself prefer both—1st, beneath the floor to inside of fender; 2nd, through lower part of door, and covered with perforated zinc, fixed in a sliding frame; 3rd, through upper part of door and ditto; 4th, through the window, guarded with perforated zinc, by fixing a fillet in front of the lower sash of the window, which injects the air upwards, and works on a pivot, so that the lower part may be used at one time, and the upper one at another, in this our English climate, because it will be grateful in the summer months through the lower openings, and not disagreeable through the upper openings in the months of winter. I will allude first to the influx beneath the floor.

Influx of air beneath the floor is formed by first fixing a sliding air brick at outer wall, and extending the joists from thence in the direction of the fire-place, so that an air channel may thus be formed by the floor above, a joist on each side, and pieces of wood below, the channel terminating inside the fender, and another sliding air brick placed there, a little elevated to prevent ashes entering it. If required, the outer air can be admitted there, when a portion of it will be drawn to the fire, which it will quickly revive, whilst another portion of the air will be warmed while ascending in front of the fire, and thus feel agreeable and also fit for respiration.

The next mode of admitting air at the lower part of room, especially bedrooms, is through holes in a door of about half-inch in diameter, and bored obliquely upwards, with a view of directing the current towards the mouths of the inmates for inspiration. Lest, however, by a north or east wind, even in summer months, too much cold air might then be admitted, I fit a sliding frame with a piece of perforated zinc on the outside of the door, and can thus shut out any excess of the colder air.

I here invite your attention to this model, which you perceive is perforated below, to admit the outer air, as already described, but, in addition to this, is also used for disinfecting an infected room, by charging a bottle with carbolic acid, or chloride of lime, &c., and conveying it by means of a lamp wick to the upper edge of this expanded piece of muslin, down which the fluid extends, at the same time evaporating, and being carried and diffused by the current through the perforated holes in the door throughout the infected room.

The outer air may also be admitted into the room at the upper part of it, either through the door, or, in new houses, through the brickwork above such door, or in any more convenient part, remembering the upper part of the room is the warmer; consequently, while so, the impurities of the breath, &c., will ascend there; and it is on this principle that, in a theatre filled with spectators and heated by them, as well as with much polluting gas, the carbonic acid from the breath of hundreds will ascend with the sulphurous acid, &c., in the gas from the pit; so that, under such circumstances—see letter in *Times*, 24th inst.—the boxes are not so healthy as the pit, there being also a larger quantity of air in a cubic foot in this latter place than elsewhere. The atmosphere of a theatre, under the circumstances here alluded to, must be injurious, therefore a nuisance, and ought to be removed by the same power which orders a similar nuisance to be remedied in our licensed lodging-houses for the vagrants of the land. And now, after the late Brooklyn Theatre conflagration, with its 360 deaths, we are promised a more ready escape from fires in these unhealthy places of amusement, I venture to hope that, at the same time, the Lord Chamberlain will also insist upon as ready an escape for vitiated air, not omitting the regulated and agreeable admission of an ample supply of the outer air. The whole of the trees on the Albert Embankment, from Lambeth-bridge westwards, have been removed, the reason being, as we are informed, that the exhalations from the adjacent potteries and manufactories have destroyed their vitality. The subject is serious from a sanitary point of view, and no less so in its æsthetical aspect, as fumes which prove so deadly to vegetation cannot fail to have fatal effects, not only on human beings, but possibly on the architecture of the Houses of Parliament also.

The combustion, also, of between five and six millions of fires in London largely diminishes the sustaining properties of the atmosphere, by robbing it of the very oxygen we require. Although the Government spend about £200 in cotton-wool alone yearly for the purpose of filtering the London air before the members of the House of Commons, &c., breathe it, yet the noxious gases which cross the Thames to kill the above trees will also enter the Houses of Parliament, and they defy the cotton-wool to arrest them, just as the polluted water of the Thames defies the water companies' filters, through which impurities pass.

Having thus described the easy mode of admitting the outer air into a room, I now come to the more difficult one of carrying, or conveying, the impure or vitiated air out of such room. This most important act has been much overlooked by many, who simply satisfy themselves with admitting the outer air—and rather disagreeably so sometimes—into a room, which merely dilutes the impure air, without removing it, and cannot be truly called ventilation.

I here direct your attention to the ventilator in question. It may be regarded as a tube, about 25 in. to 27 in. long, bent upon itself in a somewhat syphonoid form. It is more than a syphon, being composed of an ascending, descending, then ascending channel, amounting, as it were, to a syphon and a-half, or what I may term a sesqui-syphon, the object in view being partly to reduce the length of the tube to its present height, as well as to increase the strength of the current through it; for there is a syphon-like current going on at the present time through that ventilator, as might be shown by lighting a piece of fumigating paper, when the fumes will first ascend, then descend along the middle channel, and ultimately ascend through the third one into the smoke-flue, where they mingle with the ascending smoke when fixed in the chimney.

Having thus described the *modus operandi* of this ventilator, it enables me now to speak of the mode of carrying off the impure or vitiated air in a room as fast as it is generated there—either night or day—by placing this efflux ventilator in the breastwork of the chimney, just beneath the ceiling, with one opening communicating with the room and the other within the smoke flue, when, of the two currents already alluded to, one will be brought into play, and draw the impure air out of the room, through the ventilator, into the chimney, where it will blend with the smoke and be carried off, and in summer without the smoke. In infectious diseases, as scarlatina, &c., there is an advantage in removing the air from an infected room into the chimney when there is a fire beneath, for the sulphurous acid, &c., in the smoke has a tendency to destroy the infectious germs after escaping from the sick abode, so that there is then no fear of the infection being conveyed into the air and afterwards breathed by other children—say, in a storey above—to reproduce the same disease.

The size of this ventilator is such that it will convey away the impure air of half-a-dozen persons as fast as it is expired or breathed into an ordinary-sized apartment, so that what is now considered by a sanitary inspector as over-crowding would not be deemed so by adopting this plan, which agreeably admits, all night long, an ample supply of pure air, at the same time carrying off the vitiated air as fast as it ascends from the mouths of the inmates to the efflux ventilator. It has recently been contended that carbonic acid descends from our lips to the floor, which, at the ordinary temperature of inhabited rooms, is not the case, as I will now attempt to prove.

If a waterproof well were placed in this room, and filled with lime-water, while the room was filled with breathing beings, and all the doors and windows open, and no fire, I have no doubt that the carbonic acid escaping from the mouths would at once be so reduced in temperature that it would descend and find its way into the lime-water in the well, and combine chemically with it, thus forming a film or crust of carbonate of lime, which would very soon render the translucent lime-water milky, for it is now converted into chalk or whiting, by the carbonic acid in the breath combining with the lime, and uniting and forming carbonate of lime. By adding another acid to it, as vinegar, or tartaric or sulphuric acids, &c., any of which three would combine with the lime, forming sulphate of lime or plaster of Paris, &c., and thus set the carbonic acid obtained from the breath at liberty again, and even in this water, at the temperature of the room, we could perceive it to ascend from the bottom of the vessel to the top, where it would escape with an effervescing hissing. Afterwards it still ascends in a warm room to the ceiling, where it accumulates, for the want of an efflux ventilator; and if the doors remained closed for a time, this accumulation will increase, until the vitiated air be forced to descend on its way to escape through the throat of the chimney. But, on its way there, it unfortunately has to re-pass our lips, and we have consequently to re-breathe our own carbonic acid, as well as breathe that of others, and this occurs to a great extent in our bedrooms, where the doors are closed all the night long, and little or no pure air admitted, and no impure air carried off.

It is well known that carbonic acid, under certain conditions, is so heavy that, like water, it can be poured from one glass to another and back again for some little time, as proved by a lighted taper at the bottom of a glass being extinguished by collecting a glassful of the acid and then pouring it upon the lighted taper, which at once ceases to burn; but as soon as this carbonic acid is warmed by the heat of an occupied room, then such acid gas will ascend towards the ceiling, and can no longer be poured from one vessel to another.

Water also, under certain conditions, will ascend in the form of a vapour, or descend as a solid in the form of ice; and invisible carbonic acid may be compressed in a strong glass syringe by the piston until it becomes a solid, and appear very much like a piece of camphor, and again become invisible on removal of the pressure, consequently, when we contend that carbonic acid will either ascend or descend, we must qualify such statement by a dependence upon the conditions it is subjected to at the time of its ascent or descent. For example:

carbonic acid will gradually descend and accumulate in a cold well, and remain there for years.

On the other hand, if carbonic acid were introduced into an ordinary inhabited room, with a fire and gas or lighted lamp in it, and the doors and windows closed, the temperature of that room would so warm the acid in question that it would ascend towards the ceiling.

The air in the room is as much vitiated by the sulphurous acid, &c., from the consumption of coal gas as from the carbonic acid of our own breath; it tarnishes our silver and plated goods; it also bleaches or fades our furniture, especially drawing and dining-room curtains. I am, however, pleased to learn that the use of coal gas has been abandoned in Winchester, Poole, the Shaftesbury-park Estate, and some regal palaces, as well as in some of our clubs, and this has led the alarmed gas companies to try and deprive their gas of this vile compound, for I read that within the last few weeks £300 were first expended in the attempt, but in vain. This was followed by £3,000, but with the same result. It, however, looks as though the gas companies were afraid of the consumption of their gas going out of fashion, as Royalty and some of the clubs have set their faces against it. Nevertheless, I feel confident the unthinking many will still patronise it, in spite of its dirtiness, unwholesomeness, and unsteadiness of light, whilst the thinking few will fight shyer and shyer of it, until a light as convenient but cleaner, more wholesome and steadier, be substituted. As carburetted hydrogen, a compound of charcoal and hydrogen, is the illuminating agent in coal gas, I feel confident that a sulphurless gas will ere long be obtained, and I firmly believe that a competition, with prizes, in connection with an exhibition of such gas lights, would hasten that period, just as the late exhibition of fire grates and stoves led to their very great improvement as regards economy of fuel and utilisation of wasted heat.

I must apologise for having thus digressed somewhat upon this interesting sanitary subject, trusting its importance will in some measure justify me, since it is only by a correct knowlege of the effect of temperature upon this and other gases, including the diffusion of them, that our sanitary views can be properly carried out.

Now, with regard to heating.

An idea struck a friend of mine that two rooms might be warmed with a single grate, as well as one; and having his coach-house separated from his saddle-room by a wall, in which was a fire-grate and boiler for the latter room, he first removed the grate, &c., then its back, and substituted a second face for it; after which he broke an opening into the coach-house, and then refixed the grate, when, to his surprise, he found the grate burn better than ever, which, however, we ought not to wonder at, inasmuch as the coal was now receiving a double supply of oxygen from the air to fan the flames, producing a cheerful blazing fireside in both rooms at the same time. Having commanded now an extra supply of air, he substituted coke for coal, and found it burn remarkably well, and was of course much cheaper. Knowing also that the small pieces of coals called nuts are of the best quality, and much cheaper than the larger sized coals, he next combined them with the coke in such a manner that he utilised the smoke therefrom by consuming it, and thus obtained additional blaze and heat. This was accomplished by sliding a grated drawer beneath the coke fire, which set fire to the small or nut coals below; from whence the smoke ascended among the incandescent coke, and was there consumed, yielding the extra light and heat already alluded to. Not content with obtaining this increased and cheap amount of caloric, he next aimed at warming two or four more rooms above, by providing a hot air chamber on each side of the grate, and tubes or channels extending therefrom to the apartments above, each room being provided with a couple of valves, to admit or exclude the warm "moist" air as wished, so that, about an hour before bedtime, any or all of such rooms could be readily warmed without trouble or expense.

The hot-air chambers are somewhat peculiarly constructed. They are not added to this Janus grate because the tenement in which it is to be placed, in a block of model dwellings for the poor, would be uncomfortably heated by them, even at this season of the year; consequently, they are intentionally omitted. The interior of the chamber is provided with gills, or cast-iron plates, and has a short cross plate, the object of which is so to retard the ascent of the pure air which enters the chamber at the floor of the room that, when it reaches the upper part of such chamber, it will do more there than was ever wished, for it will boil water, as ascertained by fixing a vessel of water there for the purpose of providing the hot dry air with moisture, and thus be equal to a summer's atmosphere in the coldest weather; consequently, from the too rapid evaporation of the water, this evaporating vessel is placed at the bottom of the hot-air chamber, where sufficient vapour is generated, but not too much. At the upper part of this chamber are two openings, one into the room, and provided with a valve so that the hot air can be excluded from the parlour when sufficiently warm, and then conducted through the other opening along metal or other channels up to the rooms above. In the event of no more hot air being required, the lower opening in this hot-air chamber is provided with a valve, which will exclude the entrance of cold air in the room altogether, consequently none can enter to be warmed.

I would next invite you to notice the economical construction of the bottom of the grate for the coke; it is shaped so that the centre of it will hold but very little coke, whilst a good depth is retained at both fronts, in order to yield a large cheerful blaze in each room. The next thing to notice is the small or nut coal grated drawer, which may be used, if desired, either for cooking purposes only, or when at a distance from the pits, where coals are a consideration.

At present there are only three designs for the Janus grate, viz.:—

1st. The one you now witness, made expressly for the Artisans' Model Dwellings in Disney-street, and manufactured by Kennard and Co., Upper Thames-street.

2nd. A cottage range with oven and boiler and hot-air chambers, with a cheerful English fire-side blaze in both parlour and kitchen at the same time.

Also a 3rd kind, or large Janus-faced grate, with hot-air chambers and sliding drawer for small coals beneath the coke, to be fixed in a partition wall between two large rooms, one of which kind has been most satisfactorily at work all last winter at Portsmouth, between the two club-rooms of the Royal Naval officers there, where I have seen it in operation. Other designs are in preparation for warming a hall, and, say, a library and reception or consulting room, as well as to convey warm moist air upstairs to the bedroom doors, upon the first landing, all from one grate. A coach-house and a saddle-house, with adjoining conservatory, can also be heated by placing a small boiler within the middle of the Janus grate, one of which is now in operation in Spalding, warming a large steam printing room, besides two printing offices, the sole chimney of which is provided with a couple of ventilators, one in each of the two rooms, carrying off the impurities from the gas and the impure breath of the printers as fast as they ascend to the ceiling. The outer air is also admitted beneath the floor to the inside of the fender, where it escapes through a sliding air-brick into the office, when a portion of such air rushes to the fire, which it revives; whilst another portion ascends before the fire, which warms it before it is diffused throughout the room. This is described by the occupants as being most comfortable.

When a stove projects into a room, a larger quantity of heat is radiated from it than from an ordinary grate imbedded in the brickwork; but the projecting stove is so porous that a large quantity of poisonous carbonic oxide gas escapes through it into the occupied room, producing headache, drowsiness, &c., whereas the grate with its hot-air chambers avoids all this. Besides occupying less space, the Janus grate utilises nearly all the caloric in both coke and coal, as well as obtaining additional light and heat from the consumption of the smoke, leaving only just sufficient heat to pass up the chimney for the purpose of carrying off the impure gases there. This I regard as a desideratum even for the middle and higher classes; for if this gloomy metropolis would only consume its own smoke, and the noxious fumes from manufacturing chimneys, and substitute pure Kent for the polluted Thames water under one amalgamated company, also include a better ventilation of apartments, substituting a purer and steadier light for the abominable metal-tarnishing, curtain-bleaching, book-cover destroying, and eye-injuring coal gas, in combination with less artificial life and more temperance in articles of diet, we might then anticipate a more satisfactory state of things, next door perhaps to what is expected from Dr. Richardson's City of Health.

Some may feel inclined to inquire whether, in the summer time, the parlour would not be too warm with one face of the grate blazing into it. This has been anticipated, for two fire-clay bricks are provided, which will fill half the grate, or one quarter of it with one brick, next side the parlour, and thus exclude the chief portion of the heat, at the same time leaving sufficient to cook a dinner with the kitchen half; and, in addition to this, I have prepared to suspend in front of this face a thin pad of a cheap, non-conducting, indestructible material, called silicated cotton, from its resemblance to cotton fibre, as well as being composed chiefly of silica, which is obtained from slag, a specimen of which I have in my hand. It is used as a substitute for felt, as a cover to boilers, to retain their heat.

For a larger house, one Janus grate, with hot-air chambers, will not only warm both dining and drawing-room, but also one half of the hall, whilst another similar grate will warm a reception room and library, as well as the other half side of the hall, thus warming four rooms and a hall, as well as producing four cheerful blazes from a couple of fires. The two kitchens are also heated by one grate; and the coach-house, the saddle-house, and an adjoining conservatory, by a single grate, with a small boiler in it to convey hot water to the green-house. Two offices or a consulting room and surgery can also be warmed in a similar manner.

And now I come to a very important point with regard to rendering workmen's cottages healthy. I allude to the internal painting and decoration, with silicate paint for woodwork, and silicate wash for the walls and ceilings.

These non-poisonous paints, manufactured by the Silicate Paint Company, of Liverpool and London, do not owe their existence either to accidental discovery or to a "happy thought," but are the results of long continued research and experiment, to produce pigments free from the well-known objections to ordinary paints. The solution of silica as a base was not a solution of the difficulty in itself, for silica in various forms and varying quality was already used in the production of rough anti-corrosive and silicate paints made by simply mixing silica in a more or less fine powder with the common painting colours.

Silica was selected as the base because, when obtained absolutely pure, it has no chemical action whatever on iron or any of the metals; nor can it be destroyed by fire or by the acids. Extreme cold also has no effect on it, in fact, it is an indestructible product, incapable of injury to the most delicate pigments with which it may be combined. The silica used by the Silicate Paint Company is obtained from a natural deposit of almost pure silex in North Wales. It is found in a basin of volcanic origin, which forms the bed of a small lake, and is doubtless the product of centuries of natural levigation. When dried it is found to be in the condition of a powder, finer than it would be possible to reduce it to by mechanical means. The first great difficulty to overcome, viz., the production of a non-poisonous white paint of good body, of course necessitated the discarding of white lead and zinc oxide. The new silicate white, a patented preparation of zinc, has all the good qualities of white lead without its attendant bad ones. It resists foul air, and retains its whiteness and opacity under all conditions, will withstand 500° degrees of heat, has a covering power equal to the best lead, and, besides being non-poisonous, has no chemical action whatever on the metals.

Of the other colours it will be enough to say they are one and all non-poisonous, and contain neither lead, antimony, arsenic, or copper, in any form.

The only disadvantage from which these paints suffer, in common with the ordinary painting colours, is the inability, as yet, to discover a vehicle for them to supersede linseed oil. A step in this direction has doubtless been made in the production of the petrifying liquid, though this is not applicable in all cases. It is certainly to be regretted that a more enduring medium cannot be found, as the silicate pigments will withstand, uninjured, a degree of heat that would utterly destroy the oil with which they are mixed. In a recent letter to the *Times* on the subject of white lead *v.* zinc white, Mr. Barff, Professor of Chemistry at the Royal Academy, referring to the new silicate white, says, "I wish to call the attention of those interested in this question to the fact that they can obtain a better paint in all respects than white lead, and one that has no injurious effects on the health of those who prepare or use it." Professor Godwin, also, speaking at the late meeting of the Social Science Congress, on the subject of damp houses, &c., alluded to the preparation of the Silicate Paint Company. He said, "When we recollect the enormous amount of injury that lead paint did every year, and the number of persons who were damaged most seriously by it, and the difficulty of keeping damp out of houses, and when they found that this company claimed to meet these two points, their preparations were of the greatest importance."

The question of the cost of the silicate paint, as compared with white lead, being in many cases the all-important one, it is satisfactory to know that, notwithstanding the many advantages of the former, they are found in working to be from 10 to 15 per cent. cheaper. Though slightly dearer in the first cost, they have nearly double the bulk of white lead, and, weight for weight, will cover almost twice the space. Being cheap, non-poisonous, permanent of colour, of good body, damp proof, all but indestructible, and suitable alike for delicate interior decoration or the most exposed out-door wear, these paints surely supply the painters' "desideratum." The increasing demand for the preparations of the Silicate Paint Company, particularly from the "trade"—met by the opening of an establishment in London—would seem to indicate that the prejudice with which innovation and improvement are generally received is in this case fast disappearing, and, I venture to predict, the day is not far distant when the use of lead paint will be the exception rather than the rule.

Another specialty of the Silicate Paint Company is the petrifying liquid, for the cure of damp walls and the preservation of stone, brick, plaster, cement, &c., from decay. This preparation (also called the washable distemper), is a water paint, manufactured in two distinct forms, viz., as a transparent liquid, for indurating soft stone or brick when it is desirable to render it damp-proof without altering its character or appearance; and as a paste, in all colours. In the latter form—apart from its damp-resisting qualities—I propose to use it in the place of common distemper, for the decoration of bedrooms, corridors, staircases, passages, basements, kitchens, &c., presenting an appearance almost equal to paint, and, like paint, admitting of being thoroughly cleansed by washing; and I also intend to use it on the bare walls, which will save the cost of plastering; and I here invite your inspection of these samples, which I have had prepared to demonstrate the nice appearance, the economy, and the healthiness of this invaluable petrifying liquid. This petrifying liquid could also be used, at a very small cost, for the borders of all floors, and might be stencilled in patterns, as shown here on this margin. As it is also unaffected by disinfectants, the value of the petrifying liquid from a sanitary point of view cannot be over-estimated, and its recent introduction into the decorations of the School Board buildings, workhouses, prisons, asylums, and other large institutions must ultimately result in its general adoption for all buildings of this character, as well as by all persons who study the sanitary condition of the houses, not only of the poor, but of all classes.

The enamelling paint, which renders varnishing unnecessary, is the last of the decorative preparations manufactured by the Silicate Paint Company, and is a capital paint for superior interior work of all kinds. As its name implies, it is a paint drying with a hard, highly glossy surface, and, like the petrifying liquid and silicate paint, is admirably suited for damp walls. It will thoroughly prevent the penetration of moisture, however copious, when applied to the walls or foundations of dwelling-houses, railway arches, bridges, tunnels, viaducts, and other structures, and is invaluable for porous tile roofs. Two coats of it are quite equal in effect to two coats of ordinary paint and two coats of varnish, while on clean ironwork one coat is, in most cases, sufficient. For the production of telling decorative effects at small cost, the paints of the Silicate Company are unequalled. As an example of this, one coat of enamelling paint, succeeding a coat of silicate paint on a surface previously treated with one coat of petrifying liquid, gives an admirable result, and has also the merit of speedy execution—a point often of considerable importance.

The enamel dries speedily, and, in combination with the silicate paint, has been used with the most complete success on damp walls, to which lead paints could not be made to adhere from the presence of excessive moisture. Recent experiment has also demonstrated that the enamel is not affected by chloride of sodium (common salt). Iron treated with one coat of this paint was exposed in the open air for months, in contact with salt, and watered at frequent intervals. After a considerable time had elapsed, the iron was removed and examined, when both the metal and paint were found to be in the same condition as when first applied. This has resulted in the use of the enamel for the protection of the iron ships engaged in the salt-carrying trade, which had always previously to be cemented internally, at great cost, with loss of space and increase of dead weight.

Having thus contrived for the comforts and social elevation of the artisan and cottager, let us ask if we have fulfilled our mission as Samaritans and philanthropists? It is stated, and I fear with much truth, that there is a stratum of society still uncared for, and in a worse condition than the regular occupied labourer and artisan, for at a recent calculation there were 92,096 paupers in this metropolis, and about 32,000 more who were bordering upon it, not having proper places to lay their heads.

It certainly is as much our duty to ameliorate the condition of this substratum of society as that of the skilled artisan, and it is our interest also to provide sanitary and moral habitations for such lost and almost uncared-for dangerous creatures. The average of deaths in St. Giles's is, I believe, about 50 per 1,000; in Peabody's-buildings 15·8 per 1,000; in London as a whole 21·5 per 1,000; and at Hampstead only 14 per 1,000. There are causes for this great difference, and removeable ones too. Who then, I would ask, is responsible for such deplorable results, the removal of which would in the long run cost less than it costs now to keep and punish them in their present condition, for this neglected class cannot help itself alone, yet must increase in numbers annually, with increasing immorality, vice, and crime, which has to be punished in our prisons, &c., at the cost of the ratepayers, already over-burdened. I suggest for your consideration the propriety of erecting in different localities, blocks of buildings, with one room only in each tenement, having a slight recess to hold a couple of shut-up iron beds, concealed in the daytime by a curtain (see *Standard*, 22nd Jan.) I also suggest a cooking grate in one corner, so that four fires may be worked by one chimney. This single room, if properly ventilated, will sleep a man and his wife in one bed, and three children in the other. A superintendent should reside in each block, and a license granted to it that the police may inspect it under the Lodging-house Act. Drury-lane, Gray's-inn-lane, Golden-lane, Lothbury and Moorgate district, Poplar, Clerkenwell rookeries, and such filthy disease-creating spots, would be suitable localities to erect such blocks, and better than erecting one large block for so dangerous a class, the clergy and visitors could also reach the inmates better when thus separated, and in their sanitary abodes talk to them of the advantage of provident habits, &c., as improvident ones are the chief causes of overcrowding, sickness, and pauperism. There should also be a small mortuary connected with every block, so that any fatal case from an infectious disease might be deposited there at once, and if a small well-ventilated nursery or hospital could be spared at the top of the building for the early isolation of cases of small-pox, scarlet fever, or measles, &c., and their disinfection, I am sure many epidemics might in this way be arrested, nay, often altogether prevented.

Having now nearly completed my task, I will briefly recapitulate the sanitary objects aimed at, and then leave others to improve upon them. In the first place, then, I have alluded to a sanitary education being absolutely requisite, in order that the rising generation may appreciate the necessity for carrying off the vitiated air from their rooms, and substituting a purer and agreeably warmed one, in order thus to escape many avoidable diseases, which entail not only great suffering, but also loss of money and even of life. I have attempted to show you how to introduce fresh air into a room, and I have shown the syphon ventilator, which will extract the vitiated air. I have also shown you by these samples, which speak for themselves, how the cost of plastering the walls of cottages, &c., can be saved, by abolishing paper-hanging, and substituting silicate wash, or petrifying liquid. And, moreover, I have shown what is perhaps the greatest novelty of all—Dr. Ball's Janus, or double-faced grate, which is economical in the consumption of coal, and an excellent medium for heating rooms.

I will now conclude with reiterating that the healthier and the more comfortable we make the dwellings of the working classes, in conjunction with this sanitary education, which includes a knowledge of food, a cheap and proper diet, and suitable clothing, the sooner shall we wean the artisan and labourer from the deleterious shelter of the public house.

The conditions under which a man lives affect him morally as well as physically. Increased attention, therefore, to sanitary matters is necessary upon higher grounds than those of mere comfort, though it is important, in the case of poor people, to render their lives a little pleasanter to them.

This question, too, is not a speculative one, but one which should be pushed to actual experiment. An ounce of practice is worth a bushel of theory. However valuable the suggestions, and however attractive the theories may be, which are from time to time broached on sanitary matters, no dependence is to be placed upon them unless they are tested, just like a recipe for a new dish.

There might be, I think, some advantage in Government interference by sanitary inspectors based on experiment, which should be more searching than is at present the case. We want a Minister of Public Health, as well as of public works; in fact, the former is the more necessary. Sanitary reform is hard to effect, for we are far too conservative as regards our dwellings, and build too much on the old lines; in fact, we pride ourselves on imitating, in many cases, the architecture of nations who lived under very different conditions, both of life and climate, to ourselves. But, with due discussion and agitation, much may be done, and, from what has already been accomplished, we may look forward to a fair future for sound sanitary reform.

DISCUSSION.

The Chairman said that many of the points raised would be specially interesting to medical men, architects, and engineers. There was a pressing necessity for a great national movement in the way of improving the homes of the people, especially bearing in mind what had been said as to the heredity of criminality, and, as might also have been mentioned, the heredity of disease, which was often engendered by the wretched dwellings in which poor people lived. This was one of the most important points in sanitary reform, that by benefiting the present generation we also improved the next. He had not been able, on looking back as far as he could go, to find any new malady now existing, but diseases commenced in rude times when men were not protected from atmospheric variations, and they had continued down to the present time, though not, perhaps, in quite so virulent a form. It took three or four generations to wipe out this hereditary tendency, and it was almost impossible to conceive what would be the improvement some 60 years hence if sanitary measures went on progressing as they now were, and one generation was improved after another. Another very important subject was the influence of cold upon the economy of food, with regard to which some very remarkable researches were made by the late Dr. Milner, in the convict establishment at Wakefield. He weighed the convicts at different seasons of the year—of course they were living under the same conditions of temperature, sleeping, and diet—and he found that there was a steady waste during cold months, beginning about November, and then a steady increase under the same dietary, &c., during the summer months. In fact, the seasons themselves were not more regular than these periods of wasting and increasing in these persons, all subjected to the same conditions. This showed the influence of cold upon the bodily power, and the necessity for more food in cold weather, especially amongst the young. He was glad to say that the Board schools in London were admirably warmed, but it was very essential that the children should be warm when they got home, and free from damp. With regard to ventilation, he thought the syphon ventilator of Dr. Ball was very similar to that introduced, some years ago, by Dr. Chowne, which had considerable popularity, and would, no doubt, have extended, had not Dr. Arnott written against it. One great error in ventilation was to let the cold air come through the windows and doors, and then escape by the chimney. The proper method was to let the air come into the fireplace, be there warmed, and then find its way into the room about three-parts of the way up the wall, where it would diffuse, and carry the current of warm air right out of the room by the fire-grate. This method was effectually carried out in Captain Galton's stove, and also in the calorigen stove, which he had in use in his laboratory, and found quite effective. The cold air came in through a pipe, was warmed by burning gas, and escaped through an opening above; while the products of combustion were carried up the chimney by another shaft. Dr. Ball's "Janus" grate would serve this purpose very well, especially if Galton's air-chamber were added to it. Mr. Thicke, in speaking of gases, had omitted to take into account the effects of diffusion—because gases did not move in other gases simply in proportion to their weight. The Daltonian statement was that gases acted as vacua to each other, and ordinarily, when they were left free, diffusion took place to a considerable extent, though it varied to some degree according to their relative weights. Tho silicate washes and paints, which had been referred to, were very important, and he considered them a great advance in sanitary science. He had seen structures where these paints were applied, and thought, with a little improvement, so as to remove the coarseness of the surface, they would be one of the greatest advantages in house construction.

Mr. Botley thought it would be an advantage if the enamelled bricks could be improved by being perforated, as it would lead to economy of material, and make them lighter. In a paper he read at the British Association meeting at Bradford, he had stated the following points as of great importance in the construction of workmen's dwellings, which he had proved by experience:—1. That they should have a south aspect. 2. That all offices should be in the rear. 3. That no cottage should be built less than 15 ft. or 20 ft. above high water mark. 4. That each cottage should have a small piece of ground, on which the occupier could grow his own vegetables.

Mr. Bramwell, F.R.S., said he presumed Mr. Botley alluded to cottages in the country, because the conditions he laid down were quite inapplicable to London; for instance, a vast portion of the metropolis would be ineligible for building if it were necessary to be 20 ft. above high water mark. The house he had lived in for some years at Putney was not so high as that, but he should be sorry to have it pulled down at the dictation of a sanitary inspector. Again, where land was worth from 1s. to 20s. per foot superficial per annum, it was out of the question to talk about gardens. His experience of ventilation was that everybody desired it for other people, but no one practised it. The most ardent apostle of fresh air, when left in a room by himself, either got as far from the inlet as possible, or stopped it up. Ventilation was, in fact, one of the most difficult problems he knew. If you allowed the air to play upon a person, unless it were warmed to such a degree as to be unwholesome, it produced the effect of cold, and if the current exceeded $1\frac{1}{2}$ foot per second, or a mile an hour, it created a draught. This could be easily proved by walking along a large room at about that rate, when you felt no unpleasant effect, but on quickening the pace you immediately felt a draught. It was very difficult, therefore, to provide for the entrance of 1,000 cubic feet of air per head per hour, if the apertures were made so small as to prevent draught. When the Institution of Civil Engineers was rebuilt, some years ago, provision was made for the entry of 400,000 cubic feet per hour, but it involved the sacrifice of 2 or 3 feet at each end of the room, in order to get sufficient apertures for the air to enter without producing an unpleasant effect. Mr. Thicke proposed the use of perforated zinc, wire gauze, and so on, and this might answer in some cases, but the difficulties increased very much in a small room, and if these things were not attended to they would get choked with dirt. He had been annoyed in his own house by the smell of cooking, and last year he had a large pipe put in from the front of the house to the kitchen, the end being protected with wire gauze. For a time it answered very well, but then the annoyance re-appeared, and on examination he found that no air whatever was entering through the tube, the dust and dirt having choked up the ventilator. At the City of London flour mills, at Blackfriars, a current of air was blown between the millstones, in order that the flour might be removed as fast as it was produced, the meal being kept cool, and the stones only employed in grinding that which required to be ground. The difficulty was that you could not get rid of the air without taking some of the flour with it, and this flour carried out by the atmosphere was technically called "stive." In the country this "stive" was mixed with flour and used, but in London the air was so impure that the "stive" was only useful for billstickers. It was endeavoured to get rid of this dirt by putting screens for the air to pass through, and the amount of filth intercepted in the course of a few hours was almost incredible; but with all their effort, they could not make the "stive" fit for consumption. He believed the Galton stove was about the best plan of ventilating a room at the timo when you wanted a fire, but you had to provide for the summer, and it was difficult or impossible to introduce these stoves into old houses. Too many sanitary papers were written by gentlemen of independent means living in the country in detached houses, where they could do what they pleased, and were quite inapplicable to the majority of London houses. With regard to Dr. Ball's syphon ventilator, he could not comprehend the principle upon which it acted, and thought Dr. Arnott's valve ventilator simpler and better. In some of the best houses at the West-end, ventilating pipes were carried up from the sewers by the side of the chimney-stack, but it often happened that there would bo a down draught through one of the bedroom chimneys, and thus the latest improvement in sanitary science would be found to be an injurious contrivance for introducing sewer gas into your bedroom. The silicate paints produced a nice smooth surface, and he appreciated the advantage of a wall which could be easily cleansed; but he had a wholesome dread of rheumatism, and he feared they would show, even more than an ordinary wall, a plentiful deposit of moisture after any changes of temperature, such as had recently occurred. He had recently introduced this glazed surface into an engine-room, so that the grease and dirt could be easily removed, and Sir William Armstrong used it in his dining-hall, at Newcastle, which he sometimes lent for public meetings, so that when the people were gone, he could take in a fire-engine and give the walls a good scouring; it was also very nice for dairies or larders, but he objected to be treated like a cold joint of meat, and should not like to live in a room so constructed.

General Cotton spoke in favour of the system of ventilation which he had referred to a short time ago in that room, viz., the introduction of a current of air at the upper part of the room in a vertical direction so as to spread over the ceiling and gradually descend. This system had been tried with great success at St. George's Hospital by Mr. Brudenell Carter. The air was introduced just above the heads of the patients, and a most perfect circulation was obtained, the thermometer showing 68° at all elevations, though there was only one fire in the room. It was necessary to properly proportion the size of the inlet, and not to let the fire too low, or a cold draught might be produced; but where properly managed it had proved quite successful.

Mr. Waller said Dr. Neill Arnott's ventilators sometimes failed, but they need not do so, if the outlet at the top of the chimney were less than the inlet at the fireplace and the valve together. Dr. Chowne's ventilator he considered as good as any. It was very easy to warm and ventilate a whole house by means of the kitchen fire, if there were a good air chamber behind it. He knew of a case where this was being done, an iron pipe being carried up from the back of the fire with a 6 inch chamber round it, which warmed three rooms and the staircase; there was also a cold air shaft by the side with openings, by which either hot or cold air could be admitted to the rooms, or a proportion to each. If ventilators were put in cottages they would no doubt be fastened up, as they often were in a better class of houses. There were difficulties in this matter as in everything else, but they could be overcome if people did not mind the expense.

Mr. Blashill remarked that he had drawn attention some time ago to the fact that very few people spent more than two or three hours a day in the open air, and during the last few months probably the average had been still less, so that there could be no doubt about the importance of this question. The principal point was to have the air of a uniform temperature throughout the room, not in separate layers, as some people seemed to imagine it ought to be, for they proposed openings at the bottom for the heavy gases to go out, and at the top for the lighter air to come in. He could not agree with Mr. Thicke as to the desirability of introducing fresh cold air near the fireplace, where it might be an annoyance, and in any case would be to a great extent wasted by being consumed, whereas the ordinary air of the room would do equally well. He believed there was only one correct principle on which fresh air should be introduced, viz., by bringing it in near the top of the room in as thin a stream as possible, so that it should circulate all over the ceiling, and gradually mix with the air of the room without causing a draught. Captain Galton's stove, and one or two others on a similar principle, were well adapted for securing this end, but there were great difficulties in introducing them, except in new houses. The suggestion of General Cotton might, however, be found very valuable, provided the air in the hall, or staircase, whence it entered the room, was pure and dry. This might be secured by placing a calorigen stove in the hall. He thought it was too much the habit to talk about workmen's dwellings in regard to these subjects, and did not see how workmen could be expected to submit to sanitary inspection unless it was universal; but he hoped the day was coming when a properly-appointed official should visit and inspect every house, either on a change of tenancy, or at certain periods, with due notice given, and at proper hours, and he thought great good would result. But unless they were all prepared for such a measure, they should not think of forcing it on other people.

Dr. Ball said he had introduced the syphon ventilator, because he had found Dr. Arnott's to admit smoke into the room when there happened to be a down-draught in the chimney. This did not occur with his system.

The Chairman having explained how the supply of air was brought into the calorigen stove, either under floor, or if necessary, through an earthenware pipe, referred to the deposition of moisture on glazed walls. He considered this an advantage rather than the reverse, because it showed the existence of the evil, and enabled one to guard against it. There would be the same quantity of moisture in an ordinary wall, only it would be absorbed and gradually given off, whereas when it was so conspicuous it could be removed at once, and perhaps prevented in future. In some cases galvanised iron would be preferable to a glazed surface, and no doubt the proper construction would be to have a circulation of air close behind the surface, so as to prevent this deposition of moisture. He agreed with Mr. Bramwell that sewer-ventilating pipes might be dangerous, and one of the worst cases of infectious disease he had met with had been caused in this way; but the danger might be removed by carrying the pipe up above the chimney-pots, and surmounting it by a Banner vane, which caused the current to be carried away.

Mr. Allen said he was the builder of many of the industrial dwellings, in which all kinds of schemes had been tried; but nothing was found so efficient as a thorough draught of air through the houses. He thought many of the remarks made had very little bearing on the subject of improving the dwellings of the working classes, and feared that little good would be done until there was a radical change in the Building Act. He had built many houses himself, and was very much in favour of arranging them in flats, with a separate access to each. He had no drains under the houses at all, and the sewers were thoroughly ventilated.

Mr. Thicke, in reply, drew particular attention to the Janus stove and to the silicate compositions, and thought that if architects, builders, and workmen were more in the habit of taking counsel with each other, great benefits would ensue.

The Chairman then proposed a vote of thanks to Mr Thicke, which was carried unanimously, and the proceedings terminated.

MISCELLANEOUS.

HOUSE DRAINS.

Lord Alfred Churchill, the Chairman of the Council, having found it necessary to institute an inquiry into the condition of the drains of his house in Rutland-gate, has had them opened and examined by a competent authority, who reports to the following effect:—"I find them to be in bad condition, and being formed of brick instead of glazed pipes, and owing to the want of a trap at the sewer end of the drain, the rats have worked from the sewer to the drain, and thence under the basement paving, thus causing the openings between the joints of the paving mentioned by your Lordship, and so much earth has in places been scraped into the drain by the rats that it is partially choked. To make the house wholesome, it is requisite that the whole of the old brick drain with the adjacent earth should be entirely removed, and a new drain put in, formed of glazed stoneware pipes with Portland cement joints, the main drain to be 9 in. internal diameter, the branch drains 6 in.; glazed stoneware traps should be fixed in lieu of the present bell traps; and the rain-water pipes and wastes should be disconnected from the drains, and made to empty over the stoneware traps. The main drain should be carried quite to the sewer, and should be properly connected thereto by the parish surveyor's men, and a trap should be put at the outfall, to prevent the entry into the drain of the sewer rats and gas; this would make the house quite wholesome, but would be a somewhat expensive matter, and would cost about

£40, and would take a full fortnight to complete." The works suggested have been carried out. The house appears to have been built about thirty years ago. It may be taken, it is to be feared, as exhibiting the typical condition of a very large proportion of the houses in the metropolis.

CONSOLIDATED TEA.

A good deal is heard just now of "compressed" or "consolidated" tea, and it is a question of some interest to decide whether the process really has any good effect on the tea, or if it is merely its novelty that recommends it. Among the resolutions passed at the recent Tea Conference was one proposed by Dr. Hardwicke, to the effect, "That a critical examination of the merits of compression, and other methods of treating tea, be instituted, with a view of eliciting definitely by comparison the amount, if any, to which the tea is enhanced by the process, and what are the advantages the public would obtain were such treatment generally adopted." This will, therefore, be one of the subjects connected with tea which the "mixed committee of tea experts, scientific gentlemen, and representatives of the general public" will have to consider and report on. Without wishing to anticipate their investigations and conclusions, some remarks on the subject may just now be of interest, for, as tea has established itself as one of our national drinks, any method of treatment by which its value is increased to the consumer is a matter of considerable interest and importance.

The consolidation of tea first attracted public attention in 1873, when samples submitted to the process were exhibited in the Food Section of the International Exhibition at South Kensington, by Messrs. Goundry and Co., of Upper Thames-street, the purchasers and present owners and workers of Spratt's Patent for this process, granted in 1871. The operation of compressing or consolidating tea is very simple, and may be thus briefly described. The tea is weighed out by girls—who almost exclusively carry out the process from beginning to end—into quarter pounds, which, one after another, are passed into moulds on a revolving iron table, a piece of metal exactly fitting the mould being placed on the top. As the table revolves, each mould comes under the stroke of an hydraulic ram, which exercises a pressure of about 80 tons on each quarter of a pound of tea, reducing it to one-third of its bulk, and consolidating it into a mass, marked out by depressions into divisions of exactly half an ounce each in weight. As the table further revolves, each cake is ejected from its mould, and the process, in which, by the way, not a particle of moisture is used, is completed. The effect of this enormous pressure is stated to be to so thoroughly break the cells and smaller vesicles of the tea leaves that the theine and aromatic oil are set perfectly free, and the mass of tea is more easily affected by boiling water, in which it at once falls to pieces. The practical result is, that the liquor produced from consolidated tea after ordinary infusion is considerably stronger than that produced from loose tea, varying according to the quality of the tea subjected to the process, the higher class teas showing even a greater per-centage than that just mentioned. Dr. John Tripe, Medical Officer of Health and Public Analyst for Hackney, stated at the Conference, that "it was quite clear to him, from a microscopic examination, and from the pressure to which the tea was subjected, that the fibre must be broken up, and that the soluble matter must be more fully extracted than it would be where the tea was dealt with in the usual way;"—a statement which any person can verify by simple experiment, say with a half-ounce division of a consolidated cake of tea, and three teaspoonfuls of ordinary loose tea of the same price and quality, which represent half-an-ounce. It will be found that the half-ounce of the consolidated tea will in five minutes give the same strength of liquor as the same weight of ordinary tea in four or five hours. The truth is that the ordinary method of making tea by the infusion of boiling water does not extract from the leaves all their virtue—the theine, the essential oil, and their aromatic flavours; and a further proof of this may be seen by infusing re-dried tea-leaves which have been subjected to the consolidated process. A question, of course, may be raised by persons ignorant of the true nature of tea as sent to this country, as to whether this extra extraction of the chemical ingredients of tea does not cause a deterioration of flavour. The simple answer to this is that it does not, as judges of tea well know; the Chinese practice of the momentary infusion of fresh undried tea being nothing to the point.

The above is considered to be the main point in favour of consolidated tea. But there are other considerations alleged in its favour of more or less importance. The reduction of ordinary tea to one-third its bulk is obviously a matter of no slight value under a variety of circumstances, such as war or travel. Consolidated tea was used in the Ashantee Expedition in 1873, and more recently our Government supplied it to the Arctic Expedition. The Canadian Government has also obtained supplies of it from England for its mounted police. Sportsmen and exploring parties have also found its advantage. Again, in household and public establishments, its use prevents waste, and consumption can be more accurately measured and watched. Another great point in its favour is that the evaporation of the essential oil and flavour of tea is arrested, ordinary loose tea deteriorating much more rapidly, even in lined chests, than is generally supposed. The tea consolidated for the Ashantee Expedition shows hardly any deterioration at the present time, samples having been reserved for experiment, while ordinary loose tea as old as the date of that expedition would by this time have lost quite half its strength. Yet another advantage is claimed from the fact that the process of consolidating tea is a very practical detector of adulteration and other fraudulent malpractices, for it at once discloses on the surface of the cakes all colouring matter and other soluble additions, while "foreign" substances, such as sand, metal, leaves and fibre other than those of tea, distinctly show themselves when they happen to be pressed against the side of the moulds, and, consequently, are exposed on the outside of the cakes. The trade in this consolidated tea is gradually assuming large proportions. The Russian Government is contemplating adopting it for its troops, and the manufacturers hope that it will be used exclusively in our own army and navy. The matter is certainly one in which nine persons out of ten of all classes are interested, and as it is of a practical rather than a scientific character, experiments can easily decide on the claims made on behalf of consolidated tea.

LOCAL MUSEUMS.

These institutions are being gradually established throughout the country in different forms. In some places they are connected with Schools of Art, and to some degree indirectly subsidised from the public funds. In other places they are supported by a rate obtained under Ewart's Act. In other places, again, they are partially endowed, as at Liverpool. Rules for admission vary. Birmingham is, perhaps, distinguished above other places by opening both its Public Library and its Museum on Sunday afternoons, after three o'clock. For two years past returns relating to Local Public Libraries, ordered by the House of Commons, have been in preparation, and it may be hoped that in the next session of Parliament they will be printed and circulated. In the meantime the Council of the Society of Arts request that any information about local museums, especially as regards the number of visitors, may be furnished, in order that it may appear monthly in the *Journal.*

ADULT INSTRUCTION THROUGH PUBLIC MUSEUMS.

(Subsidised by Parliament.)

The following results, giving important information bearing on public education, are obtained as correctly as possible, from inquiry and Parliamentary returns, in the hope that they may hereafter be officially collected and published periodically, like the Registrar-General's returns. The number of visitors for the month of December, 1876, are stated. When they are counted by sight the letter "S" is used, when by turnstile the letter "M":—

Institutions.	Amounts voted in 1876. £	Number of Visitors in December.	How counted.	Observations.
1. British Museum	108,947	32,793 (1)	S	Return refused. Open Mondays, Wednesdays, Fridays, and Saturdays. Closed, except to students, on Tuesdays and Thursdays. (1)
2. National Gallery, Charing-cross	6,898	132,615	S	Open Mondays, Tuesdays, Wednesdays, and Saturdays. Closed on Thursdays, and Fridays. Open from 10 to 4.30. (2)
3. Kew Gardens and Museum	22,622	..	S	Open on Sundays and week days. (3)
4. South Kensington Museum	39,058	77,274	M	Open Morning and evening till 10, on Mondays, Tuesdays, and Saturdays. Students' days—Wednesday, Thursday, and Friday, 6d. entrance. Open from 10 till Sunset.
5. Bethnal-green Museum	7,200	117,179	M	Ditto. (5)
6. National Portrait Gallery, South Kensington	2,000	..	M	Return refused. Open daily except Sundays. (6)
7. School of Mines and Mining Record Office, Geological Museum, Jermyn-street	8,947	3,940	M	Open daily, except Sundays and Fridays, and in the evenings till 10 of Monday, Tuesday, and Saturday. (7)
8. Patent Office Museum, South Kensington	..	19,247	M	Open daily, except Sundays. (8)
9. Edinburgh National Gallery	2,100	5,656	M	(9) Closed for the month.
10. Edinburgh Museum of Antiquities	..	7,222	M	(10) Ditto.
11. Edinburgh Museum of Science and Art	10,320	27,964	M	Open daily (10 a.m. to 4 p.m.) except Sundays, and Friday and Saturday evenings (6 to 9). Students' days—Monday, Tuesday, and Thursday; admission 6d.; other days, admission free. (11)
12. Edinburgh Botanic Gardens	1,750	1,164	M	(12)
13. Dublin Museum of Natural History	1,742	7,593	M	Open daily, and in the evening. (13)
14. Glasnevin Botanical Gardens and Museum	2,224	4,770	M	Open daily, including Sundays. (14)
15. National Gallery of Ireland	2,339	6,381	M	(15)
16. Museum of Royal Irish Academy, Dublin	300	..	M	(16)
17. Zoological Gardens, Dublin	500	2,741	M	Open daily, including Sundays. Number of visitors in July, 15,281. (17)
18. Tower of London	1,590	19,595	S	Open daily, except Sundays. (18)
19. Royal Naval College, including Greenwich Painted Hall	38,051	15,467	S	Open daily, including Sundays. (19)
20. Royal Naval Museum, Greenwich	1,055	1,203	S	Open daily, except Fridays & Saturdays. (20)
21. India Museum, South Kensington	..	2,888	M	Paid for by Indian Government. Open on Mondays, Tuesdays, Fridays, and Saturdays, 1d. admission; on Wednesday and Thursday, 6d. admission. (21)
22. Hampton Court Palace	7,475	..	..	Open on Sundays, and on week days except Fridays. (22)

NOTES.

(1) The numbers are those for the corresponding month of last year, as given in the Parliamentary return.

(2) 16 public days, from 10 to 4 o'clock. Trafalgar square, 922,720 (nine months); South Kensington, 298,334 (five months); total for the year 1876, 1,222,024.

(5) The numbers in this month and November were increased by the attraction of the Prince of Wales' East Indian objects.

(9) (10) (12) (16) No information as to opening.

(22) As far back as 1855 returns of the number of visitors were made to Parliament and printed, but this practice, for the present least, has been suspended. The statistics published by the Board of Trade every three years give returns.

CORRESPONDENCE.

HOUSE DRAINAGE.

As a practical commentary upon the views expressed at the recent Society of Arts discussion upon sanitation by some of the officials of the Vestries, may I venture to lay before you a sample of my every-day experience of mis-management by the conservators of public health, and the indifference of a rather numerous class of small property owners, that came under my observation this afternoon.

Having business near Clapham-junction, on its conclusion I took a stroll, as I often do, to look into the state of the houses in the locality. Within pistol shot of the station were several houses in course of erection; between them was a group of four houses already occupied, some for ten months past and others four months. On entering these they were seen to be in an incomplete state, doors without locks or bolts, walls unpapered, and woodwork partially painted. In the area of some of them the water lay several inches deep, with no drain to carry it off, and the occupants have to bale it away to the rear. The roofs leaked, and water poured in down the walls, through to the very basement. The chimneys smoke, it seemed their chronic nature, the back-yards retain the virgin mud, and causeways are unpaved. The water-cisterns supply the household and water-closets from the same tank, whilst the overflows are into the pans of closets.

I must now refer to the dwellings (?) separately. The first contains a water-closet inside the house, the scullery sink is at the back, the drain-pipes are laid under the basement floors to the first area, where they terminate unconnected with the street sewer, so that there is immediately beneath the rooms four months' accumulation of closet and sink deposits, and the vile smells prevalent in the apartments arise through the crevices. In the other three houses the drains are laid under the floors, and are also unconnected with the sewer, the closet and sink-pipes were until yesterday severed from the drain, and simply emptied into a hole dug in the yard at the back-door; when this had filled and overflowed the yard and closets, and after numerous complaints were made to the agent, inspector of nuisances, surveyor, and Vestry, then another hole was sunk to receive the overflow of the first. After more complaints were tendered by the unfortunate occupants, the sink and closet-pipes were yesterday joined to the drain proper, and running beneath the house, but which is not yet in communication with the street sewer, so that the three houses are now in the condition of the first one, and will, it is presumed, continue to receive the deposits beneath the floors until sheer force of circumstance compels the landlord to connect, perhaps a year or two hence. To show that the foregoing are not isolated cases, I may add, that on continuing my ramble in the same district, I found four houses in a vilely filthy state. They are truly in a risky condition, for the lean-to, containing wash-house or scullery, and water-closet, not being fixed to the main building, has slipt away. The bricks are loose and hanging out, and the structures may topple down at any moment. I do not know how long these buildings have been erected, but probably from five to six years, and yet during all this time the sewage has been retained in and about the premises—at the back doors, saturating the subsoil and flooding the yard surface, until last Monday, when pipes were put down under the floors and connected with the sewer in the front. These two examples serve to illustrate a very ordinary condition of affairs, such as ought not to be tolerated, and my experience, as a sanitary detective, teaches me that in the metropolis alone they could be speedily increased a thousandfold. The tenants suffer by ill health and from the foul nuisances, and are most anxious that defects should be remedied. They have taken the proper course by complaints to the right quarters, whilst the only redress so far obtained is the doubtful one of diverting the sewage from the yards, to benefit the floors where, if its putrescence is unseen, it is the more readily felt.

The landlord is sharp enough in demanding every Monday morning the sum of 12s. as rent for each of these wretched pest-houses, and if it were not forthcoming he would doubtless quickly enforce his right and seize the goods. Indeed, I am not quite sure if he did not actually do so with one tenant.

Richard Weaver, C.E., F.C.S.

Scientific Club, 7, Savile-row, W,
December, 1876.

THE HISTORY OF THE ART OF COACH-BUILDING.

In the last number of the *Journal*, Mr. Thrupp, in his lecture on the art of coach-building, regards it as probable, that the term "hackery," used by Europeans in British India to designate a cart, has been derived from the French word "haquet," a cart. He also names the one-horse car of India as "hecca" or "heka;" and mentioned that the universal term for a vehicle is "garry."

It is, however, likely that "hackery" is derived from the two Urdu words "hank-re," literally "drive-fellow," the imperative "hank" (pronounced "hangk") from "hankna," to drive, being momentarily shouted when urging the driver to press on the two bullocks in the cart, or only alternated with the causal verb "hakalo."

The "ekka" is so designated from the Hindi word "ek," one, because of its being a one-horse car. I have heard it said that the "jatka" in use around the shores of the Bay of Bengal, Singapore, Penang, Rangoon, Calcutta, Madras, and Bangalore, is a corruption of the word ekka. In these localities the single horse jatka is everywhere for hire. It is a box, placed on springs with one pair of wheels, with one front and two side windows, and a windowed door behind.

"Garry," as Mr. Thrupp mentions, is a term in general use for a wheeled conveyance. But it is so only amongst the people who speak the Urdu, or Hindustani language. Throughout the south of India, amongst the Tamil race, the sole term applied is "bandy," and it is given to every wheeled conveyance, from a handbarrow to a four-wheeled coach. It is a general term, and when a particular carriage has to be indicated the name of that required has to be used.

O. Balfour.

2, Oxford-square, January 8, 1877.

NOTICES.

PROCEEDINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday evenings, at 8 o'clock. The following arrangements have been made :—

February 7. — "Street Tramways," by Captain Douglas Galton, C.B., R.E., F.R.S.

February 14.—"Zinc White as Paint, and the Treatment of Iron for the Prevention of Corrosion," by Professor Barff, M.A.

February 21.—Lecture, by Sir John Lubbock, Bart., M.P., F.R.S., on "The Relations of Plants and Insects."

February 28.—Middle Class Education in Holland," by John Yeats, Esq., LL.D., F.R.G.S.

African Section.

Tuesday evenings, at 8 o'clock. The following arrangements have been made :—

February 13.—"Recent Explorations of the Lake Systems of Central Africa," by Robert James Mann, M.D., F.R.G.S., &c.

March 13.—"The Geographical and Commercial Character of the District between Mogador and Cape Juby, North-West Africa," by N. Giammal, Esq.

April 10.—"The Social State and Prospects of the South African Communities," by Robert Richards, Esq., of Grahamstown.

April 24.—"The Trade and Resources of Morocco," by Dr. Arthur Leared.

Indian Section.

Friday evenings, at 8 o'clock. The following arrangements have been made:—

February 2.—"Indian Tea Cultivation; its Origin, Progress, and Prospects," by A. Burrell, Esq. Dr. Forbes Watson will preside.

February 16.—"Indian Railways," by Juland Danvers, Esq.

March 2.—"The Progress of Trade in Central Asia," by Sir T. Douglas Forsyth, C.B., K.C.S.I.

March 16.—"The Native Indian Press," by Dr. George Birdwood, C.S.I.

April 20.—"The Existing and Possible Commercial Communications between Persia and India," by Major-General Sir Frederick John Goldsmid, C.B., K.C.S.I.

May 4.—"Thaumato-dendra, or the Wonders of Trees," with illustrations from life, by Wm. Tayler, Esq.

Chemical Section.

Thursday evenings, at 8 o'clock. The following arrangements have been made:—

February 8.—"Some Processes of Nature's Hygiene (Improvements in the Production of Antiseptics, Disinfectants, and Blood Albumen)," by C. T. Kingzett, Esq., F.C.S. Dr. B. W. Richardson, F.R.S., will preside.

February 22.—"Spontaneous Combustion in Factories and Ships," by C. W. Vincent, Esq., F.R.S.E.

March 8.—"The Sizing of Cotton Goods," by W. Thompson, Esq., F.C.S., of Manchester.

April 12.—"The Cinchona Alkaloids; their Sources, Production, and Use," by Dr. B. H. Paul.

Science Lectures.

These will be given on the following Wednesday evenings, in place of the usual paper and discussion. The rules for admission will be the same as for the Cantor Lectures. Each member can admit ONE friend by giving the usual order from the book supplied at the commencement of the Session:—

February 21.—Sir John Lubbock, Bart., M.P., F.R.S., "The Relations of Plants and Insects."

March 7.—Professor A. B. W. Kennedy, C.E., "The Growth and Present Position of the Science of Mechanics."

March 21.—Dr. B. W. Richardson, F.R.S., "Vital Air."

April 18.—E. J. Reed, C.B., M.P., F.R.S., "The Modifications which Ships of War have Undergone during the last 20 Years."

May 2.—J. Baillie Hamilton, "New Music Instruments."

May 16.—Professor W. K. Clifford, F.R.S.

MEETINGS FOR THE ENSUING WEEK.

Mon. ...Farmers' Club, Caledonian Hotel, Adelphi, W.C., 5½ p.m. Mr. S. B. L. Druce (the Secretary), "The Operation of the Agricultural Holdings (England) Act, 1875."
Royal Institution, Albemarle-street, W., 2 p.m. General Monthly Meeting.
Society of Engineers, 6, Westminster-chambers, 7½ p.m. Inaugural Address by the President, Mr. Thomas Cargill.
British Architects, 9, Conduit-street, W., 8 p.m. Mr. F. C. Penrose, "The Optical Refinements of Greek Architecture."
Medical, 11, Chandos-street, W., 8 30 p m.
Victoria Institute, 10, Adelphi-terrace, W.C., 8 p.m. Mr. David Howard, "The Chemistry of Geology."
London Institution, Finsbury-circus, E.C., 5 p.m. Mr. J. Norman Lockyer, "The Elements of Spectrum Analysis."

Tues... Royal Institution, Albemarle-street, W., 3 p.m. Prof. Garrod, "The Human Form; its Structure in Relation to its Contour." (Lecture IV.)
Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Mr. C. Norman Bazalgette, "The Sewage Question."
Pathological, 53, Berners-street, Oxford-street, W., 8½ p.m.
Biblical Archæology, 33, Bloomsbury-street, W.C., 8½ p.m.
Zoological, 11, Hanover-square, W., 8½ p m. 1. Dr A. Günther, "Description of the Tortoises Collected During the Visit of H.M.S. *Petrel* in the Galapagos Islands." 2 Mr Robert Collett, "*Phylloscopus borealis*, Blas, and its Occurrence in Norway." 3 Mr. Sclater, "The Spur-winged Geese of the Genus *Plectropterus*, living in the Society's Gardens." Prof. A. H. Garrod, "The Mechanism of the Intervertebral Substance and Some Effects of the Erect Position of Man."

Wed....**SOCIETY OF ARTS**, John-street Adelphi, W.C., 8 p.m. Captain Douglas Galton, "Street Tramways."
Geological, Burlington House, W., 8 p m 1. Mr. J. Arthur Phillips. "The Chemical and Mineralogical Changes which have taken place in Certain Eruptive Rocks of North Wales." 2 Prof Ralph Tate, "New Species of *Belemnites* and *Salenia* from the Middle Tertiaries of South Australia" 3. Prof H. G Seeley, "*Manisaurus Gardneri*, Seeley, an Elasmosaurian from the Base of the Gault at Folkestone."
East India Association, 20, Great George-street, S.W., 3 p.m. Colonel A. B. Rathborne, "The Depreciation of Silver."
Entomological, 11, Chandos-street, W, 7 p m.
Microscopical. King's College, W C., 8 p.m. Anniversary Meeting. President's Address.
Pharmaceutical, 17, Bloomsbury-square, W.C., 8 p.m. 1. Professor Bentley, "The Admixture of Veratrum with Valerian Root." 2 Mr. Harold Senier, "The Colouring Matter of the Petals of Rosa Gallica."
Archæological Association, 32, Sackville-street, W., 8 p.m.
Obstetrical, 53, Berners-street, Oxford-street, W., 8 p.m.

Thur. ...**SOCIETY OF ARTS**, John-street, Adelphi, W.C, 8 p.m. (Chemical Section) Mr. C. T. Kingzett, "Some Processes of Nature's Hygiene (Improvements in the Production of Antiseptics, Disinfectants, and Blood Albumen)."
Royal, Burlington House, W, 8½ p.m.
Antiquaries, Burlington House, W., 8½ p.m.
London Institution, Finsbury-circus, E C., 7 p.m. Mr. A. Severn, "Cloud and Sunshine, by a Landscape Painter."
Society for the Encouragement of the Fine Arts, 9, Conduit-street, W., 8 p.m. Mr. William Simpson, "Illustrated Journalism."
Royal Institution, Albemarle-street, W., 3 p.m. Dr. Wright, "Metals and the Chief Industrial Uses of these Bodies and their Compounds." (Lecture IV.)
Inventors' Institute, 4, St. Martin's-place, W C., 8 p.m.
Royal Historical, 11, Chandos-street, W., 8 p m. 1. Mr. Sidney Robjohns, "Buckland Abbey and Sir Francis Drake." 2 Mr. G Laurence Gomme, "Sovereignty in Relation to the Origin of Social Institutions."
Mathematical, 22, Albemarle-street, W., 8 p m.

Fri.......Royal United Service Institution, Whitehall-yard, 3 p.m. Major-General T. B Collinson "The Present Facilities for the Invasion of England, and for the Defence Thereof." (Part I.)
Royal Institution, Albemarle-street, W., 8 p.m., Weekly Meeting; 9 p.m. Mr. Francis Galton, "Typical Laws of Heredity."
Astronomical, Somerset House, W.C., 3 p.m. Annual Meeting
Quekett Microscopical Club, University Coll., W.C., 8 p.m.
Clinical, 53, Berners-street, W., 8½ p m.

Sat.......Trades' Guild of Learning and National Health Society (at the House of the Society of Arts), 8.30 p m. Prof W. H Corfield, "The Laws of Health." Part II. (Lecture III.)
Royal Botanic, Inner Circle, Regent's-park, N.W., 3¾ p.m.
Royal Institution, Albemarle-street, W., 3 p.m. Mr. J. A. Symonds, "Florence and the Medici." (Lecture II.)

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JOURNAL OF THE SOCIETY OF ARTS.

No. 1,264. Vol. XXV.

FRIDAY, FEBRUARY 9, 1877.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

DOMESTIC ECONOMY.

With a view of aiding in the teaching of Domestic Economy in elementary schools, the Society of Arts will give three prizes for the best Syllabuses of a course of instruction in that subject.

Under the head of Domestic Economy are included (1) food, cookery, and clothing; (2) health, the management of the dwelling, and the sick room; (3) cottage expenditure and thrift.

The Syllabus should give in detail the heads of such instruction as can be taught in an ordinary elementary school; and should be accompanied by explanatory notes as to the manner of imparting the instruction, and the various requirements for conducting the classes efficiently.

The Prizes will be £30, £15, and £10.

The Society of Arts reserves the right of publishing the Prize Syllabuses, and also of withholding any or all the prizes if, in the opinion of the judges, the papers sent in are not of sufficient merit.

It is essential that the subject should be treated in a manner which shows how the teaching of Domestic Economy can be practically introduced into elementary schools, but long dissertations should be avoided. The Syllabus should, in fact, be a skeleton course of instruction, to be filled in by the teacher, with such notes and suggestions as the author has found practically useful. It should also be carefully framed with reference to the time and opportunities of instruction available in the elementary schools of the country.

The Syllabuses should be sent, neatly and legibly written on one side of the paper only, to the Secretary, Society of Arts, John-street, Adelphi, London, before the 15th April. Each Syllabus should be distinguished by a motto, the name and address of the writer being sent in a sealed envelope, with the same motto outside. Those papers to which prizes are not awarded will be returned to the writers on application.

INSTITUTIONS.

The following Institution has been received into union since the last announcement:—

Dewsbury, Mechanics' Institute.

INDIAN SECTION.

Friday, February 2nd, 1877; Lieut.-Col. Yule, C.B., in the chair.

The paper read was—

INDIAN TEA CULTIVATION: ITS ORIGIN, PROGRESS, AND PROSPECTS.

By A. Burrell.

There is no more appropriate place—at least out of India—than in this hall, nor a more fit audience than a meeting of the members of the Society of Arts, for a review of the whole course and history of the culture of tea in India.

Nearly sixty years ago, at a time when the overbearing arrogance and intolerable extortions of the Chinese officials led thoughtful men to contemplate the possibility of a rupture of the commercial relations between this country and the Chinese Empire, menacing the interruption of our importations of tea from that—then the only—source of supply, the Society of Arts took up the subject, and offered their Gold Medal, or fifty guineas, to any one "who should grow and prepare the greatest quantity of tea of good quality, not less than twenty pounds," in the East or West Indies, or any other British colony. For nearly twenty years this offer was annually repeated, till at last when, under the auspices of the East India Company, tea had been so grown in India, they bestowed the medal on the gentleman pointed out by the Government of India as most deserving of that reward.

When the first consignment of tea actually grown commercially in India reached London, the Directors of the East India Company forwarded samples to this Society, and requested them to report on it. At that time there were among the active members of the Society many of the then magnates of Mincing-lane—Mr. Thompson, Mr. Twining, Mr. Gibbs, and other well-known names, of the highest authority in the trade, and these gentlemen afforded the Society the benefit of their experience and advice, and joined in the report, which was considered of such value that the directors of the India-house printed and transmitted it to their servants in India, with special reference to the practical suggestions it contained for improving the preparation of the tea of future crops. The tea so examined was declared to be of superior quality, the infusion of a deep, rich red, of pungent flavour, and resembling the Pekoe of China.

On the occasion of the second importation the Company again forwarded samples to the Society for their opinion, when a committee again reported (9th March, 1840), and stated that this "Indian tea possessed all the richness, strength, and flavour of the very finest kind imported from China; that the preparation now exceeded every expectation that could have been formed of improvement in so short a time; and that India unquestionably possessed every requisite of soil and climate for producing teas of the finest quality."

It would occupy too much time to rehearse all that the Society has since done in the furtherance of this important industry. By the close and continuous attention bestowed on it, the able papers read on the subject, and the still more valuable discussions which ensued on them in this room, by deputations to Government and to the Indian authorities, the most important events connected with the enterprise have been duly kept before the public, so far as the influence of the Society could reach them. I have said enough, I hope, to prove that this is the place, as I am sure it is a fitting occasion, to gather up and present in a connected outline and summary the whole history of the business, tracing it through its early struggles, discouragements, and difficulties, in more recent times when it gradually attained a most successful development, down to the present moment, when the cultivation of tea has been fairly established as one of the most promising of the economic productions of India; and this with the object of spreading among the public—too long indifferent to the concerns of India, but now awakening to a due sense of the importance to them of all that influences the material and moral progress of that great dependency of the Crown—some definite and reliable information on the subject, to show them that India now produces, and is capable of producing in any quantity, teas of a quality, strength, flavour, and purity not only equal but superior to those of China or any other country in the world, adapted to all tastes, the plainest or the most fastidious, at prices, too, suited to the means of all classes; and finally urging them, in their own interests as consumers, and as a duty they owe to their countrymen in India, who have long toiled and struggled to meet their wants without as yet any adequate profit in their investments, to a more direct and extended use of Indian tea, thereby affording a fair harvest of profit to its cultivators, for which nothing is now wanting but an increased consumption of their produce in this country.

I.—Origin of Tea Culture.

From the constant intercourse between India and China, by the ships of the East India Company engaged in the China trade, the tea plant, as a curiosity, was being constantly brought by the captains to Calcutta. I find Colonel Kyd, a gentleman who devoted much of his time to such pursuits, had it growing in his garden there, in 1780. He was a correspondent of Sir Joseph Banks, and through their instrumentality the Calcutta Botanic Garden was established in 1782, Colonel Kyd's garden being made over to the Company, and forming the nucleus of that establishment, over the interests of which he watched with zealous care during the remainder of his life. In a letter to Sir Joseph Banks, he says—"The tea plants received from Canton have thriven well, although in a most unsuitable soil and climate; the supercargoes are blamed for having sent only the worst sort, which are never prepared for the European market, and refusing to procure native cultivators at the requisition of the Bengal government."

About the same time (1780), Warren Hastings, the Governor-General, writing to Mr. George Bogle, then in Bhootan preparing for his mission to Thibet—an interesting account of which has lately been published for the first time by Mr. Clements Markham—"Sends him some seeds of Hyson tea, to aid his benevolent plan of introducing the luxuries and excellencies of our world into that of Bhootan."*

There are other traces I have found of a familiarity with the tea plant at that time, and speculations as to its adaptability for acclimatisation in India, but from them no practical result seems to have followed.

We owe, I think, the first really practical effort to introduce tea culture in India to that great and good man, Sir Joseph Banks, who spent a long and laborious life, and freely bestowed his means in advancing that and other objects calculated to promote the industrial interests of India and England. In 1788, at the request of the East India Company, he drew up for their information and guidance a series of memoirs on the proper means to be adopted for the growth of new staples, or the improved culture of such as were already imperfectly cultivated in India, such as cotton, sugar, cochineal, spices, vanilla, coffee, chocolate, and notably tea. As regards tea, that formed the subject of a special communication, dated 27th Dec., 1788, of which I have succeeded in finding a copy at the British Museum, after searching in vain for it through the vast MSS. records of the India-office. It is too long a document to give you in full, though I think it well deserves publication, now that the reasons that induced its author and the company to treat it as a strictly confidential document have long since disappeared. It was sent to Bengal with a request that it should receive the attentive perusal of the authorities there, and directing them, after procuring the best information, to give the directors "their sentiments at large, in a point of view both political and commercial." The Bengal Government referred Sir Joseph's memoir to Colonel Kyd, who in a very long and interesting report cordially endorsed his opinions and recommendations, and that was sent home, and simply referred to by the Calcutta authorities, without, as far as I can find, any expression of their views, as desired, on the "political" or "commercial" aspect of the subject. I have no doubt that "the political and commercial" reasons connected with the company's most lucrative tea trade with China led them to discourage any such attempts as regards tea, though they cordially carried out Sir Joseph's suggestions relating to the other products, and I fear the same feeling influenced the directors, till the monopoly they enjoyed of the China trade was abolished in 1833, for till that date they seem to have treated the constant and urgent applications made to them on the subject with a deaf ear.

Sir Joseph's memoir commences with a comprehensive and scientific account of the soil, climate, and districts in which tea is successfully cultivated in China and Japan, so lucid and complete that, if it had been known fifty years later, it would have saved much discussion and many blunders. He then remarks:—"To search in the territories of the East India Company for all the varieties of climate necessary for the production of the various sorts of teas would be useless, as they do not extend over a sufficient number of degrees of latitude, nor is it practicable to attempt at once to dispossess the Chinese of the whole tea trade. All undertakings of new manufacture should commence with articles of inferior quality, they being less difficult in preparation, and more certain (as they fall into the hands of the lower order of the people) of being admitted into immediate use than higher priced commodities intended for the consumption of those who have more distinguishing palates, and fewer reasons for being economical in their purchases; and, moreover, as the profit they bring is derived from the extent of sale that cheapness always commands, though little upon each bargain, it ultimately becomes an object of great magnitude and proportional importance. Black teas are exactly in this predicament, and may certainly be cultivated with success in the northern parts of the province, Behar, Rungpoor, and Cooch-Behar, for instance, where the latitude and cooling influences of the neighbouring mountains of Bhootan give every reason to expect a climate eminently similar to the parts of China in which good black teas are at present manufactured. The mountains of Bhootan afford, in a short distance, all the climates that are found in the cooler parts of the empire of China, and, consequently, every variety necessary for the production of green teas. If, then, the culture of the black teas is once established in the neighbouring provinces of Behar, and the inhabitants of Bhootan are invited by proper inducements, they will certainly undertake that of green, and thus, by a gradual change, the whole of the tea trade will be transferred into that quarter."

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* Markham's "Mission of Bogle and Manning to Thibet." Int., p. 148.

At the time Sir Joseph thus wrote, the British territory to the north, west, and east of Bengal was as nothing to what it is now—Assam, Cachar, Sylhet, and all that region in the north-east, much of the present North-Western Provinces, and all the Punjab, the countries where the present tea culture is most successfully carried on, were not then ours, so that Sir Joseph had to confine his selection to a comparatively small slice of territory, and it is certainly striking how accurately, as events afterwards showed, he pointed out the most suitable districts.

"The inhabitants of Canton," Sir Joseph continues, "are now in the habit of shipping themselves on board our Indiamen whenever hands are wanted; we may, therefore, safely conclude that their neighbours in Honan may be induced, by the offer of liberal terms, to follow their example, and, moreover, to embark their tea shrub and all their tools of culture and manufacture, and migrate with them to Calcutta, where they will find the Botanic Garden ready to receive them, twenty acres of which, at least, might be allotted to their immediate reception, which is already cleared and prepared for similar purposes, and, lying very nearly under the same latitude as Canton, could not fail to suit in every particular this infant adventure, and here the shrub might be increased under the direction of the able and indefatigable superintendent, and the natives taught the culture and manufacture of the article, who, when fully instructed, might be detached with a proper supply of tools and shrubs to the places ultimately destined for the permanent establishment of the manufacture.

"Presuming the Court of Directors to agree in the propriety of attempting the execution of this plan, two things only remain to ensure its success, which are, to find out the proper means of getting access to the cultivators and manufacturers of teas in China, and to induce them to repair with their shrubs and their tools to Calcutta. To intrust the execution of this business to the Company's supercargoes at Canton would be imprudent; they have an interest in its failure, and by their interest on the spot could, no doubt, if they chose it, prevent the success, not of the present only, but of all future attempts of the same nature. The undertaking ought, therefore, to commence with the Court of Directors here; there must be in the Company's service officers capable of executing commissions of every degree of delicacy. To some of those whose secrecy in the execution of it may be relied on, the business ought to be intrusted; and for my part, if my advice or assistance in preparing the details of the plan should be required, I shall at all times be ready to come forward, convinced that the object is of real importance, not to the Company only, but to the country at large. I consider it incumbent on me to use my utmost assiduity in bringing it about, and I shall at all times think it my duty to obey with alacrity any commands with which the directors may be pleased to honour me."

When Lord Macartney's embassy to China was despatched in 1793, he was directed to procure all possible information on the subject of tea. He did send on to India some tea-plants and seeds, which were reared in the Botanic Garden at Calcutta; and the able naturalist, Dr. Abel, who accompanied the expedition, selected and fully instructed by Sir Joseph Banks, devoted special attention to the subject. Unfortunately, his collections and journals were lost in the wreck of the *Alceste* frigate on their way home, though in his own and the other published accounts of the embassy much valuable information was given to the public about tea cultivation in China. The troubles that ensued in India and the great Continental wars in Europe afterwards diverted the attention of the authorities from such peaceful topics, and it was not till India and England were again at peace that the subject was revived. Then it began to be suspected that it was not necessary to go to China to find the true tea-plant, but that it was actually growing through a wide extent of our own then greatly-increased territories on the North-east and West of India.

In 1816, the Hon. Edward Gardner, Resident at the native court of Nepaul, an accomplished naturalist, who devoted much of his time to plants and seeds likely to be of use in India proper, found a tea tree growing in the palace garden at Khatmandu, the capital of Nepaul, and evidence that the plant was cultivated and manufactured in that province for use as tea. He sent specimens of the plant to Dr. Wallich, at that time the superintendent of the Botanic Garden of Calcutta, who again forwarded them to Sir Joseph Banks, and to Mr. Don, the botanist, who in his "Prodromus Floræ Nepalensis," states that it is found growing in Nepaul, but whether it is or is not indigenous he cannot positively say. The very specimens sent to Sir Joseph Banks are still preserved in the British Museum, and no modern botanist would for a moment hesitate to pronounce them genuine tea plants.

In 1819, Mr. Moorcroft was despatched by the Company on a journey to Cashmere, Bokhara, and Thibet. When he arrived at Ladak, he ascertained that tea was largely imported into that district from Bissahir, a small native state under British protection, immediately to the north of Ghurwahl and bounded on the east by Chinese territory, where it grew most abundantly on the banks of the Sutlej. Both the black and green sorts were, he reports, gathered, dried, and rolled, like the Chinese teas, and about 8,000 lbs. were annually brought into the capital of Ladak, where, however, it was not so much esteemed as the Chinese tea, with which it was mixed by the poorer classes. Moorcroft adds, "It was the opinion of a native wholesale trader that the teas of Bissahir differed from the coarser teas of China only in the mode of preparing them for the market."[*] These facts were at the time communicated to the Bengal Government and by them to the home authorities.

About the same time Dr. Buchanan Hamilton, when travelling in Burmah, found, as he says, "that chief plant of renown, the tea plant, growing in the woody mountainous districts to the north-east and south of Umerapoora, as well as in various other parts of a similar character. It is cultivated by the Sheen, who inhabit the towns on the Irrawaddy; they bring it in large baskets to Umerapoora, and hence it is dispensed all over the kingdom."[†]

Bishop Heber records, in the journal of his travels in India, under date 5th Dec., 1824, "The tea plant grows wild all through Kumaon, but cannot be made use of, from an emetic quality it possesses. This might, perhaps, be removed by cultivation, but the experiment has never been tried. For the cultivation of tea I apprehend both the soil, hilly surface, and climate of Kumaon—in all which it resembles the tea provinces of China—are extremely favourable."[‡]

In 1817, the Botanical Garden at Saharunpore, in the North-West Provinces, was established by the Company, on the recommendation of the Marquis of Hastings, then Governor-General, and Dr. Govan was appointed the first superintendent. He was a correspondent of Sir Joseph Banks, and I think there is evidence in their correspondence to show that both were then aware that the tea plant was indigenous in that district. Indeed, Dr. Sigmund, the author of a very superior little book on tea, and who had access in 1839 to the records of the India-house, then, perhaps, more complete than now, after the labours of a "Committee of Destruction" has purged them, declares that Sir Joseph Banks was aware, even in 1788, of the same fact, but I have not found any other evidence of it. Be this as it may, the question received no public notice till Dr. Royle, who succeeded to Dr. Govan as superintendent at Saharunpore, revived it in 1827, in its more theoretical form. In the early part of this year, Dr. Royle "first mentioned to Earl Amherst, the Governor-General, the probability of the successful cultivation of tea in the Himalayan mountains, and included it specially in a report which was presented to the Indian Government at the end of that year." In 1831, on Lord W. Bentinck visiting the gardens, he again mentioned the subject, and included it in the report which was presented to his Lordship, read to the Asiatic Society of Bengal, and printed in their Journal of 1832. In the year 1833, in the introduction to his "Illustrations of Himalayan Botany," Dr. Royle adds, referring to the slopes of these mountains, "here there is considerable prospect of success in the cultivation of the tea plant, for the different elevations allow of every variety of climate being selected," and the "geographical distribution of the plant is extended, and the natural sites sufficiently varied to warrant its being beneficially cultivated."[*]

In 1827, Dr. Corbyn found the same wild tea plant, "at Sandoway, in Arracan, and a plant in its natural soil was forwarded from that place for the Governor-General's garden at Barrackpore, and the report was considered of sufficient importance to induce Lord Amherst to place it in the public records, and to forward a copy for the information of the Honourable Court of Directors."[†]

But the real and practical discoverer of this indigenous tea plant was, as I believe, Mr. David Scott, a very eminent civil servant, and, as a contemporary styles him in Indian phrase, "one of the Company's best bargains," who was settled as judge and commissioner in Cooch Behar and Rungpore, in the very places pointed out by Sir Joseph Banks as suitable for tea culture, and who, when the first Burman war broke out, in 1825, was appointed commissioner on that frontier, conducted the affairs of the war, and, when Assam was ceded to us, took charge of the settlement of that province, dying in the prime of life, in 1831, worn out by his labours in that post. I cannot resist this opportunity of asking for some tardy justice here to the memory of that very eminent man, because, many years after his death—when the merit of the discovery was claimed by others, and they were rewarded for it—his efforts in the cause were forgotten or neglected in India, and evidence which I have recently fallen upon in London seems to place his claims beyond any reasonable doubt.

Mr. Scott was a man who, beside his abundant official labours, devoted much of his time and means to agricultural and horticultural pursuits for the benefit of India. He was one of the original members of the Agricultural and Horticultural Society of India, founded by the venerable Dr. Carey, at Calcutta, in 1820, and contributed one of the first papers read to the Society, on "A New Mode of Preserving Seeds."

To resume.—Sometime after 1819, and certainly not later than 1821, Mr. Scott sent down to Calcutta to his friend, Mr. James Kyd, the son of Col. Kyd, the correspondent of Sir Joseph

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[*] Moorcroft and Trebeck's Travels, 1819-1825. Edited by H. H. Wilson, London, 1841. 8vo., vol i., pp. 329 and 351.

[†] Hamilton's MSS., India-office, quoted by Walker, Tea Report, 183 [illegible] 8.

[‡] Heber's "Journal." London, 1828. Vol. i., p. 513.

[*] "Report on the Culture of the Tea Plant in the Himalayas from 1835 to 1837," by Dr. Forbes Royle, *Journal of the Royal Asiatic Society*, p. 1849.

[†] "Corbyn's Indian Review," vol. i., p. 311. Calcutta, 1837.

Banks, a specimen of this tea, writing thus:—"The enclosed leaves are said to be those of the wild tea plant. I have not been able to get the flowers with seeds, but I have some plants that I hope will survive, and plenty more are favourable. The Shans, Burmahs, and a Chinaman that is here, say that it is the tea plant, perhaps the species that Mr. Gardner sent down from Nepal." That specimen was handed to Dr. Wallich by Mr. Kyd, and included in the Indian herbarium brought home by him, and presented by the East India Company to the Linnean Society of London. When examining the catalogue of that collection drawn up by Dr. Wallich, I was struck by an entry titled, "Camellia? Icottiana," and on referring to the actual plant I found still attached to it the last sheet of Mr. Scott's letter, quoted above, in the shape of a P.S., but unfortunately without the date of the year, which also the post-mark does not bear. I do not detain you with the evidence that satisfied me of the real time, and that this specimen was in no ways to be confounded with others sent from Munnipore by Mr. Scott in and after 1826, to the secretary of the Indian Government, and others that have been confounded with it. I found also that Dr. Thistleton Dyer, of Kew, had recently examined the plant, and in a memoir he read to the Society, "On the Determination of Three Imperfectly Known Indian Tea Plants," in 1873, had described it, stating that, "After careful examination I feel satisfied that Mr. Scott's belongs to the Assam tea plant, and the late Dr. Anderson appears, from a MS. note in the Kew herbarium, to have arrived at the same conclusion." Desiring to satisfy my surmise, I applied to Mr. Clark Marsham, resident of Calcutta, at the time, and he was kind enough to write to Mr. M'Clelland—the very highest living authority on the subject—and that gentleman, in a letter I received yesterday, fully confirms the claim, writing thus:—"The circumstances brought to light by Mr. Burrell coincide exactly with what I have always understood to be the fact, that specimens of the plant and seeds of the indigenous tea plant had been sent by Mr. Scott through Mr. Kyd to Dr. Wallich as early at least as 1821. I may have obtained this information from old Mr. Inglis, of Sylhet, who was a contemporary of Mr. Scott as well as a personal friend, and very likely to be acquainted with such a circumstance. I may also have learned it from Mr. Griffith, who was quite positive as to Mr. Scott's claims, and who had the advantage of looking over Dr. Wallich's collections in England before he went out to India in 1832, and may possibly have come across the very specimens brought to light by Mr. Burrell. Had Mr. Scott's discovery in 1821 been taken up in an active and enlightened spirit, several years might have been gained, but public spirit was not prepared at that period for much enterprise, and we were content to receive our teas from China. Besides, Mr. Scott had not at that time reduced the tribes on the frontier to subjection, and their troublesome character was kept alive by our war with Burmah, and, above all, we wanted Lord William Bentinck, without whom the second discovery of the tea plant might have shared the fate of the first. What we have most to regret is that Mr. Scott's discovery was not properly recorded, when steps might have been taken, with his assistance, for the transmission of seeds and plants to the Botanic Garden in Calcutta, where the tea plant could have been propagated twelve years before its subsequent discovery in Assam."

I have recorded these authentic and undoubted facts, and others, though perhaps not so reliable, could be mentioned, to show that long before 1834 (an era in the history of the enterprise to be immediately adverted to) along the whole range of the sub-Himalayan region, from the head waters of the Jumna and the Ganges to the frontiers of Assam, and through that province to Burmah, in the very tracts where tea at the present time is most successfully cultivated, indigenous tea, capable of being used as a beverage, was believed or known to exist, and because, in ignorance or neglect of these facts, and when the observers I have quoted were all dead, other claimants for the merit of discovery appeared, and were rewarded, as I think, unjustly.

It naturally occurs to one to ask how came it that all the information was neglected? It all went before the authorities at Bengal and reached England. Well, the answer is this. At that time the Linnean system of botany was in the ascendant, its great author had made tea a separate species, parting it from the camellia, to which it was nearly allied. The great botanical authority at Calcutta, Dr. Wallich—a Dane—was a pupil of that school, and whenever any of these tea plants were submited to him he decided they were camellias, and not tea plants at all, and pooh-poohed the possibility of any tea being found wild in India.

It is only fair to say, however, that though scientific botanists ought to have judged otherwise, it was no wonder that others were not ready to identify this indigenous tea plant with that of China, considering the very different size of the leaves and external appearance of the plants. By the kindness of Mr. Sowerby, excellent specimens of the two plants, in full growth, have been sent here to-night from the gardens of the Royal Botanic Society, Regent's-park, and are now on the table before you; and you have on the walls very beautiful dried specimens of the leaves, from which you will observe that, while the China plant has leaves about the size of the myrtle, those of the indigenous plant are very greatly larger, resembling in size the laurel, or the cultivated camellia, with which last they would, to an unscientific eye, appear almost identical. But botanists, now-a-days at least, disregard such merely external differences, and class plants by more certain analogies.

From 1830 to 1832, committees of both Houses of Parliament examined the whole affairs of India and its relation with China, in connection with the policy to be adopted towards the East India Company, whose charter was expiring. The question of tea was largely dealt with in connection with the China trade, and they took some notice, though not much, of its possible cultivation in India.

At that time, Sir Charles Grant (afterwards Lord Glenelg), chairman of the Board of Control, paid particular attention to the tea question, and at his request Dr. Wallich, who was then in England, drew up a memorandum, which was presented to Parliament, and he was also examined on the subject before the committee.

Lord William Bentinck was appointed Governor-General of India, in July, 1827, and arrived in India about a year afterwards to fill, in the interests of peace at least, and of the moral and material interests of India, his bright though bitterly criticised term of office. While in London preparing for assuming that high office, the subject of tea culture in India was specially brought under his notice. A Mr. John Walker about that time presented to the directors a very able memorial on the subject, and that and other information was communicated to his Lordship, with, it is presumed, an intimation of a more favourable disposition on the part of the magnates of Leadenhall-street to promote its success. At this time the policy of renewing the Company's charter was under discussion, and as the event proved, its monoply of the China trade was abolished. In 1833, the whole trade with China, and the right to import tea, was thrown open to private enterprise.

At last, in 1834, the East India Company sanctioned proceedings really calculated to promote the growth of tea in India. On 24th January, 1834, Lord William Bentinck, as Governor-General of India, issued a minute, constituting a committee in Calcutta, "for the purpose of submitting a plan for the accomplishment of the introduction of tea culture in India, and for the superintendence of its execution." "It is not necessary," his Lordship remarks, "that I should trouble the Council with many remarks to support the abstract question of the great advantage which India would derive from the successful introduction of the tea plant; and the only points for consideration are, whether there are not reasonable grounds for the conclusion that there must be, in all the varieties of climate and soil between the Himalayas and Cape Comorin, combinations of both, that must be congenial to this particular plant, and knowledge and skill for its cultivation and for the subsequent process of preparing the leaves for use. * * * The naturalisation of so many foreign plants and vegetables, the natives of climates very different from our own, would of itself afford very sufficient encouragement for any attempt of this kind. There are, however, some shrubs and trees that are familiar to us, of such delicacy as hitherto to have languished wherever transplanted; the mangostein is one of these; the claret grape has deteriorated in every other spot, and probably the same is the case of the hock grape. In both instances the desideratum has been a peculiar soil, united to a particular climate. We have no such cause of apprehension with regard to the tea plant, which flourishes over a space embracing many degrees of latitude. As a practical agriculturist, I am inclined to think that few of the foreign herbs or plants that are become not only naturalised but also the mainstay of our agriculture, did not afford, in the first instance, a greater promise of successful experiment. * * * The only real difficulty that occurs to me is the impossibility of having access to the tea countries, and of thus having personal and local knowledge of all particulars relating to the cultivation and manufacture. If I had not been to the eastward, when the opportunity was given me of observing the character of the Chinese adventurers there, their superior energy, their industry, their spirit of speculation and calculation of profit, quite equal to that of any European nation, I should never have entertained the conviction which I did from that moment that this or any other scheme was perfectly practicable through Chinese agency. I, therefore, now most strongly and confidently recommend that the attempt should be made; and I propose that a committee, of which I will present a list hereafter, shall be formed for the purpose. * * * My own idea is that an intelligent agent should be selected, who should go down to Penang and Singapore, and in conjunction with the authorities there, and the most intelligent of the Chinese agents, should concert measures for obtaining the genuine plant and the actual cultivators, who, upon inspection of those spots that upon their representations of the requisite peculiarities of soil and climate shall have been selected as the most eligible shall then be employed, under the promise of a liberal remuneration, to carry on the cultivation. I know no one better qualified to select the best means adapted to that end than Mr. Gordon, of the late firm of Mackintosh and Co."

I have quoted this minute almost entire, because it is no mere dry official production, but as showing that the "man," as well as the "hour" adapted and propitious for the enterprise, had at last arrived.

Within a week (1st February, 1834) a minute of the Governor and Council of India was issued in exact accordance with Lord Bentinck's proposal. The committee consisted of 13 gentlemen, seven then holding high office in the Bengal service, among whom I may specify as well-known names Messrs. Pattle, MacSween, J. R. Colvin, Sir R. Colquhoun, and the only now surviving members, Sir Charles Trevelyan and Mr. Ross Donelly Mangles; three great Calcutta merchants, Messrs. Grant, Robinson, and Wilkinson; Dr. Wallich, the botanist; Mr. Gordon, who was also appointed secretary; and two native gentlemen of eminence.

The committee met on the 13th February, and had before them a very enthusiastic memorandum, drawn up by Dr. Wallich, and the secretary, predicting "that the cultivation of tea in India for the English market would be an addition to the wealth of India, after making every allowance for the fall in price that may be expected to follow the opening of the trade with China, of from two to three millions sterling per annum;" and recommending that they should be at once despatched to the Himalayan districts, to select sites there for the purpose. This proposition, however, did not commend itself to the committee, and instead they directed a series of queries to be prepared and forwarded to gentlemen in various parts of India likely to afford valuable information. These queries, after being sanctioned by the committee, were circulated, and produced important information from many sources, and notably two very remarkable answers, which mainly directed their future proceedings and may be truly said to have influenced the whole after course of the culture of tea in India.

The first received was from Dr. Hugh Falconer, then an obscure medical servant of the company, who had been quite recently attached as deputy, and ultimately succeeded Dr. Royle as superintendent of the Saharunpore Botanic Garden. To those who knew Falconer it is needless to say how able and exhaustive any such work of his should be, but what will surprise them was the alacrity and speed with which he responded to the committee's call—within the space of a few days,—I can speak with confidence, for I have had his original draft and all the correspondence before me—and, without the aid of books or scientific apparatus, he prepared and forwarded to Calcutta one of the ablest papers that even he ever drew up, and which so struck the committee that, in their report to Government, they acknowledge that "for the facts and reasonings which led them to adopt the sub-Himalayan regions as entirely suitable for the projected culture, they relied especially on the able and interesting report they had received from Dr. Falconer on the subject."

Mr. Gordon, the secretary of the committee, was sent off direct for China in June, 1834, and arrived at Macao in the middle of July, whence he reported that he was promised every aid from Messrs. Daniell, Reeves, and Beale, the company's chief officers, as well as from the great houses of Dent and Jardine, who all took a lively interest in the proposed scheme. Our relations with China were at that time in a very critical position, and presented obstacles to Mr. Gordon's exertions which he could not altogether overcome. He succeeded, along with Mr. Gutzlaff, the missionary, and others, in an excursion to the tea-hills, where the Ankoy tea was made, and obtained information of great value, but an attempt to ascend the river Min, with the view of visiting the more important tea districts of Fo-Kien, was frustrated. Nevertheless, Mr. Gordon succeeded in obtaining a large supply of seeds of true Bohea tea, which arrived in Calcutta, on 23rd January, 1835, filling one hogshead, one quarter cask, and a smaller case. These, in accordance with the directions of the committee and Government, were divided and distributed for cultivation in Kumaon and Sirmoor, in the Himalayas, in Assam, and to Madras, to be tried in Mysore and the Neilgherrie hills. The fate of these seeds I shall afterwards relate. Mr. Gordon had sanguine expectations of being able to penetrate the tea countries in the ensuing spring, and thence obtaining plants from the best districts, and labourers skilled in the manufacture of the plant, but a new phase occurred in the procedings of the Tea Committee, which led them to recall Mr. Gordon from China with his task only partially fulfilled. This they did on 13th March, 1835, and that gentleman, in obedience to his instructions, immediately left China, but, on his arrival in Calcutta, the committee were so impressed by his representations of the impolicy of his recall, after making all the arrangements necessary for procuring plants and skilled workmen, that, in September, 1835, they applied to and obtained from Government authority for his return to continue his labours there, and he returned to China accordingly.

The second important communication replying to the circular and queries of the committee was received in May, 1834, from Capt. Francis Jenkins, the agent for the Government in Assam, who from Gowhatty wrote thus: "From general information, and from my own observation, I am so fully impressed with the belief of the fitness of Assam for the growth of tea, that I beg to call the attention of the committee to that region in the most forcible manner in which I can, with the view to its examination by a competent individual. * * * Camellias are found in every part of this country, and within the jurisdiction of the Singpho district, a coarse variety of the tea plant is, as I am informed, undoubtedly indigenous. A plant was given to me at Sudya, which I have reason to believe was a genuine tea tree, and I intended to have brought it to Calcutta for examination; but I received it in a sickly state, and, from the prevalence of great heat, I was unable to take it to the Presidency. I shall endeavour to take another plant or two for the satisfaction of the committee. I have no doubt myself of the fact of the tea shrub being found wild in the Eastern parts of Assam."

It would appear that the old bugbear of camellia was still maintained, but Captain Jenkins was, as Sir Charles Trevelyan, who knew him well, tells me, "a zealous large-hearted public servant of the old Anglo-Indian school," and as I will add, a worthy pupil ot David Scott, his predecessor in the post, and was not to be put off thus. In effect he plainly told Dr. Wallich, "I don't care what you call it, a camellia if you will, but it is a tea plant nevertheless, and tea can be made from it. We must have some really competent and unprejudiced person here to decide the fact." A few weeks later Captain Jenkins increased the evidence, by sending a letter he had received from one of his own officers, Lieut. Charlton, stationed at Sudeya, abundantly proving the prevalence of the plant in Upper Assam, and that good tea was made from it, and he finally clenched the nail on the 8th November, 1834, by forwarding another letter from Lieut. Charlton, accompanied by seeds and leaves, and stating, "As the best test that the tree is not a camellia, as Dr. Wallich imagines, I send also some of the leaves made into tea. It appears coarse, owing to the leaves being large and much too old, which could not at this season be obviated, but at the end of the cold weather, when the young leaves are on the trees I hope to send you as good black tea as is generally received from China;" to which Captain Jenkins simply added this significant indorsement, "I have sent the jar of tea leaves and box of seeds. I hope you will see from them that ours is genuine tea, as it appears to me."

This was such a challenge as Dr. Wallich could neither avoid nor decline. A week's examination of the seeds and leaves sufficed to convince him. He drew up a learned paper, with elaborate drawings of the Assam tea plant now so called and his old friend the camellia, and pointed out those distinctions which satisfied him at last that they were different plants. Not only so, but he went off quite on the opposite tack, and immediately announced, *urbi et orbi*, the grand discovery in the following gowing terms (10th Dec., 1834): "We feel no hesitation in looking upon the fact of the genuine tea plant being a native of our territories in Upper Assam, as incontrovertibly proved, and in pronouncing the discovery (which is entirely due to the indefatigable zeal and research of Captain Jenkins and Lieutenant Charlton) as the most important and valuable that has ever been made in matters relating to the agricultural or commercial resources of this Empire, promising incalculable benefit to the country, and amounting also to a demonstration of the object of the committee's investigation being before long completely attained."

There is no zeal, surely, equal to that of a recent convert. This somewhat inflated announcement was a little toned down, but in substance adopted by the committee on 24th Dec., signed by all the members, with the significant exceptions of Sir Charles Trevelyan, and Mr. MacSween. I should mention that though Lord Bentinck nominated the committee, it was among the last of his official acts, and he left Calcutta before the committee was fairly in operation. His restraining hand, sound judgment, and thorough interest in the cause were therefore wanting, and the committee, all of them men heavily engrossed in their own pursuits, perhaps left too much sway to their zealous and active colleague, Dr. Wallich, and hence arose many unfortunate events in their history which might have been avoided. At the same meeting the committee further adopted the recommendation of Captain Jenkins, and submitted to Government the names of Dr. Wallich, Dr. M'Clelland, an eminent geologist, and Mr. Griffith, another rising medical man in the Company's service, and who was soon to prove one of the first botanists of the day, "as a deputation to Assam for the purpose of collecting on the spot the greatest variety procurable of botanical, geological, and other details, which, as preliminary information, are absolutely necessary before ulterior measures can be successfully undertaken for the cultivation of the tea-shrub of that country." A month later the requisite authority was obtained from Government, and in March the deputation was directed to proceed to Assam after the rains, and, in the meantime, Mr. Gordon was recalled from China, as I have already stated.

The deputation left Calcutta on 29th August, 1835, and arrived at Sudeya, the frontier station of Upper Assam, close to the Chinese province and tea country of Yunan, early in January, 1836, and thence traversed the country along the Berhampooter, finally quitting it on the 9th of March, after having collected the most satisfactory evidence of the widely spread prevalence of the genuine tea plant. Mr. Griffith and Dr. M'Clelland published detailed reports, but Dr. Wallich confined himself to a few letters to the committee when in deputation, and did not furnish any completed report as was expected. Thereupon ensued a long and bitter controversy—the battle of the botanists—relative to the merits of indigenous or imported tea, and the proper climates and soils for their cultivation. I shall not go further into detail of these miserable quarrels that raged for years among these eminent and excellent men and their partisans. It is painful to read even the printed record of their disputes, but still more saddening to examine, as I have recently done, the dim and faded letters of their private correspondence, in which the controversy is carried on with still more vehemence and angry feeling, and with little other result than to complicate and retard the progress of an enterprise that all of them had so much at heart. Suffice it to say, that the result of these inquiries was to satisfy the Government, and led to a determination on their part to cultivate the tea of Assam. The Court at home thereupon authorised the Indian authorities to "establish an experimental establishment in Assam, for the purpose of cultivating and manufacturing of tea; and when the experiment should be carried to a successful issue, the future cultivation and manufacture should be left to industrial enterprise."

The initiation of the culture was left by the local government too much in the hands of the committee, or rather of its officials, and the great mistake was committed at the outset of commencing on too grand a scale. Instead of beginning with one small experimental garden, as was apparently intended by the home authorities, numerous and widely scattered plantations of large extent were at once opened, and in the meanwhile Chinese cultivators and operators, having been despatched from China by Mr. Gordon, had arrived and were prematurely set to work. An expensive class of superintending officials, in no way fitted by previous experience, were appointed, and for two or three years, notwithstanding several checks from the Government, both in India and Europe, things were carried on with a high hand, in the belief that the fortunes of India, rather at a low ebb at the time, were destined to be retrieved by their exertions.

In 1836, a small sample of the tea, made from the wild plant, about 1 lb. weight, reached London, and was laid before the directors. This had been taken from the wild plant in the neighbourhood of Sudeya, and had not undergone the proper process of manufacture.

In the following year, about 5 lbs. were received by the company, and on being submitted by them to the London brokers, were reported on favourably, and as holding out a fair promise that good tea could be made in Assam.

At last in 1838 a consignment of 12 small chests, made from plants that had been transplanted and more carefully manipulated, and exceeded all the expectations that had been formed, weighing about 40 lbs. each, were received, of which the directors distributed 4 chests among brokers and others, and the remaining 8 chests were disposed of at the public tea sales in Mincing-lane, by Messrs. Thompson and Co., the Company's brokers, in January, 1839, and fetched fancy prices, the Pekoe kind from 24s. 6d. to 34s. a lb., average 28s.; the Souchong, 16s. to 21s., average 19s. per lb. The novelty of the supply excited great attention among the brokers and tea dealers, who were naturally anxious to obtain some portion of the tea. A competition of an unusual character ensued, which raised the price far beyond the most sanguine expectation that had been entertained. Although the tea was known to have been slightly deteriorated by inattention during its transit, and by the firing it had gone through in re-drying it at Calcutta, it was generally acknowledged to be equal to the China Souchong tea of the market; it was expected that a price somewhat higher would be given for it as an article of curiosity, but such was the anxiety to get possession even of a single chest, that prices were run up to a mark never known before or since in Mincing-lane. It transpired, however, that the whole had became the property of Captain Pidding, the proprietor of the then celebrated "Howquas Mixture," who determined to secure this novelty of British industry at any price. That gentleman does not seem to have made a bad investment, for, as alleged, he afterwards disposed of it in small samples at the rate of half-a-crown an ounce. This, of course, was no test of the commercial value of the tea and no guide to the directors of the Company, but the valuations and reports of the brokers and other authorities, among whom the other four chests were distributed, were of a different cast and value. Most of them were in writing, and the whole, now forming a considerable volume of the India records, have been partially printed here and in India. They were on the whole very favourable, and were unanimous in the belief that, with more careful manipulation, the Assam tea would prove equal if not superior to China, but the most practical test of all was an offer from a Liverpool house to contract for 500 or 1,000 chests at from 1s. 10½d. to 2s. per lb., the current price at the time for the best class of China teas of corresponding kinds in bond.

The next year's crop, that of 1839, reached London in the beginning of 1840, and consisted of 95 boxes, of which 10 were distributed, and 85 sold by auction on 17th March. Although the prices which the sale produced did not approach those of the former year, they were still, nevertheless, excessive as regards the relative value of the tea, as compared with tea of a similar character from China, running from 4s. 9d. to 11s. 1d. per lb. The opinion of the brokers and other experts were still very favourable, and they generally remarked the decided improvement which had been made in the manipulation and firing of the teas, to adapt them to the existing tastes of the English market.

These very favourable results induced many attempts in London to form companies, with the view of carrying on the cultivation so inaugurated by the Indian Government. Numerous applications of the kind were made in 1839 and 1840 to the directors, and the Court intimated to them all "that there was every disposition on their part to encourage and promote the views of any capitalists of respectability who might be desirous of undertaking the culture and manufacture of the article on an efficient and extended scale, consistent with the rights of individuals, the prevention of monopoly, and the protection of local interests." The upshot was that two of the most powerful applicants coalesced, and formed "The Assam Company," to whom, in 1840, the Government of India ceded the greater part of their tea plantations in Assam, and thenceforth practically withdrew from the enterprise.

II.—Progress of Tea Culture.

In order to save time in verbal geographical descriptions, I beg to call your attention to the maps on the wall—the very large outline map of India belonging to the Society, and the large administration map which has been lent me from the India-house. On these I have distinguished all the tea-growing localities in India by small coloured flags, the blue showing those where the indigenous plant is chiefly grown, and the red where the China shrub prevails. There are also maps of the Assam districts—one in 1846, when the Assam Company only was in the field; another for 1866, when the cultivation had attained very great proportions during the tea mania of 1862-4; and one showing the whole existing plantations in Assam at the present time. There are others of the tea districts of the North-Western Provinces and the Punjab, and finally of the tea gardens of Southern India on the Neilgherries. On all these sectional maps each individual plantation is coloured green, so that they speak to the eye, and give you a good idea of the extent and distribution of the whole tea-planting industry in India.

The Assam Company was constituted on 31st January, 1840; a few months later they organised a separate establishment in India, to whom they devolved the practical direction of affairs. They received a charter of incorporation from the Indian Government in 1845, and ultimately found it necessary to abolish the Calcutta management, and concentrate the entire control of the company's operations in London, under a special Act of Parliament. The first general meeting was held in London, on 7th May, 1841. The capital was £500,000 in £50 shares, but no more was ever called up than £200,000, upon which the company has worked from the outset.

It would be interesting and instructive to follow out the operations of the company in its earlier years and later progress in full detail; but, besides there being no time for it here, the conditions and progress of the whole Assam culture has already been described and discussed here by Mr. Leonard Wray in 1861 (*Journal of the Society of Arts* vol. ix., p. 137); by Mr. Filder 1869 (*Journal*, vol. xvii., p. 291, 323); Mr. Frederick Campbell, in 1872 (*Journal*, vol. xx., p. 424, 450, and 498); and still more recently in 1874, by Dr. Campbell (*Journal*, vol. xxii., p. 174), formerly superintendent of Darjeeling, I shall, therefore, content myself with a short account by an eye-witness, which very graphically sums up the history of the Assam adventure. I quote from a work published by Colonel Nassau Lees in 1863, the fairest, the ablest, and the most readable of any of the numerous books on the subject, and as coming from a practical tea-planter, not in Assam only, but in the Himalayas, speaks with great authority.*

> In 1840 the Assam Company commenced operations, on a scale of expense in keeping with the existing idea that the profits of the undertaking would be so rapid and so enormous, as to render any attempt at economy imprudent and unnecessary. Under the exciting influence of this false idea, the most extravagant expenses were incurred and sanctioned; and that nothing might be wanting to promote the enterprise, Government liberally transferred to the company its superintendent and two-thirds of its own plantations and establishment.
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> But alas for the vanity of human expectations! Both Government and the company were doomed to disappointment. The soil in one place was not selected with reference to the requirements of the plant—labour in another was insufficient, the cultivation in a third was bad, the superintendence in a fourth was inefficient, ignorance every where was rampant, and to crown all, the tea, when manufactured, was pronounced by the London brokers to be bad. The Assam Company having spent £200,000, the whole of its called up capital, and about £20,000 more, was reduced to a state of insolvency so nearly verging on bankruptcy, that £20 shares were sold in the Calcutta-market for less than one rupee. It was proposed to wind up its affairs. But this catastrophe was averted by the exertions and sound practical advice of one of their local directors. On visiting the plantations this gentleman found them so choked with weeds that not a single plant was visible. Large sowings had been very regularly made, but, unfortunately, had as regularly been suffered to be destroyed, by the jungle and rank vegetation which springs up in Assam with magic rapidity. The company's capital had literally been poured out upon the earth, and there allowed to rot. With the keen eye of an experienced man of

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* "Tea Cultivation in India." A review, by W. Nassau Lees LL.D. London, 1863. 8vo.

> business, however, Mr. Mornay saw in in the devastation before him the germs of success. Instead, therefore, of advising the company to wind up its affairs, he at once set about rectifying the errors that had been committed. But to make a tea garden is a matter of time, and consequently for some time the position of the company, in public opinion, did not improve (1846-7-8.)
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> The prospects of tea in Assam, so bright in the commencement, were now dimmed almost to extinction; and had it not been for the energy and perseverance of a few individuals, it is possible that the cultivation of the plant would have been abandoned altogether. Among them should be specially mentioned Mr. de Mornay, the regenerator of the experiment, Mr. Williamson, and a military officer, the late Lieutenant-Colonel Hannay, Commandant of the 1st Assam Light Infantry. The latter gentleman having, by high and careful cultivation, brought a small experimental garden of the China plant into a flourishing condition, he obtained a further grant of land, and extended his cultivation with great success (1851). Encouraged by the success which attended their operation, others soon followed their good example, and the work rapidly progressed. The choked up gardens of the Assam Company had by this time been completely reclaimed. A dividend was declared (1852). Planters generally took heart. Proper care was bestowed on the selection of the soil, the cultivation of the plant, and finally on the manipulation of the leaf and other processes of manufacture. The tea, always in itself good, gradually assumed an altered appearance, until at last the produce of the indigenous Assam plant, which the brokers rejected, became more sought after, and once more fetched higher prices in the London market than the very finest China teas.
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> Applications for grants of land now poured in, and were complied with by Government on the most liberal terms. Tea gardens sprung up in Upper Assam by dozens, in Lower Assam (1854), and others in Central Assam, followed in the same course. And, finally, an impulse was imparted to the new cultivation, which has resulted in giving to a province, heretofore a penal settlement, an importance second to none in the British possessions in India.
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> The quantity of land appropriated to the cultivation of tea by the latest returns (July, 1862) had reached the sum of 71,218 acres, 13,222 of which are actually under cultivation, bearing an estimated crop of 1,788,737 lbs. of tea, and affording employment to 16,611 daily labourers. There are now in Assam 160 plantations, owned by 60 companies and individuals. Of the companies, five are joint-stock concerns, the Assam, the Jorehat, the East India, and the Lower and Central Assam; besides which there are 15 private companies, and, if an idea be required of the favour with which the public had come to view India tea investments, it may be gathered from the stubborn fact that the shares of the company which, as before mentioned, were once sold in the Calcutta-market for less than one rupee, can with difficulty be obtained for four hundred and fifty.

At the time when Colonel Lees so wrote, a "tea mania" had begun, and continued to rage for several years afterwards. India was represented in elaborate prospectuses, setting forth in unexceptionable tabular statements the most fabulous profits, as an agricultural El Dorado, where gold and silver were to be plucked off tea-bushes, instead of being dug out of the ground. While the mania prevailed, there seemed to be a notion abroad that any man in the world could plant and manufacture tea. A sailor by profession, who had been all his life at sea; a soldier who for years had pursued the unvarying round of regimental duty; clerks who had never left their desks for two days together; younger brothers of directors, who never had any opportunity of acquiring the requisite knowledge; members of every class of every profession, with all kinds of antecedents, and one common feature—ignorance of tea culture and manufacture, were entrusted the with management of estates, generally the property of joint stock companies, on large salaries; some of them never learned at all, others did, but the experience was dearly paid for by the shareholders. Not a week passed in Calcutta without a new company being launched, and the mania spread to London, and prevailed with even more imprudence there. Tea companies were formed on the most magnificent scale, and it is even on record that one promoter, after he had established his company in London, instructed his correspondent in Calcutta to find some place on the wilds of Assam that would answer for the purely imaginary plantation he had so created. At last the inevitable reaction came. Very many of the companies collapsed, and perished altogether; a few survived, and by restricting their cultivation, placing it under skilful managers, happily tided over the evil crisis, and at last were rewarded in better times for their patience. The results in India especially were very sad. The banks and mercantile community lost largely, but it was not the commercial world who suffered most severely. Civilians and retired officers invested the savings, perhaps of a lifetime, upon which they depended for the means of educating their children, or starting them in the world, or providing for their own old age, in the sanguine expectation of reaping a great increase, and lost all. The estates from which they expected so much were thrown into the market with no demand for them, in many cases abandoned to weeds and wild beasts. At the best, what had been bought at extravagant prices, and managed with ruinous expenditure, did not realise above five to ten per cent. of the outlay; one estate, which was valued at £10,000, and on which the whole resources of the proprietor had been expended, was sold for seven rupees, or fourteen shillings.*

The Assam Company, though they suffered in many ways during this crisis, were benefited in another way. They sold their outlying plantations for high prices, received large prices for their superfluous tea seed, and having at last got their concerns in better order, with superior management, they continued to flourish, paying large and progressing dividends, till last year they divided 26 per cent., with a fair prospect of an increase this year, maintaining themselves still at the head of the enterprise, and obtaining for their produce the best prices in the market.

Such was the progress of the cultivation of indigenous tea-plant in the Assam districts, and we now return to the original China plants imported by the Tea Committee in 1835 and 1836. The first consignment numbered upwards of 40,000 seeds, of which one-half were sent up to the Himalayan district to Dr. Falconer, to be reared in experimental nurseries he had selected for the purpose, in Gurwahl and Dehra Dhoon, and in Kumaon, where at first the enterprise was in the hands of Mr. Traill, the commissioner of that district, but soon fell also to the charge of Dr. Falconer, who, up to 1842, when he returned to Europe on sick leave, had sole charge of all the tea plantations in the north of India. Of all these 20,000, seeds not more than 2,000 with the utmost care bestowed on them, germinated, and even these were very sickly. The same fate attended a large quantity sent to Assam, where, however, they were not carefully nursed, the superior claims of the indigenous plant causing them to be neglected; and as regards the rest sent to Southern India, the whole perished except a few which struggled into existence in the Neilgherries, but were left to grow wild, to be afterwards discovered by Dr. Hugh Cleghorn, on whose report the Government of Madras was long after induced to resume the enterprise with such success, that now tea-planting in that district is in a flourishing condition, and very fine tea is beginning to be imported and consumed in London.

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* "Prichard's Administration of India, from 1859 to 1868," London, 1869. Vol. I., p. 141.

As Dr. Falconer states, "the brilliancy of the discovery of the indigenous plant in Assam very naturally concentrated the attention of the Tea Committee upon that quarter; and after the recall of Mr. Gordon from China, feeble efforts were made towards furnishing the Himalayan nurseries with fresh supplies of Indian seed. They were left in a great measure to work on with the weakened remains of the first despatch." With these, however, he persevered for several years, and having at last, after most urgent representations to Government, obtained the service of several Chinese cultivators and tea-makers, when he left Saharunpore for Europe, in 1842, he carried with him samples of the first tea manufactured in the north of India, which, when submitted to the London brokers, were pronounced to be of the very highest quality, quite equal as regards aroma and fragrance to the most delicate teas of China. He had made a report of his efforts in Dehra Dhoon, Kumaon and Gurwhal, in 1836, but it was neglected, and was not even given in the Blue-book of 1839. In estimating the merit due to those who laboured in the cause, I think his services have been overlooked. He felt this; but when a friend asked him to remonstrate, while others were being rewarded, he declined, but said, "My tea services are undeniable, the experiment was attempted on my recommendation, and conducted by me. The first tea was manufactured under me, and the produce declared by the London brokers to be equal to the best China tea."

On his retirement in 1842, he was succeeded in the management of the Saharunpore gardens, and the superintendence of the tea enterprise in the north of India, by Dr. Jameson, who, up to a few years ago, continued his most valuable and persevering efforts, till the successful cultivation of tea was fairly established. In a series of yearly reports which he made to Government, the whole history of the enterprise is fully and lucidly described. He planted new and additional nurseries. grew and distributed seeds by hundreds of tons, and sent out seedlings in enormous quantities, which were given gratis to all applicants. The tea grown under his care fully maintained in the London market the high reputation gained by the experimental growths of Dr. Falconer; large quantities were sold in India by auction, and realised high prices; the troops were supplied from his gardens, and the beginning of a trade in tea was established with the native merchants of Central Asia, which, though even yet still in its infancy, bids fair, under the more favourable relations with the Chinese authorities, recently established, to grow into great dimensions.

When the Punjab was annexed by us in 1849, Dr. Jameson extended the cultivation of tea there. On the occasion of Lord Dalhousie's first visit to that province in 1850, he was so much struck by the healthy and thriving appearance of the tea plants there, that he authorised the extension of the culture. The lovely valley of Kangra especially attracted his attention, and there Dr. Jameson, profiting by his great experience, selected a site at Holta, near the central town of Kangra, admirably suited for the purpose. When the country was settled the waste lands were not reserved, and considerable difficulties were therefore experienced in obtaining from the natives land for the purpose, but at Holta there was a large tract which, from superstitious reasons, they refrained from cultivating, and that was made over to Dr. Jameson for the purpose, and formed the mother colony of all the numerous supplementary plantations he formed. The success attained by Dr. Falconer and Dr. Jameson, at last, and through the earnest representations of Lord Dalhousie, roused the attention of the home authorities, and they employed Mr. Robert Fortune to go to China in 1848, for the purpose of procuring tea seeds and plants to re-stock the nurseries. That gentleman's mission was very successful, and he returned to India with a supply drawn from the best districts of China, inspected the plantations in Upper India, and reported to the Government on their condition and requirements. Several years later, he was again despatched by the Directors of the East India Company to China, and the facilities he by that time found enabled him still more successfully to introduce the finest kind of seeds and plants, and to report still more favourably on the success, present and future, of tea-planting in the North-West Provinces and the Punjab.* The history is henceforth one of rising and regular progress. By the efforts of Sir Douglas Forsyth, Mr. J. H. Batten, Mr. Egerton, and Col. Paske—who succeeded, by negociation with the natives, in securing land on equitable terms—private enterprise was attracted, and in 1865 the Government sold the bulk of their plantations, retaining a small one for growing seeds and distributing seedlings to the natives, but have since sold it, leaving the business entirely in private hands. When Dr. Jameson commenced the culture in Kangra, the country was in a miserable condition. In his first report for 1852, he gives this description:—

> At the present moment, the great crops in Kangra valley are rice, wheat, barley and sugar, a third of which is exported to the plains. But the time is not far distant, when the canals now in progress in the Punjab are opened, for us to expect that this market will be closed, or rather, that the cultivators will not be able to grow grain at a sufficiently low rate in the Kohistan to compete with the produce of the plains. At the present moment, two-fifths of the Punjab are lying waste, partly owing to the bad management of former Governments, and partly owing to the want of population. Now, security to life and property prevail. Natives are encouraged to settle, populate the country, and break-up the waste lands; and not, as in former days, look to aggression for aggrandisement. The Punjab is eminently an agricultural one, and with the impetus which has, within the last few years, been given to cultivation, it must shortly become the granary of upper India. At present the vast works going on, and the immense demand for foreign labour, tend to keep up the prices of grain; once, however, let these be completed, and the tens of thousands of acres irrigated, which the canals are intended to do, the markets will be so glutted with home

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* See Mr. Intime's "Visit to the Tea Districts of China and India," 1852. 8vo. Also Reports to Government of 1851 and 1856.

> produce as to exclude all foreign competition. Even now the cultivators in the Kangra valley declare that they export their grain at a small remunerating return, and the men who carry the grain complain that their trade is scarcely worth keeping up, owing to the small hire that they receive. caused by the settled and firm Government prevailing in the Punjab, giving security to property, and inducing vast numbers to look to the plough for their livelihood, instead of, as in former days, to the sword. It, therefore, requires no foresight to predict that the Punjab will become the great granary of upper India, and exclude imports of grain from all other quarters. Such being the case, grain will not be worth exporting from the Kohistan. This will be so far satisfactory, as it will greatly lower the prices in the hills, and thus enable the enormous number of idle men, estimated by Mr. Bayley, Deputy Commissioner, at upwards of 10,000, to get food at a low rate. These men, the remnants of the Sikh army, and of bands kept up by the petty Rajahs in the Kohistan, despise the plough, and consider it derogatory to their caste to be engaged in ploughing, though at the same time they will willingly work with a phourah or spade. In this manner alone the introduction of tea into the Kohistan is likely to confer a great benefit on the people, by ensuring work to thousands who might, otherwise, look for a livelihood in rapine and plunder. For employment at Holta, hundreds of Rajpoots have presented themselves, and are willing to be employed, provided that they were not obliged to handle the plough. The plantation in several places admits of the plough being used, but the greater portion must be broken up with the Indian spade or phourah, owing to the high inclination of the land. As soon as the land is planted with tea plants, the labour will be chiefly manual. Under these circumstances, tea cultivation will become popular with a class who have hitherto despised field labour. In Kumaon and Gurwal, high caste Rajpoots and Brahmins willingly engage themselves as servants in the plantations. So in the Kohistan of the Punjab, it will not be long before employment of a similar nature becomes equally popular, and the men who have been in the habit of looking to the sword for their livelihood, find a more certain and profitable work in the spade.
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> Nor is land fitted for tea cultivation in the Kohistan, limited. The Kangra valley is about sixty miles long, and averaging ten miles in breadth; and of it at least half is well adapted to tea cultivation; much land well fitted for the same purpose is to be met with in Kooloo, Mundee, &c., and throughout the western hills. By Captain Hay, Assistant Commissioner, Koolo, a small tea nursery has already been formed at Kanghur, and the plants are growing with the greatest vigour, many of them being four or five feet high. Further to the westward, in the Hazara country, a tea plantation is being formed by Mr. Carnac, Deputy Commissioner, Sind Sagor District, under the auspices of the Commissioner, Mr. Thornton, and his labours will, no doubt, be attended with success. Moreover, and this is a fact of the utmost importance, the inhabitants to the west and north-west are a tea-drinking nation, large supplies being imported from China to supply their wants. So that here there is a market at hand, and all that is required to make a large demand for Punjab teas is low rate of sale. A foreign market is not, therefore, wanted, at least for a time. In addition, the Kohistan of the Punjab, and the north-western frontier generally, possess extraordinary capabilities through means of their rivers; as by them teas can be conveyed, at a small rate, to Kurachee and Bombay, and from thence shipped to the European markets. The roads too, in the Kohistan, are admirable, and admit of beasts of burden being employed in the carriage of teas to the river ghauts, a point of great importance.

This was in 1853. I cannot go over in detail the progress in later times, but the following graphic description of what was the result twelve years later—in 1865—will suffice. I take it from a minute of Sir Robert Montgomery, the Governor of the Punjab, who visited Kangra in that year:—

> Having just completed a tour of the Kangra valley, I am desirous, before my departure from India, of recording my impressions of the state and prospects of tea-culture in that locality, and of the results which have been effected by private European enterprise.
>
> At the period of my last visit, four years ago, with the exception of the Government plantations at Holta, Nagrotah and Bawarnah, there was hardly an acre under tea cultivation. Since then a striking change has taken place. Tea planting has extended through the Kangra and Palam valleys, and has reached even as far as Kulu, and there are now on the slopes of the great Chamba range, between Shaphur near Dharmsala on the west, and Baijnath on the east, and at Bajaarah in the Kulu valley, seventeen estates, covering an aggregate area of upwards of fifteen square miles, belonging to European proprietors engaged in the cultivation of tea. The peasantry, too, are joining eagerly in the movement; tea is now grown in small quantities in 47 villages, and during my march I was not unfrequently besieged by zemindars exhibiting samples of tea, the produce of their own fields.
>
> The difficulties at first experienced in the acquisition of land, have been, to a great extent, overcome through the judicious conduct of the planters in securing the good will of of the inhabitants, and the assistance, so far as it could be legitimately rendered, of the civil officers; and I am now informed that, with conciliation and tact, land may be purchased from the native proprietors without recourse to the good offices of the local authorities.
>
> Most of the estates are grouped in the vicinity of the mother plantation at Holta,—and few localities could have been chosen more desirable or beautiful. Holta is situated about 23 miles east south—east of Kangra, upon the high road to Kulu, Lahoul, Ladak, and Chinese Tartary, and may be described as an undulating slope, descending from the base of an offset from the Chamba range towards the lower hills, enclosing the valley of the Byas. Its altitude, from 4,000 to 4,500 feet above the level of the sea, secures a temperate climate throughout the year; and such is the proximity of the main range, that, within a few hours, you may either ascend to the regions of perpetual snow or descend to the temperature of the tropics. Immediately above are forests of oak, rhododendra, and cheer, the most useful of Himalayan pines, and wild tracts abounding in pheasants and jungle-fowl; beneath are the lowlands of the Palam valley, watered with innumerable streams, which render its fertility proverbial. Labour is plentiful; the people honest and tractable; supplies cheap; irrigation abundant; and, in a short time, there will be road communication with the plains at a gradient suitable for carts. During my stay in this locality I took measures for ascertaining the position and wants of the planters, and the feeling of the native population towards them, with a view of rendering such assistance in the development of this important branch of commerce as the Government can legitimately afford. Nothing can be more satisfactory than the relations between the planters and the native inhabitants of the valley. Though my camp remained here for several days, I heard not a word of complaint; on the contrary, the villagers seem fully sensible of the benefits resulting from the presence of English capitalists; for, as one of them remarked, "cultivators, who a few years ago had hardly clothes to cover them, now count their rupees by hundreds." They have further applied for the establishment of two schools for teaching the English language, half the cost of which they agree to defray themselves.
>
> With regard to the prospects of tea planting, those best capable of judging, namely the planters themselves, are sanguine of success. There can be no doubt that the valley is capable of producing excellent tea, which, even in this infant stage of tea planting, can be profitably sold at from 12 annas, (1s. 6d.) to 2 rupees (4s.) a pound. Local consumption is steadily increasing, and there can be no doubt, from the reports of English brokers. that the finer qualities will find a remunerative sale in England, for mixing with other teas; while there is a prospect of a market for the inferior qualities, prepared in the form of brick tea, in Cashmir, and Central Asia, where such tea is largely consumed, and in those cities in the Punjab where Kashmiris reside, such as Ludianah, Amritsar, Gujrat and Jalalpur. Cakes or brick tea, prepared as samples by the Nassau Tea Company, and priced from one rupee four annas to one rupee eight annas, were valued by Ladak merchants in my presence at from three rupees to three rupees four annas per cake.
>
> As compared with Assam, tea growing in Kangra, it must be admitted, has many disadvantages, in the necessity for high manuring, which renders grazing grounds and herds of cattle an indispensable adjunct of a plantation; in the comparatively slow growth and smallness of yield of the plants,

and in the absence of water carriage; on the other hand, it possesses advantages in the local abundance of labour, which has in Assam to be imported at a considerable expense, and in the great superiority of climate. Upon the whole, there is in my opinion no reason to doubt that tea planting in these regions will yield a good return for capital expended, and though it may be that fortunes will not be realized so quickly as in Assam, it is certain they will be made more pleasantly in the noble scenery and genial climate of the Kangra valley.

Seeing, then, that the cultivation of tea may be considered firmly established in this locality, the time has now come for Government entirely to withdraw from the manufacture.

It is, accordingly, decided that the large Government plantation at Holta shall be sold by auction (of which a notification will be at once published); the small plantations at Nagrotah and Bowarnah being retained for seed purposes only; and arrangements have been made for disposing of the large stock of tea at present on hand.

I cannot conclude this minute without placing on record my highest appreciation of the services of Dr. Jameson, the superintendent of the Government tea plantations, who himself selected the locality, and, after many years exertion, has satisfactorily proved the suitability of the Kangra valley for tea cultivation, and has thus conferred a great, and, it is to be hoped, a lasting benefit on the community.

Colonel Paske, the assistant commissioner for the Kangra district, deserves special recognition for the long continued and persevering attention he has devoted to the success and progress of the enterprise. His reports to the Government in 1869 and 1872 give the fullest details; he has laboured on his visits to Europe on leave, and since his final return to England, to call the attention of the public to the quality of these Indian teas, and to facilitate their consumption here and in the Russian markets. As a farther illustration of the benefits conferred on the district and its natives by the introduction of tea culture, I shall quote from a letter recently addressed by him to the *Times*, which, though directly relating to the question of silver specie in India, affords a more striking idea of what tea has done for Kangra, and aptly supplements the account given in 1865 by Sir Robert Montgomery:—

"In the Kangra district, of which I held charge for several years, the income, mainly from land revenue, was formerly greatly in excess of the expenditure, and the surplus, to the extent of £20,000 per annum, was remitted in specie to meet the Treasury requirements of other districts. In 1873, owing to the rapid extension of tea cultivation and the gradual development of trade, the demand for silver specie became so great within the limits of the district that remittances to other districts entirely ceased. In 1874 and 1875, the income of the district did not meet its requirements in silver currency, and that without any increase of local establishments, or any increase of the military force quartered in the district. In those years I had to apply for specie remittances, to the extent of £20,000 annually, from the treasuries of other districts. At Palumpur, in the Kangra Valley, the centre of the tea estates, there was formerly little or no demand for silver currency. In 1873, 1874, and 1875, I had to send specie remittances to the extent of 30,000 rupees per mensem, for several months in each year to Palumpur to meet the demands of tea planters for the encashment of Government currency notes. Up the time when I left India, in November, 1875, the increasing demand for silver specie, not alone in the populous tracts of Kangra Proper, but in the thinly-populated outlying sub-divisions of Kulu and Lahore, was very marked. The still continuous extension of tea cultivation and manufacture, and the expansion of trade with Ladakh and countries in Central Asia, lead to the belief that the local demand for silver will still continue to increase. Such are facts relating to one only out of the 32 districts comprised in the Punjab Provinces. It is true there is a special industry—tea cultivation and manufacture—confined to the Kangra district in the Punjab, the rapid extension of which, during the last few years, has given increased employment to the labouring classes. But I believe that the extension of cultivation and the development of trade throughout the provinces generally have led to a great increase in the demand for silver in all other districts, and the general cry among treasury officers has been and still is for more silver coin. While this increased demand for silver for circulation in the interior of districts in the North-West Provinces and the Punjab is very marked, the absorption of the metal for purposes of ornament and jewellery is still more remarkable. As the result of my personal observations in the extensive tracts of country comprised in my district, I can testify that in every town, village, and hamlet, the number of working jewellers and silversmiths is on the increase, and that the bulk of the labouring and agricultural classes are gradually, and to a surprising extent, substituting silver ornaments for men, women, and children, in place of those of brass and copper, and of beads, &c.

And I conclude with quoting the words of the present Governor-General of India, who visited Kangra in the course of his progress to the great assembly at Delhi, in December last, and thus addressed the tea planters, who were urging the Government to afford them further facilities for the transmission of specie through the Government treasuries:—

Before I reply (Lord Lytton said) to the memorial you have just read, allow me in the first place to assure you that it has afforded me a triple pleasure—a pleasure which I appreciate as a traveller, as a guest, and also as a man interested in, and to some extent responsible for, the government of this great empire, to have the opportunity of meeting you here upon the ground which your enterprise, your capital, and your intelligence have converted into what seems to me an earthly paradise. It is said to have been the custom of the old Greek exiles to carry with them in their wanderings, wherever they went, a handful of their native earth. But you, gentlemen, have carried with you, not indeed a piece of English earth, but an abundant store of those English habits and qualities which improve and embellish every piece of earth beneath their beneficent influence. Where you settle, there the church and the school spring up; and round the church and the school, the graceful villa, the thriving village, the blooming garden. And now, having congratulated myself on the welcome you have given me, let me also offer to you, gentlemen, my sincere congratulations on the success with which you have established your domicile in this delightful valley—a valley which so far resembles the happy valley of Rasselas, that nothing seems wanting to the happiness of its inhabitants except the fulfilment of those wishes which happiness itself creates. This, at least, is the impression I derive from a sympathetic attention to the memorial you have presented to me. I gather from that memorial that your enterprise has been, commercially and financially, so successful that at the present moment you are actually suffering from what our French neighbours would call an embarrassment of riches, in other words, from a plethora of currency notes, which you cannot get rid of fast enough. As a consolation for the misfortunes of less favoured mortals, proverbial philosophy assures us that every cloud has it silver lining, but in the present case, gentlemen, it is the absence of a silver lining to these pockets full of notes which seems to be the only cloud on your prosperity. I consider that your case is an exceptional one. In the excellent results of these tea-plantations of the Kangra Valley, which, as you remind me, have been fostered and encouraged by the Government of India, I recognise imperial benefits so considerable as to entitle the authors of those benefits to a special claim on the consideration of the Government. Your undertaking has not only been remunerative to yourselves; it has afforded lucrative employment to thousands of the population of this district. The effect of its example, no less than that of its results, is not merely local; and, so far as its social and political influence extends, besides being eminently creditable to the British character, it is also conducive to the stability of the British Raj. For all these reasons, gentlemen, my sympathies are with you; and it will afford me sincere gratification should I find it practically in my power to give effect to your wishes.

III.—Prospects of Indian Tea.

I can only detain you further with a few words on the prospects of Indian tea, and I could not introduce the topic more appropriately than by quoting the remarks on the subject of one of the leading houses in the trade, Messrs. Travers, in their annual tea circular for 1876, issued a few days ago, remarks:—

> "The Indian tea trade during the past year (1876) has been uninterruptedly prosperous, for the greater imports have been followed by a proportionate increase in the use of Indian tea, which now, indeed, forms not far short of a fifth of the whole consumption, while the larger supplies have been disposed of at rates highly remunerative to the planters. During the last ten years the weight exported from India has arisen from 2,500,000 lbs. to 28,126,000 lbs. —an increase of over eleven times; and while the next crop is expected to yield 35,000,000 lbs., it is generally thought that the great extension of the gardens, caused by the profitable character of the trade during the past few seasons, will within a few years lead to an export of 60,000,000 lbs. If the present promise for the coming season be maintained, it appears probable that we shall receive 32,000,000 lbs. during 1877, and if the increased imports be consumed—as there seems little doubt that they will be—Indian tea will form about one-fourth of the consumption. Many of the leading and keenest grocers now use one half of Indian tea in their mixtures, and are thus enabled to buy lower-priced China teas. By this course they are enabled to offer a better tea than their neighbours, and the public, who still adhere to the traditional teaspoon as the measure of the quantity to be infused, do not, as it might be thought that they would, diminish their consumption, but congratulate themselves on getting more strength and flavour for their money. Some progress has also been made in the retail sale of unmixed India tea, as most of the leading grocers who study the trade now make separate offers of it. But as the flavour is so totally different to that to which the public are accustomed, the planters can only expect a very gradual advance in the use of their tea by itself, for which, however, the increasing quantity used in mixing is gradually educating the nation."

Let me now show you in a very few and striking figures the wonderful development during the last 15 years in the consumption of the Indian tea in the United Kingdom. I shall not refer to quantities grown or imported, but only to the actual amount that went into the British tea-pot during these years.

In 1861 Indian tea was taken to the extent of 1¼ million of lbs., and formed only 1 per cent. of the total consumption.

Three years later, in 1864, when the duty was reduced to 1s. a lb., the Indian supply had reached 2½ million lbs., and was 2½ per cent. of the whole.

In 1867, the duty having been reduced in 1866 to 6d. the lb., the Indian consumption had again doubled to 6 million lbs., but the relative proportion was increased still more, viz., to 6 per cent.

In 1870 the quantity rose to 13½ million lbs., and the ratio to 10 per cent.

During the last six years a still greater increase was attained, the whole quantities increasing by about 3 million lbs. a year, and still encroaching rapidly on the relative proportions of the total supply, the figures are:—

1874 ..	21 million lbs.	=	15 per cent.
1875 ..	24 „	=	17½ „
1876 ..	27 „	=	19 „

And as Messrs. Travers and other trade authorities estimate, the current year is expected to raise the supply to 32 million of lbs., or about one-fourth of all the tea we shall consume throughout the United Kingdom, a quantity equal to the total consumption of the country in 1841, and half of that even so late as 1857, when the great reduction of the duty had been for some time in operation, and had led to a vastly increased consumption.

The proportions, as at present supplied from the different tea districts of India, are roughly these—

	Per cent.
1. Assam	50
2. Cachar and Sylhet	25
3. Darjeeling	13
4. The Himalayan Districts of Kangra, Kumair, and Dehra Dhoon	10
5. Chittagong, British Burmah, Chota, Nagpoor, and the Nilgiris	2
	100

These quantities and proportions, great as they are, are but a small part of what India, if called on, could produce. In Assam alone there is at present under actual cultivation as much land, if raised to its full bearing powers, as would in a few years meet the whole demand of this country. Much of the land actually under crop is occupied by new and immature plants, which produce no tea till three years old, and do not attain their full bearing till the seventh year. Nor have the plantations, as a rule, yet attained anything like their maximum capacity of production, the average yield per acre of the Assam Company, the oldest of them all, and some of the more advanced plantations in that or other districts, producing at present double or treble the crops of others not yet cultivated to the fair limits of their resources. In fact, with her present cultivation, and the increase of existing plantations within their present holdings, not to speak of millions of acres of still available land, from Cape Comorin to the Himalayas, possessing every advantage of soil and climate for the growth of tea, India could supply not only all the possible demands of this country, but the wants of all the world besides.

As regards price, Indian tea has always commanded the highest rates in the London market. Last year, while the average price for Indian tea in bond was 1s. 11d. per lb., that of China tea was only 1s. 3d. per lb. Thus, also, the statistical tables of the Board of Trade show the declared value of the importations of 1876 to have been, for Indian tea, 2½ millions of pounds sterling, while that from China, Japan, and all other sources was declared at ten millions of pounds sterling, so that while the quantity of Indian tea was 19 per cent., its value was 25 per cent. of the total quantities of 1876. This fact is accounted for by the very large quantity of cheap, sweet tea now imported from China, which sells in Mincing-lane at from 5d. to 9d. a pound, to be fortified by mixture with the strong and more pungent growths of India, so enabling, as Messrs. Travers have told us, the tea dealers to supply us with tea suited to our present tastes at 2s. a pound, a price at which tea fit for decent drinking cannot be produced either in China or anywhere else.

And yet all these enormous quantities have been consumed by us without, generally speaking, being aware of it. We have all been unconsciously drinking in larger and still larger proportions Indian tea for the last ten years. I have not a word to say in disparagement of China tea. It is a necessity for us, and the taste of the public has been formed on it. In their interest any interruption of the supply from China would be a calamity.

Much has been said of the special flavour of

Indian tea; I can only say that I never knew anyone who once tried it that ever disputed or discontinued its use. Like wine, coffee, chocolate, and other such beverages, it has its own peculiar taste. The teas of Assam, which have always been best known—indeed, are yet the only kinds of Indian tea popularily recognised—are so very strong that the general taste, accustomed to the weaker potations of China, cannot at first stand these robust flavours. But this objection does not apply to the produce of other districts of India. The Darjeeling and Neilgherrie teas, and specially those of upper India, designated hill teas, grown from the acclimatised China plant on the flanks of the Himalayas, or other elevated regions of India, have much less strength but superior aroma and delicacy of flavour, and I am quite within the mark when I say that nothing that China now or has ever produced can excel them in these respects. Therefore, the tea planters of India can honestly tell the English consumer that they are now producing teas—and are prepared to produce them in any quantity that may be required—of all kinds; there is no tea in the world that can approach that of Assam in strength; there is none imported here superior in aroma and delicacy of flavour to those of the hill districts of India, while all intermediate grades are cultivated in other districts.

There are two classes who are or ought to be very influential in encouraging the consumption of good tea, to whom I should like to address a few words—the ladies and the teetotallers. To the former I shall use the language of the *Times* :—

> "It is not easy to be extravagant in tea-drinking. One bottle of vintage wine will much more than balance the cost of the highest quality of tea for a large circle, and now that afternoon tea-drinking has become an established institution, people have at least as good a reason for being careful about their tea as about their wines.
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> "It may safely be affirmed that to tens of thousands of English tea-drinkers it is a very insignificant consideration whether they pay a few shillings more or less a pound for the article. Possibly some weight must be given to the fact that while it is the men who stock and empty the wine cellars, it is the ladies who rule the tea-table. They make their purchases on the economical principles which prevail in good housekeeping, but, perhaps, with too little regard for quality. Hence men are not much accustomed to taste and enjoy the aroma of high-class teas as they do of favourite wines. We have few connoisseurs in tea-drinking among us, and no real guarantee, therefore, that we shall obtain quality for price. Yet we venture to affirm that it would be well worth someone's while to try the experiment of making a market for really good teas, charging as high prices as he pleased. If the 'fancy teas' which now go to the Russian consumer could be thus supplied in London, we entertain no doubt that they would achieve an enormous sale for afternoon use. The idea is worth developing, if only because it would enlarge the scope and increase the intensity of an innocent and healthy enjoyment."

That, perhaps, is more delicately put than I should be inclined to do. Cheap tea is the first point with most of our friends of the gentler sex, and of course the demand creates the supply. But in this, as in most other things, the dearest is the cheapest in the long run. If instead of demanding tea at 2s. or even less per lb., they would give 3s. and upwards for the genuine article, they would find it more economical; one spoonful would go as far as two. I take the liberty further of saying that generally their treatment of tea is not fair; they stew it on the hob, or by a detestable invention they call a "cosy;" or, even worse, they utterly destroy all the flavour of the plant by infusing it with carbonate of soda and other chemical abominations, to extract all the strength as they think, but rather all the tannin and other ingredients that are neither pleasant nor innoxious.

As to teetotallers, surely it is a fair appeal to them that, as regards a beverage they exalt above every other, they at least should be as curious in their selections, and pride themselves as much in the varieties and exellencies of their stock of tea, as those who are not of their persuasion do in stocking their wine cellars. It is a melancholy fact—and I speak from experience—there are exceptions; that you will find the most execrable tea out of a London coffee-house supplied at the teetotal hotels, where being an article in special demand, it is usually kept on tap, steaming and boiling, to the utter destruction of all its good qualities. Could my feeble voice reach Sir Wilfred Lawson, the great apostle of the cause—which I much respect—I would urge him that our Indian tea deserves the patronage of his ardent votaries, and that they should treat it justly and considerately. An abundant reward will follow. They could then with confidence challenge us to partake of the cup that cheers but not inebriates. I hope they will take the hint.

I do not recommend you to rush into speculative companies for the production of Indian tea, there has been quite enough of that, and to very little advantage; the existing companies and concerns are quite sufficient for the purpose, and you may buy their shares if you wish so to invest. The only advice I would venture to offer is—to buy their tea; see that you have it genuine; pay a good price for it, and treat it fairly; put plenty into the pot, and drink it off before its fragrance is dissipated; and, my word for it, you shall neither regret the cost nor the consumption.

DISCUSSION.

Mr. Maitland would have liked the lecturer to have given more information on the subject of tea cultivation in the central parts of India and the Kangra Valley. Assam, Cachar, and Darjeeling had advanced to that point, that all they needed was to be let alone. Indian tea had, in his opinion, taken such general hold on the English people, and on other parts of the world, that it had long passed beyond infancy. There was a *concessus* of opinion that the tea received from China of late had been of a very inferior quality; and that fact had given a stimulus to the importation of Indian tea. All that was wanted in India from the Government was that they should aid them in getting full supplies of labour, and improve the means of transport. The tea from the Kangra Valley district went into Central Asia, while that from Assam and Cachar was largely sent to England. There was a large consumption of tea in Thibet which was procured from China, and if facilities could be given for the transport of the tea produced in the Kangra Valley to Central Asia, it would be of great advantage to the district.

Sir T. Douglas Forsyth, K.C.S.I., had had the honour, in conjunction with Dr. Jameson, to provide the tea seed which was first planted in the Kangra Valley. He assembled the Zemindars of the Kangra Valley, and made them a grand oration in Hindustani, and told them of the benefits that would accrue by the growth of the tea trade, and then distributed the tea-seed amongst them, but the first thing they did with it when they got out of his sight was to throw it into the river. That was 25 years ago.

But the change which had since come over the valley was perfectly extraordinary. The Zemindars now planted it round their houses, and thus it was not merely grown by European capitalists, but by the Zemindars also, which was a very healthy sign, because the amount of land which Europeans were able to get was limited, and they had now got almost as much as they were likely ever to obtain. As the people of the country there took gradually to tea cultivation, it would be of great advantage. The prospect of getting a market for tea going into Central Asia from Kangra Valley was, he thought, problematical. In 1869 he went to Russia on the part of the Government, and one of the questions he had to negociate was, with regard to the prohibitions which Russia put on importations into Bokhara and that part of the world. Then they denied there were any orders for prohibitions, but now they made no secret about it. Some of the merchants had made large profits, and that had tempted others to go on; but he looked upon it as a precarious trade, because it was well known that wherever the Russians went they always took the most strict precautions to prohibit the introduction of such things by others, and pushed their own trade to the utmost. For a time we tried sending tea up to Kashgar, but that could only be done to a limited extent. The profits were very great which were made by those who were venturesome enough to send their goods there, but not such as would satisfy gentlemen who were in the habit of dealing with large figures. It was to England the tea planters must look, and not to Central Asia; and he thought it would be a good thing if there could be some abatement of the duty, which was at the rate of sixpence per pound, and which practically amounted to 25 per cent. Great excitement had been caused in England by the passing of the Tariff Bill in India, which had imposed rates, not as a matter of protection, but of revenue; but it must be remembered that Manchester goods sent to India were only liable to a duty not exceeding 5 per cent.; and *per contra*, he thought they might ask for an abatement of the duty on Indian tea.

Mr. Clark thought that with regard to the question of a comparison of duty on manufactured goods imported into India, according to the history of the tea duties in England, the present duty consisted of customs and excise; and it was more properly an excise than a customs duty, for the purpose of obtaining revenue conveniently, and the question of excess had to be taken into consideration with regard, not only to the tea duties, but to everything of the same kind. The author of the paper had given them certain figures with regard to the quantity of tea, but the export to Australia and the internal consumption in India ought to be included, and then the per-centage would be much greater.

Mr. Ward thought it would be a disadvantage if the duty were lowered. Indian tea was so very much better than China tea that it could well afford to pay the duty. If the duty were off, he did not know what rubbish might be imported. The abolition of the tea duty would tend to injure rather than advance the interest of the Indian tea trade. The profit was limited, and if the whole expenditure were taken into consideration, it was no very extravagant amount. The 1877 crop was estimated at 30,000,000 lbs. or £2,000,000 sterling, which was a very great advance. A great deal of profit had been recently made by those who sold their tea in India, by the exceptional rate of exchange, which was down to 1s. 6d. instead of 2s. Some, however, did not like losing 15 per cent. by the exchange, and so bought tea and lost 20, and it was well known in Mincing-lane that many parcels of tea were arriving which actually showed a loss of 2d. to 3d. per lb. As regards the Assam Company, a great deal of capital was absorbed in that undertaking of which the present holders were reaping the return. The price of tea varied very considerably in different years. It went as high as 3s. a lb., and as low as 1s. 6d., which was less than the actual cost of the tea.

Mr. Barry congratulated the Society of Arts upon the change of opinion which had taken place since the papers which had been alluded to were read before the Society many years ago, when it was thought impossible that tea cultivation in India could be profitable. With regard to the North-West Provinces, tea would not be an industry there had it not been for the discovery in Assam of the indigenous plant. The history of it showed that had it not been for the tea introduced through the Assam and other companies, tea would be now extinct. It was the seed from the tea tree discovered in Assam that formed the industry in India. He complained of the means of transit being inadequate to the requirements, and suggested that it would be better for the Government to clear the rivers than spend money in the making of railroads.

Captain Marsh referred to the great facilities there were in India for buying tea, as contrasted with the difficulty in England. There you could obtain the upper leaf, the central leaf, or the lower leaf. In England it was impossible to know what one was buying. The tea which was obtained from the lower leaf presented a very different flavour from that obtained from the upper leaf, but in England it was impossible to get what one wanted. The tea traders and planters in India complained of the China trade sending such stuff into the market, and he thought, if facilities were afforded in England to buyers for obtaining the kind they wanted, great advantage would ensue, and the Indian tea trade be greatly extended.

Mr. J. T. Wood inquired whether the trade in the growth of tea was a distinct branch from that of its manufacture? He had come across an observation in a book of travels that it was, and that the manufacturers got the tea ready for the market.

Sir Douglas Forsyth replied that the native cultivators generally manufactured their tea in their houses, and the tea was of a very inferior kind. They did it very cheaply indeed. They bought pans, such as are used in the European factories. A man would have a pan, and take it home to his village, and all the villagers growing tea would use that man's pan. They made up a very inferior kind of tea, and sold it to their friends, and a small quantity was taken to the market and sold at a low price. The satisfactory feature of that, however, was that people acquired a taste for tea. In Japan he had seen tea manufactured much in the same rude way that he had seen it in the Kangra Valley. In Assam and the lower parts of Bengal there had been very great difficulty in getting coolie labourers for the tea planters. In the Kangra Valley there had never been that great difficulty in procuring labour, and there were a number of native states close round where there was a large class of common labourers who were never paid in money but in kind by the rajahs, and who were very glad to come into the British territory and work in the plantations. They did not like to go far from their homes, but went to plantations close by, and took low wages. In the Kangra Valley they were never likely to be troubled with the great difficulty of labour which was to be met with in Assam and elsewhere.

Mr. Staines spoke of the Neilgherrie hills on the south-west coast, where he had been for a great many years. During the last six years he had paid attention to the cultivation of tea and the study of the plant, and during the last five years it had been a successful enterprise. A number of gentlemen had arrived from England, and 5,000 acres of land was taken up with this cultivation of tea. Tea grows at a higher elevation than coffee, and there were large tracts of land on the hills suitable for its cultivation. The only drawback he had found was the quantity of leaf produced per acre. From the reports on his plantation the production was 150 lbs. per acre.

A Member asked what was the age of the plant?

Mr. Staines replied from six to seven years. He believed that in Assam they produced as much as from 300 to 400 lbs. per acre. In his little garden nearly half the plants were of the China description. They produced a very hard leaf, and people were now throwing the China tea away and planting the indigenous Assams, and the quality of the tea from that leaf was far better. Some he had sent to Mr. Thompson was worth 3s. a pound.

A Member asked what was the price of labour?

Mr. Staines replied that women's wages were 4½, men's 6½ to 7 rupees; and, in reply to a question as to the elevation, said it was about 6,000 ft., and that there were gardens 7,000 ft. above the level of the sea; and, as to the rainfall, it varied very much, not more than 100 inches.

Capt. Cockburn suggested that the Society should take up the question of the best method of taking the tare of the boxes of tea which had to pass the Custom-house. In China the carpenters could make any number of boxes within a variation of one ounce, but in India they could not, and therefore they bulked the tea, which frequently resulted in a considerable loss, for sometimes there was an improper tare deducted from the net weight. He also alluded to the great ignorance which until recently had existed amongst the British brokers with regard to tea, and cited in illustration of his remarks the evidence which had been given by some of the witnesses before the Committee of the House of Commons on the question of the Adulteration of Tea.

The Chairman said he was not competent to say much on the subject before them; but he felt especial interest in the historical branch of the subject, and that had been treated by Mr. Burrell with a thoroughness of research not hitherto attempted. It was interesting to find the names of several very illustrious men connected closely with this history, *e.g.*, Sir Joseph Banks, Lord William Bentinck, and Dr. Hugh Falconer. His own earliest Indian service was on the borders of Assam, in the Kasia hills, some six and thirty years ago; when in the small society there, the Assam tea gardens, then in earliest infancy, were often a subject of conversation. The members of that society would have received with incredulity a prediction that the whole importation of tea into England in that year (1841), viz., 32,000,000 lbs. would be exactly equalled by the estimated consumption in England of Indian tea alone in 1877; but this was the fact. They had been told that the Kangra tea formed an insignificant proportion—only six per cent.—of the whole Indian produce. But he must confess that he regarded this comparatively humble field with greater interest than any other, because there the old Indian peasantry had shared amply in the profits, and had adopted the cultivation on their own lands, whilst tea-planting there was clear of those dark spots of fraud and misery which had stained one period of its history in the more important fields to the eastward. The improvement of rivers in such a region as Assam would be a matter of expense beyond calculation; and to devote "a few thousand rupees," as had been suggested, to such an object, would be futile. The cost of a railway, though heavy, would be within definite limits. But even now the rivers of Assam and Kachar were traversed by numerous steamers monthly, affording a striking contrast to the earlier days of which he had spoken. He then spoke of the great change which had come over certain parts of India within the last few years, and, in conclusion, remarked that there was nothing in tea-drinking repugnant to the strictest prejudices of the people, and thought it by no means unlikely that they would soon be rivals to other countries as tea-drinkers and buyers.

Mr. Burrell, in reply, expressed his regret that the necessarily limited time had prevented him from embracing in the limits of his paper, as read, an account of the different districts of Assam, Cachar, Sylhet, Darjeeling, and the others. These had been, so far, brought before the notice of the Society on previous occasions, but there was much recent information in regard to them which he should have gladly epitomised. If, as it was, he had directed more attention to other districts not previously described there, he would redress the omission in an extension of the paper, which he intended to publish, where scope would be afforded for more general treatment of all the tea-producing districts of India, and for many points of interest necessary to a full comprehension of the subject. He would endeavour to profit by the hints and suggestions thrown out by the various speakers, and expressed his thanks for the considerate manner in which the paper, with all its omissions, had been received.

A vote of thanks to the lecturer concluded the proceedings.

TENTH ORDINARY MEETING.

Wednesday, February 7th, 1877; Edward Woods, C.E., in the chair.

The following candidates were proposed for election as members of the Society:—

Arnot, William, F.C.S., St. Margaret's, Kirkintilloch.
Baker, Francis Henry, 24, Portsdown-road, Maida-vale, W.
Beresford, Lieut. Claudius, R.E., Learmount-park, Londonderry, Ireland.
Byas, Edward Higley, 25, Belsize-park, Hampstead, N.W.
Chadburn, William, 71, Lord-street, Liverpool.
Dellagana, James, junr., 106 and 107, Shoe-lane, Fleet-street, E.C.
Fuller, Thomas C., 2, St. Mary's-villas, The Elms, Ramsgate.
Haworth, W, 80, Warwick-gardens, Kensington, W.
Keates, Thomas William, The Acacias, East Dulwich, S.E.
Litting, George, M.A., LL.B. (London), Grammar-school, Stevenage.
Lowe, Charles Harlowe, A.I.C.E., Vestry-hall, Hampstead, N.W.
Lundie, George Archibald, Tweed-lodge, Charles-street, Cardiff.
Pope, William, 89, Cold Harbour-lane, Camberwell, S.E.
Rowley, Captain Charles J., R.N., H.M.S. "Iron Duke," Kingstown, Ireland.
Shepherd, H. H. B., 24, Victoria-road, Kentish Town, N.W.
Tappley, Rev. Frederick, 18, Victoria-grove, Folkestone.

The following candidates were balloted for, and duly elected members of the Society:—

Colomb, Captain John Charles Ready, Droumquinna, Kenmare, Co. Kerry, Ireland.
Crawshaw, Edward, 15, Charterhouse-street, E.C.
Dempster, Robert, Gas Engineering office, Rose Mount, Elland, near Halifax.
Forbes, James Staats, junr., Engineer's office, Great Northern Railway, Derby.
Hepworth, Joseph, Carlisle.
Hudson, Robert S., 58, West-end, Redruth.
Lovell, Miss Matilda, Calke Abbey, near Derby.
Sachs, Christian Philips, 53, St. Paul's-road, N.

The paper read was—

STREET TRAMWAYS.

By Captain Douglas Galton, C.B., R.E., D.C.L., F.R.S.

I cannot better commence this paper than by calling attention to the remarks made last autumn by Mr. E. Chadwick at Glasgow, in which he points out that the best remedy for the insanitary condition of towns by overcrowding is to cheapen transit by every means, so as to spread the population to fresh suburban lands, where ground rents are less expensive and sites more open.

Science has now rendered this comparatively easy by providing mechanical appliances that will, to a great extent, supersede the use of horse-power in public vehicles. The social problem in this matter is at least as important as the engineering problem, but it is only by public discussion that these appliances can be brought into more extended use.

The railway affords communication between *foci* of population—but the railway is especially calculated for conveying large numbers of passengers, and large quantities of goods in each train; and for the efficient working of the railway the distance between the points where the traffic is collected must be sufficient to allow of the train acquiring speed between its several stoppages; for unless this is the case one of the main advantages of a railway, viz., speed, is lost.

In towns, the points at which passengers desire to be taken up or set down are so numerous that the number of stations cannot be multiplied sufficiently to accommodate everybody. In the country districts, on the other hand, the traffic is scattered, and the railway itself has to be fed by roads, along which the traffic comes to the station in quantities which would be insufficient to fill a complete train. The ordinary railway is inapplicable to either of these cases; but cheapness of transport is as desirable in the collection of traffic as it is in its subsequent conveyance. The cost of transport depends on the smoothness of the road.

Thus the tractive force required to draw one ton on a level on well laid iron rails on a railway is about 7 lbs.; stone tramway (smooth), 20 lbs.; asphalte, 27 lbs.; wood pavement, 38 lbs.; macadam (very good), 40 lbs.; ditto, gravelly, 50 lbs.; ditto, new, 96 lbs.; soft, sandy, and gravelly ground, 210 lbs. Thus after the iron rail the smooth granite affords the best surface. The provision of a smooth surface for wheel tracks for ordinary horse traffic is of old standing. A description of this system, as adopted in Italian towns, was given by Mr. P. Le Neve Foster, jun., C.E., in a former number of the Society's *Journal.** It may be seen in the Commercial-road. Mr. Chadwick has proposed, in lieu of the granite slabs, asphalte wheel tracks. These wheel tracks must necessarily be somewhat broad, to enable them to accommodate the various widths of vehicles. Where one horse is used the intermediate space may be so paved as to afford a foot-hold for the horses; but where two horses abreast are used a proportion of their useful power is lost by the slippery foot-hold afforded by the broad slabs.

The harder the material of which the wheel track is made, the more slippery does it become. It follows that, for the convenience of horse traffic, it is preferable to limit as much as possible the width of the wheel track; but when this width is closely limited it becomes necessary to provide it with a flange, or some means of keeping the wheels in their place.

The tramway, as it is now understood, consists of an iron rail adapted to a particular width between the wheels, and constructed so as to admit only of a special form of wheel.

It is to this form of tramway that recent legislation has applied, and it is to its aspect as a means of extending the advantages of the railway system that I propose to devote this paper.

Tramway Legislation.

Parliament first recognised the importance of tramways by general legislation in 1870.

The General Act of 1870, to facilitate the construction and to regulate the working of tramways, enables the Board of Trade to make provisional orders authorising the construction of tramways, such tramways to be constructed, either by the local authority or authorities of the district, out of rates, or out of money borrowed on the security of rates; or else by private companies, with the consent of the local authority, or of the road authority of the district. But in cases where the proposed tramway lies in more than one district, the Board of Trade may overrule the opposition of a minority of districts, provided two-thirds of the proposed length lies in districts in which the authorities are consenting parties. All land must be taken by agreement.

The main provisions of the Act, so far as construction is concerned, are, that the tramway in towns shall be laid in the middle of the street, and shall not approach nearer than 9 ft. 6 in. to the outer edge of the foot pavement, unless with the consent of the adjacent occupiers. And the Act lays down that the provisional order is to specify the nature of traffic and to fix the tolls, and to limit the time allowed for construction. The proprietors, unless they are a local authority, are to deposit either a sum not less in amount than £4 per cent. on the estimated cost of the tramway in some prescribed bank, or else to adopt some approved form of equivalent security.

The time for commencing the works is limited to one year, and for completing the line to two years from the date of the provisional order. And when the tramway is made by a private company, the local authority has a right of purchase at the end of 21 years at the then value, exclusive of any allowance for past or future profits, or of compensation for compulsory sale, &c.

The Act fixes the gauge at 4ft. 8½in., unless the Board of Trade in the provisional order prescribes some other gauge; and it gives all necessary power for taking up and reinstating streets and roads, and for laying the line and leasing the line and the tolls, and making bye-laws, and other matters for which a special Act would otherwise be required. The Act recites that, in the absence of other directions in the provisional order, animal power only is to be used.

This Act has been put in force to a considerable extent. About 60 provisional orders, authorising tramways, have been passed by the Board of Trade; and Parliament has authorised from 40 to 50 schemes, upon direct application for Acts of Parliament.

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* See *Journal* for June 25, 1875.

It does not, however, appear that steam, as a motive power, has been adopted upon more than two tramways, viz., the Wantage Tramway, a line which connects the Wantage-road station of the Great Western Railway Company with the town of Wantage, and the Vale of Clyde Tramways. Steam has also been in use on the tramway on the Ryde Pier.

In the present session, however, a wider development of steam-propelled carriages seems probable, as seven applications have been made to the Board of Trade for permission to use steam power. The Board of Trade have framed bye-laws to regulate the use of steam on tramways. These bye-laws afford an index of what the public feeling is in respect of the use of steam. The provisions are generally as follows, subject to alterations under special circumstances:—

The permission to use steam power is limited to the time during which the restrictions imposed by the bye-laws are adhered to; and power is reserved to the Board of Trade to vary the bye-laws.

The steam engine is to be so constructed that, if it at any time attains a speed of more than ten miles an hour, the steam shall be at once shut off by self-acting machinery, which shall also apply the breaks. The engine shall be fitted with an indicator and recorder of the speed, with a fender to throw off obstructions, and with a bell to be rung as a warning when necessary, and from time to time, to give notice of the approach of the engine. The engine shall be free from noise produced by the blast and clatter of machinery; it shall not emit steam or smoke; no fire shall be visible from it; the machinery shall not be exposed to within four inches level of the rails; no hot air shall issue in a way to annoy passengers; the entry to and exit from the car shall be separate from the steam engine and its appurtenances.

The bye-laws specially limit the actual rate of speed to be allowed, which may vary in each case, but they provide that the speed through moveable facing points shall not exceed four miles an hour. In the event of a horse being frightened when near any steam engine in motion on the tramway, the driver of the engine shall immediately bring the engine to a stand.

It is noteworthy that more progress would seem to have been made in foreign countries, in the use of steam as a motive power for tramways, than in this country. It is in use at Brussels and Vienna, and is on trial at Paris, Stockholm, and Copenhagen, Philadelphia, Chicago, San Francisco, and New York.

Average Cost of Horse Traction on Tramways.

In the discussion of the question of steam and horse power for tramways, it is necessary, first of all, to understand the actual merits of each, so far as cost of working is concerned; and if there is any pecuniary advantage in the use of steam, to consider how far it is counterbalanced by other difficulties.

The estimate given by Mr. Alphonse Spee, of the Société des Ingénieurs de l'Ecole de Liège, of the cost of horses to horse a tram-car capable of holding 44 persons, drawn by two horses, on the Bois de la Cambre tram-road at Brussels, having gradients of 1 in 33, and an incline nearly 1¼ miles long, of 1 in 100, are as follows:—

Cost of Working the Tramway to the Bois de la Cambre in Brussels by Horse Power.

	£	s.	d.
Ten horses, at £37 10s.	375	0	0
Stables, at 10 square metres per horse = 100 square metres, at 16s. 8d. per square metre, + £1 13s. 4d. per horse, to cover cost of building	250	0	0
Yards, 10 square metres per horse; 100 square metres, at £1,	100	0	0
Total	725	0	0

Which, at 5 per cent. per annum, = say 2s. per day.

	£	s.	d.
Daily keep of each horse—			
Food	0	2	1
Harness, &c.	0	0	10
Total	0	2	11
Or say, £1 9s. 2d. for 10 horses.			
Sinking fund for horses, at 20 per cent. on £375	75	0	0
Which is equivalent to (per day)	0	4	1½
Therefore 2s. + £1 9s. 2d. + 4s. 1½d. = per car per day	1	15	3½

The horses perform each total journey of nearly sixteen miles a-day. In Belgium, on tramways with gradients not exceeding 1 in 100, and with cars holding 30 passengers, drawn by one horse, the cost for horse cars was estimated at 17s. 6d. per day per omnibus.

The cost of running expenses in the best-managed horse tramway lines in England, including horse hire, horse keep, drivers and pole-shifters' wages, but excluding stable rent, car repairs, and sinking fund, have been stated at 8d. per car-mile run.

The cost of horse-power to the London Tramway Company has been published as follows:—

	£	s.	d.
1 car-driver, at 25s. per week } 45s. 1 conductor, at 20s. „ }	117	0	0
12 horses required to work 1 car; cost of keep, wear, &c., of each horse, inclusive of deaths and loss by re-sale, 22s. per week; 26,260 miles per annum; 12 horses at 22s. per week	686	8	0
Repairs of car, at ¼d. a mile	27	7	1
Total	830	15	1
Or per car per day	2	0	0

This does not include interest of money, or the cost of lighting, cleaning, and general expenses, which would be approximately the same in horse and steam cars, and may therefore be omitted for purposes of comparison.

The cost of the horse traffic in the Wantage tramway is stated to have been as follows, per day of twelve hours:—

	£	s.	d.
Four horses, at 3s.	0	12	0
Two drivers	0	6	0
Conductor	0	2	4
Oil and light	0	0	2
Wear and tear estimated	0	6	0
Rent of stables	0	1	0
Total	1	7	6
Cost of working per mile	0	0	8½

A great difficulty in the traction of tram-cars results from the frequent starting and stopping of the car for taking up and setting down passengers, because of the heavy strain at starting.

The following table of some experiments, published by Mr. Alph. Spee, shows the tractive force required to start a tram-car on various sorts of roads, the weight of the car, with its load, being about four tons:—

Nature of Road.		On Level.	On Incline.			
			1-200th.	1-100th.	1-50th.	1-20th.
		lbs.	lbs.	lbs.	lbs.	lbs.
Paved road		264·5	308·5	352·6	440·8	705·3
Railway		44·	88·1	132·2	220·4	484·8
Tramway	Straight, clean	88·1	132·2	176·3	264·5	529·
	Straight, dirty	176·3	220·4	264·5	352·6	617·
	Curved, clean	176·3	220·4	264·5	352·6	617·
	Curved, dirty	264·5	308·5	352·6	440·8	705·3

A comparison between this table and the previous one would seem to show that the tractive force required to start a car is from four to five times as great as that required to keep a car in motion. Therefore, the ordinary tram-car, whilst in motion, runs smoothly so far as the horses are concerned, but when it is stopped, and has again to be started, the strain is enormous on the horses, and wears them out rapidly. In America, several persons have invented appliances, termed "car starters," to relieve the horses of this strain at starting, by accumulating the force lost in stopping by means of springs compressed by the action of stopping, and then releasing the springs at the moment of starting, so as to use this accumulated force in moving forward the car, and thus relieve the horses. None of them seem to have attained any extended application in practice.

Mechanical Appliances for Traction on Tramways.

The use of mechanical appliances to relieve the horses on road carriages is of old date, but it would lead me beyond the limits of this paper to describe the progress of invention in this respect.

The earlier carriages moved by power other than animal power were devised for running upon ordinary roads. Of these, the most successful were the inventions of Mr. W. Hancock, some of which ran regularly between Paddington and the City before the year 1837. The enormous proportion of tractive force to the weight of the vehicle required for moving carriages on ordinary roads, and especially on macadamised roads, offered great impediments to inventions of this class.

The introduction of iron tram rails on to the ordinary road has afforded a new starting point.

Every variety of motive power has been sought to be applied to the movement of tram cars. Steam, superheated water, water under high pressure, hot air, ammoniacal gas, carbonic acid gas, compressed air, steel springs, haulage by ropes, and electricity as a motive force.

The latter has not hitherto yielded any successful result.

The use of ropes for haulage is only applicable in limited cases. At San Francisco, Mr. Holliday constructed a rope tramway, about three-quarters of a mile in length, on an incline of 1 in 10. The rope was enclosed in an iron pipe, below the surface of the road, with a groove to admit a flat bar, which was fixed to the car. The end of the flat bar was provided with a clamp, which could be attached to or detached from the rope at the will of the conductor. But the opening in the pipe was liable to fill with dirt.

All the other methods of propulsion—except steam generated by the combustion of fuel in the car, or hot air or gases expanded by heat generated in the car—are limited by their own nature. The force which they exert is stored with more or less economy, for a defined object; if, from unexpected causes, a greater amount of force than usual is required, there is no margin left, and failure is the result. If the stored up force is suitable at one time it is insufficient at another. For instance, on a tramway with numerous alterations of gradients, the stored up force must be sufficient for the steepest gradient. Such appliances are, therefore, limited in their application in respect of time, in respect of weight, and in respect of gradients.

But the weight of these appliances, whether springs or air compressed in cylinders, or other appliances, increases very rapidly with the stored up strength, and thus adds largely to the whole weight to be moved.

With steam, on the other hand, such temporary alterations in the amount of work to be done are easily overcome by increasing the pressure of steam, by means of an additional consumption of fuel.

Motive Power by means of Steel Springs

Force obtained by springs does not appear to afford great promise at present.

The work necessary to bend a bar of steel to rupture may be expressed by the formula :—

$$\frac{1}{6} \times \frac{B^2}{e} \times \frac{E\,l}{Z}$$

Where

B = maximum tension per inch to which the bar is subjected.
e = the modulus of elasticity.
E = the moment of inertia of the bar assumed rectangular.
L = total length of bar, and
Z = distance from the central line of the bar to the line of maximum extension.

The average of the tractive force required on the journey being assumed at from 40 to 45 lbs. per ton on a level tramway, including the resistance at starting, it will be found that with a car weighing from 4 to 4½ tons with its load, a weight of springs, made of the best steel now in use, nearly equal to that of the car will be required to effect a journey of half a mile.

For the present, therefore, it is not probable that this mode of obtaining force can be utilised for locomotion.

Motive Power by means of Superheated Water.

The use of superheated water as a motive power has been adopted in Chicago, New Orleans, and New York, by M. Lamm. A certain quantity of water heated to a very high temperature stored in a reservoir at the beginning of the journey, gives out the steam necessary during the usual journey of the omnibus. The reservoirs can be applied to the carriage itself, or to a separate vehicle.

To avoid priming, the reservoirs are only three parts full, the initial temperature being about 374° Fahr., which is equivalent to a pressure of 12 atmospheres. Supposing that this temperature is lowered, by the end of the journey, to 270°, it will be seen that the quantity of water turned into vapour is 12 per cent. of the whole.

Experiments at Seraing, in 1874, showed that about 60 per cent. of the theoretical power could be utilised; but, of course, this is exclusive of loss of heat by radiation, which must be prevented as much as possible by non-conducting coverings, as well as the loss by escape of steam, and especially by priming, that is to say, the escape of water with the steam.

It has been estimated that cars, with two tons of water, would make a journey of about five miles on the level, or about two and a-half miles on an incline of 1 in 50. The difficulty appears to lie in starting towards the end of the journey, in which case some special car-starting apparatus becomes necessary. Moreover, the discharged steam is very moist, and great difficulties exist in so condensing it as to prevent its being seen.

Mr. Todd and Mr. Bede have also proposed other forms of this class of car. The former placed his cylinders so as to be surrounded by the heated water. Mr. Bede's car has been in use at Brussels. Four horizontal reservoirs are placed under the seats, united to vertical reservoirs, on each side of the central part of the car. The steam is taken from the upper part of the vertical reservoirs, and passed through the roof. The cylinders are 4½ in. diameter, by 14 in. stroke. The driving-wheels are 2 ft. 3 in. diameter. The reservoirs contain about 300 gallons of water heated to 365° Fahr., and at a pressure of 10 atmospheres. This reserve of heat suffices for a journey of 50 minutes, at the usual speed of tram-cars; the cars carry a load of about 1½ tons; the cars can easily pass curves of 36 feet radius, and will ascend an incline of 1 in 30 with an effective pressure of 4½ atmospheres. The adhesion of this car in starting on inclines is, however, too small, and entails trouble.

Motive Powers by means of Compressed Air.

Cars moved by compressed air have obtained a certain development.

Mr. Scott-Moncrieff has devised a car which has been in use on the Vale of Clyde tramways between Paisley-road and Govan, which performed a journey of 1½ miles each way for each charge of air; thus obtaining a distance of 3 miles without refilling.

The chief difficulty which inventors have had to contend with in working with compressed air is the excessive cold produced in the exhaust.

Moreover, in any mechanical arrangement, such as a locomotive carrying a definite quantity of compressed air, and absent from time to time from the original sources of supply at the pumping stations, it is absolutely necessary that the fullest advantage should be taken of the limited power stored in the receivers. The only way in which this can be done is by using the air expansively, and as the pressure is always decreasing towards the end of the journey, this expansion must vary correspondingly.

The peculiarity of the Scott-Moncrieff system is the valve gear, which allows the compressed air to issue from the reservoir at a uniform pressure, which may be varied at the will of the driver. By the arrangement adopted, the air is always exhausted at the atmospheric pressure, the effect of which is not merely to obviate the difficulties arising from excessive cold, but also to propel the car in silence, and utilise to the utmost the available power. The storage of the air and the requisite machinery are, moreover, brought within the dimensions of an ordinary street car.

In general appearance the Scott-Moncrieff car is in every way like an ordinary street car, with this exception, that there is an entrance direct from each end by convenient steps, instead of from the small space at the sides of the car, between the splashboard and the ends of the carriage framing, as is the case in other forms of tram cars. The tanks containing the compressed air are attached to a framing below the floor of the car, and are placed in sets of three at each end, leaving room for a smaller and stronger framing at the centre, where are placed the engines, valve gear, driving wheels, breaks, &c. These appliances do not interfere with the accommodation of the interior of the car. At each end of the car there is a platform, the front one being occupied by the driver, and the other being free for the conductor, and for the entrance and exit of passengers. At convenient places pressure gauges are placed, indicating the pressure of air in the tanks and in the valve casing, as well as tell-tales to show the position of the expansion valves. Starting handles and breaks are provided at each end, so that the car may run in either direction. The new car can be stopped and started readily, and propelled at variations of speed, and when the engines are at work there is no noise.

The expenses of running these cars per mile are stated by the inventor to be as follows:—

	Pence per car mile.
Fuel at 10s. per ton	0·5
Drivers at 30s. each, allowing for relays at the rate of three drivers to every two cars	1·35
Enginemen and firemen at 4s. a-day each	0·125
Depreciation of fixed machinery, 10 per cent.	0·125
„ of cars, 10 per cent.	0·625
	2·725
Contingencies, 10 per cent.	0·272
	2·997

The advantages claimed by the inventor for this machine are the absence of danger from explosion, and the economy in fuel for compressing the air, which he estimates at 3 lb. per horse-power.

Another form of car moved by compressed air was proposed by Mr. Mekarski, and constructed by M.M. Delletrez at Paris. In this machine the pressure at which compressed air is allowed to issue can be regulated at will, and hot water is applied to keep up the temperature of the exhausted air. A special cylinder is brought into play to assist in starting, and the force acquired in descending inclines is used to store up air, and thus provides additional motive power.

The following formula expresses the total work due to compressed air:—

$$P\,V + P\,V\,K \log. \frac{P}{P^1}.$$

When

V = volume of compressed air.
P = pressure in lbs. per square inch at the beginning of the journey.
P^1 = pressure in ditto at end of journey.
K = a constant.

From the formula it will appear that the disposible force from compressed air is about one-third of that from an equal volume of hot water. Moreover, compressed air requires more expensive fixed apparatus than that required with hot water.

There is another form in which stored-up heat has been proposed. Mr. Lamm placed a cylindrical receiver on the roof of the car filled with hot water; in this he placed another cylinder, containing liquid ammoniacal gas, obtained from sal ammoniac, heated in connection with hydrate of lime.

The gas became disengaged under the influence of the hot water by which it was surrounded, and was passed into working cylinders, whence it was carried after use into the hot water reservoir, where it became absorbed, giving its heat to the water, whence the temperature of the water was increased instead of diminished during the journey.

Carbonic acid gas is also a gas which would appear at first to provide an advantageous method of obtaining motive power. At the freezing point it is liquid under a pressure of 40 atmospheres, and at 176° Fahr., it has in its gaseous state a pressure of 80 atmospheres. But independently of its high price, the difficulty of regulating the enormous force generated by it has hitherto prevented its application.

Hot air engines are too clumsy and noisy for use on tramways. There remains, therefore, only steam carriages to be considered.

Steam Traction.

The steam carriages and engines with their own fire and boiler may be classed under two heads :—

1st. Those in which the motive power is contained in the car itself which conveys the passengers.

2nd. Those in which the motive power is separate from the car carrying passengers, that is to say, detached engines, such as is the custom on railroads.

1. Under the first head there have been numerous inventions. Messrs. Grice and Long, of Philadelphia, Mr. G. Francis Train, Mr. Nairn, were among the earliest, but these inventions more nearly resembled the ordinary locomotives, in that they allowed the escape of smoke and steam, and were not free from noise. Mr. Todd, in 1871, produced a machine intended to obviate these inconveniences. Mr. Remington, in 1872, tried a steam car in New York, on a tramway with curves, having a radius of 50 feet, and inclines of 1 in 14. There are many others.

The Grantham steam car, however, of those cars which carry their own motive power, seems to be the most successful of those which have been tried in this country.

The original car is 27 ft. 3 in. in length, 11 ft. 1 in. high, and 6 ft. 6 in. wide; is divided into first and second class passenger compartments entered from the end platforms, with the boiler and machinery fixed in the centre. It runs on four wheels, one pair for driving, the other pair fixed to a radial axle for easing the curves. It is propelled backwards and forwards without turning at either end of the line, and only requires to be replenished with water at stated intervals. It is driven from either end by removable levers, the driver having complete control of the machine, as regards turning on, shutting off, or reversing steam, as well as applying the break-power, which is sufficient to enable the car to be brought to an almost immediate standstill. It is constructed to carry, both inside and outside, sixty passengers.

In the centre is the steam boiler and condensing apparatus; the cylinders, which are placed underneath, are 6 in. diameter, and the length of stroke, 10 in. The exhaust is led into a copper vessel fixed in the uptake of the boiler; this allows the steam to expand, and pass away from the chimney-top superheated. In an improved car the bogie system has been adopted at the end furthest from the driving-wheels, to give steadiness, by means of a long wheel-base. By this means the rigid wheel-base is reduced to 3 ft., and, therefore, the car can travel easily round curves. Moreover, an arrangement connected with the bogie frame enables the car to be guided, so that no moveable switches are required at the sidings. By this arrangement, also, the car can be guided off the rails at will, and on to them again when off.

The levers for working the engines, and managing the car and breaks, are connected with each platform, so that the conductor stands always at the end which is in front. This car, in its working, is free from noise, in consequence of the arrangement for condensing the steam.

2. The second method in which steam is applied to tram-cars is by means of a separate engine, that is to say, substituting a small engine for the horses used in horse-cars. This system is that now adopted by Messrs. Merryweather. Messrs. Merryweather's engine is somewhat less than half the length of an ordinary tram-car, which it resembles in appearance; and therefore, in contrasting the steam-power with horse-power, it occupies less space than the horses of a tram-car would occupy. At each terminus it is disconnected and brought to the front of the car. This operation does not occupy more (if so much) time than is required with horses. The boiler is multitubular, so that dangerous explosions cannot occur. Each engine weighs about three tons, with sufficient water and fuel to run for four hours. The consumption of fuel is about 20 lbs. weight per hour. The pressure of steam is about 100 lbs. The engines are noiseless, and emit neither smoke nor steam. The exhaust steam is disposed of by a condensing apparatus. In this apparatus the steam is passed through a series of nozzles, arranged so as to include a large mixture of hot air with the steam, by which means part is thus condensed; and of the remainder, a further portion is condensed by passing it through wire gauze or bundles of wire, and through a surface condenser, and the residue is turned either into the smoke-box or through the fire. This plan avoids the necessity of carrying a large quantity of water; thus the whole weight

of the engine is kept to a minimum, thereby reducing very considerably the working expenses, and the wear and tear on the permanent way. The engines have all four wheels coupled; they can ascend heavy inclines, and, from their short, rigid wheel base, can pass round the sharpest curves, and they are sufficiently powerful to draw two or more loaded passenger cars. For very steep inclines they have a small auxiliary cylinder, which is fitted in the locomotive; this cylinder works a pitch chain, which is connected round a drum fixed on both axles of the car, by which arrangement the whole power of the engine is developed and extended to the car. They can be propelled at any required speed, at the will of the driver; the break power can be immediately applied, pulling up the car far quicker than can be done at present with the ordinary horse-cars. The engine is fitted with the necessary self-acting appliances for shutting off steam and applying breaks, if the driver should exceed the prescribed rate of speed. This is effected by means of a centrifugal governor driven from the locomotive wheels, and acting upon a valve in the steam pipe leading from the boiler to the engine. The starting and other levers, as well as the fire-hole door, are ready to the hand of the driver, who has an unobstructed view of the roadway on all sides, and, from the simplicity of the engines, a skilled mechanic is not required to drive them.

As a recent contribution to this class of steam-engines, may be mentioned the plan of Mr. Matthewson, in America, who, with the idea of not frightening horses, proposed a steam-engine in the shape of a horse to draw the car.

The machine consists of a platform with a canopy over it, supported on two wheels, which carries a wrought-iron tank containing gas at pressure of from 60 lb. to 100 lb. per square inch, to be used as fuel for producing steam. In front of the platform is a tubular boiler and fire-box, and two cylinders enclosed in a metal case, which has all the external appearance of a horse; under the horse are two driving wheels of small diameter. The condensation of the steam is effected by means of water, contained in a receptacle on the roof of the passenger car.

The reason why horses are frightened at carriages which are moving towards them without apparent means of propulsion, would seem to be that they fancy the carriages are being backed upon them; but the horses would soon lose their fears from this cause, if the noise of the engine and the escape of steam are avoided.

Cost of Steam Traction.

The cost of the steam tramways in Brussels, having a gradient of 1 in 33 and an incline of 1 in 100 for $1\frac{1}{4}$ miles, are stated by Mr. A. Spee to be as follows:—

Outlay:—

	£	s.	d.
1. Engine	600	0	0
2. Engine-house, at 36 square yards per engine, costing £2 8s. 4d. per square yard	72	0	0
3. Water supply and workshops	72	0	0
	744	0	0
To which add 25 per cent. for reserve engines in the proportion of 1 in reserve to 4 in use	186	0	0
	930	0	0

	Cost per day. £	s.	d.
5 per cent. per annum upon £930	0	2	8
Daily expenses of running:—			
440 lb. of coke at £1 4s. 2d.	0	5	0
Oil, grease, and various	0	2	1
Attendant	0	4	2
General repairs and Sinking Fund:—			
At 10 per cent. on outlay for engines, including reserve engines	0	4	4
Total	0	18	3

This compares with £1 15s. $3\frac{1}{2}$d. before mentioned as the cost of horse traction.

The following is stated to be the cost of working the Grantham steam-cars:—

		£	s.	d.
1 engine-driver, at 35s. per week 1 stoker " 25s. " 1 conductor " 20s. "	80s.	208	0	0
Fuel—7 lb. of coke per mile for 26,260 miles = 82 tons, at 15s.		61	10	0
Oil, tallow, waste, and sundries taken at $\frac{1}{4}$d. per mile—26,260 miles		27	7	1
Water supply, at 1s. per day		18	5	0
Repairs of car and machinery—26,260 miles at 1d. per mile		109	8	4
		424	10	5
Or per car per day		1	3	3

Exclusive of interest of money and cost of lighting, cleaning, &c.

This would compare with the £2 per car per day before mentioned as the cost of working of the London Tramway Company.

Relative Advantages of the Combined Car and Engine and the Detached Engine.

There is probably no very practical difference in the actual cost of running the steam tram-car with its engine contained within itself, and the cost of the tram-car drawn by a detached engine. The question as to which is preferable must therefore depend on other considerations.

The tram-car with its steam engine forming a part of itself, is very convenient and compact, especially in towns, and it will probably be preferred where a succession of single cars are required to run consecutively at short intervals, and solely for the accommodation of passenger traffic. On the other hand, when companies already possess a stock of cars, the detached engine will enable them to utilise the cars they already possess. Also, where other conditions prevail, where an extra number of passengers require to be occasionally conveyed—or where the tramway can be utilised to convey goods and merchandise as well as passengers, it is probable that the detached engine would be more advantageous than the combined steam tram-car, and I understand that the Wantage Tramway Company have now one of Messrs. Merryweather's engines at work on their line.

ADVANTAGES OF STEAM TRACTION OVER HORSES OR OTHER MECHANICAL APPLIANCES.

This brief *resumé* of the various methods which have been proposed for the propulsion of tram-cars by mechanical appliances, shows very clearly that steam generated by a fire in the car is the only method which has as yet been successful; and that the other methods are, for the present at least, only toys, but, no doubt, very interesting toys.

The steam tram-car has attained a practical *status* or position. The saving of cost by steam traction over horse traction is also abundantly manifest. The cost of working by steam traction ought in no case to exceed two-thirds that of horse traction, and it will in most cases be not more than one-half.

The Grantham steam car and Messrs. Merryweather's steam cars and detached steam engines appear to comply with the Board of Trade requirements, viz., that the steam shall be disposed of after use, imperceptibly and without noise, and that the speed shall be regulated by self-acting machinery. By the other regulations of the Board of Trade as to a warning bell, and as to stopping and speed, the general public appear to be adequately protected.

The essence of the tramway is that it should facilitate the movement of small quantities of traffic along existing thoroughfares, as contra-distinguished from the railway, which conveys a large bulk at a time along a road reserved to itself. Wherever the traffic requires long trains of passengers or goods, the tramway should give place to the railway. The tramway engine must, therefore, be essentially a light engine, but it must suffice occasionally for steeper inclines than are in general use on railways.

The limit of weight should be from 2½ to 3 tons on each wheel, unless very much stronger roads than are now laid down, be adopted.

The cost of tramways in towns is considerable, owing to the expense of the pavement, which must be laid and maintained in good order between, and for 18 inches on each side of, the rails. In country districts the cost ought not to be heavy. The following, however, is stated to be the cost of the Wantage Tramway, 2½ miles long, and laid for the greater parts of its length alongside of a very level high road. It has one bridge over a stream, built under the requirements of the Board of Trade, which, it is said, added to the cost. The cost of this line at last September was about as follows:—

Purchase of freehold land	£1,800
Construction of line................	4,600
Rolling stock	1,000
Legal, Parliamentary, and miscellaneous expenses	2,600
	£10,000

The Grantham steam car is in use on the Wantage tramways; but in this car the cylinders are 4 in. in lieu of 6 in. as now made. The car in use on this line can carry 60 passengers—it weighs 8 tons with coke and water, and has carried in addition 5 tons of passengers. When empty, it weighs 6 tons 10 cwt. The cost of the car was £800. The Wantage tramway is 2½ miles long—it has gradients of 1 in 50 for 350 yards—the sharpest curve is 75 feet radius. The cost of working the Grantham steam car on the Wantage line per day of 12 hours, as nearly as can be ascertained, is given as follows:—

	s.	d.
Distance travelled per day, 40 miles.		
Weight of gas coke, 240 lbs.		
Weight of steam coal, 56 lbs.		
———296 lbs. cost	2	9½
Fuel for lighting	0	1½
Oil and light for car	0	3
Driver's wages	5	0
Stoker's wages	3	0
Conductor's wages..................	2	4
Estimate wear and tear.............	4	0
	17	6

Cost of working per mile, 5½d. for steam car. This is in contrast with the £1 7s. 6d. per day, and 8¼d. per car mile mentioned before, as the expense of horse traffic on the Wantage tramway.

The engineer says that he would prefer a 40lb. rail in lieu of the present 30lb. rail. It will, however, be observed, that the legal and Parliamentary expenses are excessive, notwithstanding the facilities afforded by the General Act and the provisional orders of the Board of Trade.

CONCLUSION.

The general conclusion to which the consideration of this subject brings us, is that the problem of the application of steam to tramways has been so far solved by the Grantham and Merryweather steam cars and engines, that steam traction may now be advantageously brought into operation on all tramways. The cost of steam traction would certainly not exceed two-thirds (probably not one-half) of that of horse traction; and it would be more humane and convenient. Its adoption will therefore afford a large margin of profit to the existing tramway companies, who now work their lines with horse power. As a result of the application of steam traction to tramways, we may safely look to the extension of steam worked tramways for supplying cheap and convenient locomotion to the small towns and large villages which do not now enjoy railway communication, whose traffic would scarcely repay the construction of the more complete and expensive railways. The question of constructing light railways has often been mooted, but without success in this country. We have laid down a certain standard of excellence for our railways, and however much engineers and directors have desired to extend the railway system, by means of light and cheap railways, the requirements of the Board of Trade have been such as to prohibit the construction of economical lines. The argument of the Board of Trade is, that if a railway is once open, although it may have been designed for light traffic, there is nothing to prevent heavy traffic passing over it. This argument is not one which it is necessary to discuss here, except to observe that its result is that we should look all the more to the development of tram-roads in all localities where there is not a sufficient amount of traffic to support a railway of the standard pattern.

In a new country, where no roads exist, and where the railway is the pioneer road, railways of cheap and light construction will continue to be adopted; but, in a fully settled country, possessing railways of the European standard, and already provided with roads, the tramway will be a fitting auxiliary to the railway, and a supplement to the ordinary road as a means of reducing the cost of conveyance.

The tramway can follow the line of the high road, with occasional deviations to avoid steep hills or very sharp turns. From its nature, the tramway requires a less expensive permanent way than the railway, for the expense of a permanent way depends on the weights passing over it and the speed at which these weights are moved. The limit of the greatest weight per wheel moved on a tramway will probably be that on the wheels of a railway waggon, for, in country districts, it will occasionally be of great advantage to have the power of conveying a truck-load of goods to its destination without transhipment. The tramway traffic moves at low velocities; the limit of weight on railways, on the other hand, depends on the weight of the heaviest engines, and these move at high velocities. A tramway requires no expensive stations or platforms, as the passengers or merchandise can be taken up or set down at any point of the journey; no expensive signals are wanted; the only special requirement in the construction to which it is desirable to attend is, that the gauge should be that of the railway system, viz., 4 ft. 8½ in., so that, when necessary, the railway truck may pass on to the tramway.

I trust I have been able to show you that the adoption of steam traction on tramways will prove eminently advantageous to street traffic in towns; that it will extend to the artisan population similar advantages to those which the railway has long extended to professional and business men, viz., that of being able to sleep in pure country air at a distance from their work; and that it will afford a long-desired supplement to the railway system, by means of which those unfortunate towns and villages which have not held out sufficient promise of traffic to induce a railway company to approach them, may receive the advantages of cheap transport, whilst at the same time the adoption of steam traction affords a certainty of large profits to the tramway companies.

DISCUSSION.

Mr .W. Hancock asked what was the pressure of steam in the Merryweather car?

Mr. Henry Merryweather replied from 80 to 100 lbs. He added a few particulars, showing the economy obtained by the use of steam tram-cars in Paris, where there were 30 now running. They found the cost per day of 16 hours was about 48 francs, or say £2 for each engine, whilst the average daily takings were 214 francs 25 centimes, or £8 18s. 6d. The line commenced at the Bastille and ran to the Arc de Triomphe, about seven miles, and for half a mile up the Avenue Josephine, the gradient was 1 in 30. These figures included the wages of two men, but in England one would be sufficient, because in Paris one was employed entirely to blow a horn to warn passing traffic. In England they would run at a cost of 3d. a mile as against 7d., the cheapest rate by horse power.

Mr. Stevenson, engineer to the Wantage Company, after giving the detailed figures of the cost of the line, said they had now had under trial six of the steam cars. There was a deal of trouble in getting the Grantham car to Wantage, and at first, the boiler being too small, it did not generate steam fast enough. When a larger multitubular vertical boiler was put in, it worked very well; but it was now gone to Bristol to have an indicator and automatic apparatus for shutting off steam when the speed reached ten miles an hour, added to it. The great advantage of the Grantham car over the Merryweather separate car was that, in climbing a gradient of in 40 or 50, great tractive force was required, and no engine would take anything like a load up such a gradient unless it weighed four or five tons. In the Grantham car the whole weight was utilised, whereas in the other, especially in the snowy weather, the wheels slipped round. Another advantage was that you could work either way without turning round, and thus no time was lost in turning. It took less space, and was worked at the least possible expense. They did not run more than nine journeys a day backwards and forwards, which was less economical than if they worked continuously, but the cost was 17s. 6d. as against 27s. 6d. with horse-power.

Mr. King said he had some title to speak on this subject, having been the first engineer consulted by Mr. G. F. Train when he came to London, and proposed to introduce tramway locomotion. He felt that that gentleman did not receive the appreciation he deserved, and now that his plans were being largely carried out his merits were often forgotten. It was a common fault with railway engineers to get away from the ordinary routes of communication, and he thought Captain Galton had started from the right point in insisting on the common roads being utilised as much as possible. Anything which would tend to accommodate traffic along the lines over which agricultural produce and passengers had flowed for centuries was a step in the right direction. In watching the progress of tramways, he had naturally been struck with the advantages which would issue from the use of some motor other than animal power, and it seemed to him that steam was the only one really available. Condensed air, as well as electricity and springs, had been tried, and he believed had failed, even in the Moncrieff system. He did not quite appreciate the advantages of the Grantham over the Merryweather car, seeing that it must be longer, and would not go round so short a curve, nor was it convenient for passengers, especially in summer, when there must be a great deal of heat given off. Besides, there was such a large stock of cars on hand, and a method which admitted of using them possessed great advantages. He had no doubt that in course of time they would see tram-cars propelled by steam in the heart of London, as they were already with perfect safety in Paris, Vienna, and elsewhere, and this must result in great economy to the tramway companies.

Mr. Lewis B. Isaacs could not endorse the opinion of the last speaker, that it was desirable to have tram-cars propelled by steam in large towns, especially in London, though they might be very useful in the country for connecting small towns with the nearest railway station, which was often eight or ten miles off. It was in his opinion a piece of very doubtful policy for the Legislature to grant the practical monopoly of the Queen's highway to a company, and he believed the promoters of these schemes made an egregious error when they endeavoured to force them upon large and populous cities like the metropolis. He was not quite sure that he knew where Wantage was situated, but he believed it was in Berkshire, and there a steam tramway might be a convenience, but to introduce them in London would be a retrograde step. Even at present they were a great inconvenience, and he thought the inhabitants of the West-end of London had reason to congratulate themselves on the failure of Mr. Train's scheme. It was practically impossible to maintain a road with a tramway on it in a good state of repair, as might be seen all round London.

Mr. Ingram begged to remind Mr. Isaacs that Alfred

the Great was born at Wantage; and that, while monopolies were granted to gas and water companies, there could be no great objection to the same privilege being afforded to companies which provided such great facilities for transport. Manufacturers did not try to force their steam-engines on the public; they were like any other inventors who brought their machines before the tramway companies, and if they possessed advantages, economical or otherwise, they would be adopted. No doubt some time must elapse before they were introduced into the streets of London, because a great deal of prejudice had to be overcome, as had just been shown; but he hoped that, in the course of a few years, now that School Boards were established, a more intelligent generation would grow up, and these prejudices would disappear. When the advantages of steam were appreciated, it would be introduced even in London.

Mr. W. Hancock said this subject, though not directly, was very closely allied with that of steam transit on ordinary roads, in which his uncle took so great a part more than half a century ago. Instead of looking upon the use of steam as a retrograde step, he considered that the use of horses was a distinct step backwards, looking at what had been done then. From 1824 to 1836 his uncle devoted himself to this subject, and ran his steam carriages from Stratford up the Mile-end-road, through Leadenhall-street, Cornhill, Moorgate-street, up the City-road, down Pentonville-hill, and so on to Paddington, than which a more crucial experiment could hardly be tried. His largest car carried from thirty-six to forty passengers, it made several journeys a day for six months continuously, and, during the whole of that time no horse was ever frightened, nor did any accident ever occur, except on one occasion, when the driver of a heavy van backed intentionally against the car, and before it could be pulled up it ran on the pavement and into a shop window. It fully complied with the conditions laid down by the Board of Trade, for there was neither noise nor smoke, nor was there any danger from the bursting of the boiler. The large car he had spoken of was fitted with boilers of 12 in. diameter and 12 in. stroke, and with a chamber boiler of his uncle's own invention, the steam being at a pressure of from 100 lbs. to 140 lbs. On one occasion, when going along the road, the carriage stopped, and on examination it was found that the boiler had burst, but neither the engineer nor passengers were aware of it, so that it was perfectly safe. One of the greatest disadvantages of the present system was the way in which the roads had to be paved, which led to the jerking of ordinary vehicles passing over them; but if the lines were laid out for steam carriages this difficulty would be to a great extent removed, and the road might be practically as level as if no lines were there.

Mr. Light said his experience went farther back even than Mr. King's, for he had constructed the first tramway ever laid in the Northern States of America. Since then he had been engaged in constructing tramways all over the world, and had watched with great interest the various improvements which had been made. He was very much surprised to hear the remarks of Mr. Isaacs with reference to the use of steam, which seemed to take him back to the objections made by people unacquainted with the subject to the use of steam on railways. If they looked at the matter from a common-sense point of view, they must see that something more than horse-power was required for tramways. On the Surrey side of London the tram companies paid little or no dividend, simply because they had to depend on horse-power, and did not know how to manage it. At first the cars were horsed by the London Omnibus Company, which did very well by it, and then the companies thought they would manage it themselves; but they did not know how to manage matters properly, one great fault being a constant change in the drivers, which never worked well, and now they were looking forward to the use of steam as the only way of making a dividend. The best proof that steam was making its way was the fact that it was now being employed in Russia, Germany, and France. In Paris he had seen 20 or 30 steam-cars working continually, and doing a large and profitable business, and in St. Petersburg, where there were twice as many tram-cars as in London, they wanted steam, though horses, fodder, and wages were much cheaper than in England. He had seen both the Grantham and Merryweather engines, which were both very good. The Grantham car had its faults, no doubt, but it did its duty well, was noiseless, and stopped in a very short distance. Many engineers had seen and approved it, though they thought it might be improved, and a further step had been to make the engine separate from the car. This was necessary on account of the large quantity of rolling stock already in existence which it was necessary to utilise, and this was accomplished by the Merryweather engine. Everybody who knew anything about steam knew that the days of horse-power were gone by, the first proof being the carriages of Mr. Hancock which had been already referred to; and he himself had ridden on one of Dr. Church's steam carriages in Birmingham about the same time.

Mr. Robarts said that on one occasion a horse he was riding was so frightened by Mr. Hancock's steam carriage that he had to return home.

Mr. J. Scott Russell, F.R.S., said he had lately ridden on a Moncrieff car in Scotland, where it was still in use, and in Sheffield he had seen tram-cars propelled by a separate steam car similar to Mr. Merryweather's. He thought the great value of Captain Galton's paper was that it drew attention to the relation of tramways to the present stage of civilisation, and it led to the conclusion to which all practical engineers had come, that although in some cases there might be advantages in using steam cars on ordinary roads—and no one had advocated this more strongly than himself—yet that it was far wiser to use steam in connection with tramways. The railway system had been developed until the country was pretty well covered, and in some places, where there were two or three lines connecting the same towns, shareholders might think they had rather more than enough of them, and therefore he thought it would be as well to determine that they would not have any more railways, but that the railway stations being treated as *foci* for concentrating the traffic, they should have all round them a good service of tramways for distributing it. The inference he drew from the statements which had been made, and which he considered as an important one, was this, that there was a great advantage in having the propelling power in the carriage itself, because then you utilised the whole weight in assisting the tractive force, and were thus much better able to mount steep gradients. In other words, you make the paying weight as large and the unpaying weight as small as possible. Of course there were difficulties in carrying this into practice, but not more than could be overcome by the talent and skill of the engineers who were now studying the subject, and their greatest triumph would be in solving this problem. At the same time, there were advantages in some cases in using separate engines, or even in the compressed air system of Moncrieff; and one point to be practically attended to was the adoption in each case of the system which on the whole presented the greatest advantages.

Captain Galton remarked that he had not laid so much stress on the point mentioned by Mr. Scott Russell, of utilising the weight of the car for the purpose of gaining adhesive power, because Messrs. Merryweather had devised a plan by which they could use the loaded car for this purpose when required, by means of an extra cylinder and a chain passing round a drum attached to the axles of the passenger carriages, as described in the paper. In reply to the remark of Mr. Isaacs about monopolies, he would remind him that the

Act of Parliament gave a right of purchase to the local authorities at the end of 21 years, so that they could then work the tramways themselves for the public benefit. He was thoroughly convinced that tramways would form a proper means of extending the advantage of cheap and ready transit to all parts of the country.

The Chairman, in proposing a vote of thanks to Capt. Galton, said he had discussed the subject from the proper point of view, viz., that tramways should form the tributaries to railways. There could be no doubt that their extension would be very rapid during the next few years, and at this moment several Bills were being promoted for authorising the use of steam in connection with them. He fully concurred in the remarks of Mr. Scott Russell, and though the Merryweather system had the advantage of utilising existing rolling stock, the system of the future would probably be something like that devised by his late friend Mr. Grantham, whose labours had been so well appreciated by the Society of Arts that it had awarded him its gold medal.

The vote of thanks was passed unanimously, and the proceedings terminated.

Mr. Wilson writes as follows:—"In the discussion on Captain Douglas Galton's paper, read at your meeting last evening, there was a point raised by several of the speakers in reference to the Grantham system of steam-car, viz., that it was not capable of utilising the existing stock, that is, of being adapted to the present cars drawn by horses. Will you kindly allow me to say that this assumption is a mistaken one, the Grantham system being, to my certain knowledge, capable of being easily adapted to the present horse-cars, and therefore of utilising all the existing stock. Nothing more would be required than to remove one of the gangways at the end of the present horse-cars, and then to bolt it to the Grantham engine compartment, which would be in this case at the end of the cars, and externally in all respects similar to it."

MISCELLANEOUS.

LOCAL MUSEUMS AS A PART OF NATIONAL EDUCATION.

A meeting was held at Manchester on 2nd February, to promote the building of a new School of Art in connection with a Museum of Fine Art; Sir Henry Cole, K.C.B., was invited to attend and give suggestions. He submitted the following, which may be found useful in similar cases:—

Considerations Submitted to Municipal Corporations by Sir Henry Cole, K.C.B., late Secretary of the Science and Art Department, and Director of the South Kensington Museum.

1. *Public Museums*, to be as useful as possible to the general public, to students in Art and Science, designers, artists, &c., ought to be in direct connection with Schools of Art and Science. Each gives vitality and strength to one another. The present great public desire for Local Museums has arisen naturally from the creation of these technical schools, and the facts which have helped on this desire should be borne in mind.

2. At the first establishment of Schools of Art (originally called schools of design) Parliament voted £10,000 to purchase examples of paintings, sculptures, bronzes, &c., to be used in the schools.

3. When Marlborough House was used provisionally as the first museum in 1852, illustrating the connexion of fine art with productive industry, a minute was passed by the President of the Board of Trade, the Right. Hon. J. W. Henley, in May, 1852, by which grants of half the cost of works of decorative art were sanctioned for Schools of Art to induce the schools to buy them towards forming museum collections. As late as May, 1869, the Marquis of Ripon, as Lord President of the Council, passed an important supplementary minute with the same object.

4. Between 1853 and 1875 a system of *loans* from the Kensington Museum has been in active and successful working, and when I was secretary, grants of 75 per cent. for the purchase of objects necessary for art instruction were made to schools. Up to 1875, 26,900 objects had been lent to museums, schools, and exhibitions, which have been attended by more than six millions and a half of persons. Hitherto, all attempts have been fruitless to induce the British Museum and National Galleries to concur in a system of placing their superfluities in local circulation.

5. *Building grants* not exceeding £1,000 are made towards the erection of Schools of Science and Art, by which space in the structure necessary for exhibiting specimens is allowed. So much for direct *State assistance* to local museums.

6. As respects the action of *local authorities*, Mr. Ewart's Amended Act of 1856 sanctions the levy of a rate not exceeding 1d. in the pound to be devoted to the support of Museums and Schools of Science and Art, and the power has been used in some few places.

7. Since the passing of the Education Act in 1870, local rates may be levied for the support of elementary schools, and it may be foreseen that, in small places, free libraries, museums, and laboratories, and the like will be connected with the schools. At Birmingham, one of the Board schools is about to have a kitchen for teaching cookery.

8. Schools for elementary education, as well as Schools for Science and Art, are now supported by three respective means applied in different degrees —(*a*) *State grants*; (*b*) *local rates*; and (*c*) *the fees of the students* with some voluntary donations. The same principles are obviously applicable to the support of local museums.

9. The chief, and perhaps the only serious difficulty in establishing a local museum, is the building. Building grants are no longer made to elementary schools, but they might well be augmented for Museums and Schools of Art. The next difficulty is an adequate maintenance fund. The supply of examples will come by gifts and purchases, especially of reproductions aided by Government grants.

10. Thus it is shown that the three principles of support which now regulate the management of public elementary schools would exactly suit that of Public Museums.

11. An effort should therefore be made to induce Parliament to entrust local authorities to raise sufficient rates in aid, and such authorities might be municipal corporations or school boards, or a union of members of the two.

12. Donations would certainly come in aid of the buildings and purchases, and endowments of maintenance.

13. As respects the specimens *permanently* exhibited in museums, they would vary in kind and extent according to the size of the place. The acquisition of objects of natural history, illustrations of machinery, and technical processes, and practical science need not entail great cost. But original pictures, especially very fine ones, would cost much, and so would objects, such as bronzes, enamels, pottery, ivories, &c., illustrating fine art applied to productive industry. The highest class of ancient original works can hardly be obtained, but *copies* of them could be readily procured, and would really serve as well as originals for the pleasure or instruction of the general public. In the production of reproductions, a co-operative administration would be almost indispensable, besides being by far the cheapest mode of action. At least six large local museums should each possess a copy of the finest Raphael, Michael Angelo, Titian, Albert Durer, and Holbein, and the Science and Art Minutes in my time used to make grants of half the cost of such reproductions; so with casts of fine works in marble, sculptures, bronzes, &c., which would be made by various methods.

14. The Society of Arts has long had the advantage of the services of a most influential committee to promote the establishment of local museums in connection with public education, and a conference of municipal authorities is about to take place in London. In order to keep the movement alive, it seems desirable that an annual conference should be held in one of the great local centres of industry.

REPORTS ON THE GOVERNMENT CINCHONA PLANTATIONS IN INDIA, AND ON THE BOTANIC GARDENS, BRISBANE, AUSTRALIA.

Two reports of more than usual interest have recently been received; the first is Dr. King's annual report on the Government Cinchona Plantations in British Sikkim, and the other is Mr. Walter Hill's report on the Brisbane Botanic Gardens. Taking Dr. King's report first, which of course deals only with cinchonas, it is highly satisfactory to read that the work done during the year 1875-76 was, "unlike that of any former year, more of harvest than of planting. After thirteen years of expenditure, at first on experiments, and latterly on *bonâ-fide* planting, during which period but little return was received, the scale has now begun to turn, and, for the first time in its history, the plantation has yielded a tangible result in the way of crop, 211,931 pounds of dry bark having been collected since the last annual report." This out-turn exceeds by 62,000 pounds the amount estimated by the Indian Government as the probable yield, and the bark harvested has been entirely that of *Cinchona succirubra*, or the red bark. From about 180 acres of the plantation at Rungbee, the whole of which was planted in 1867, and which was carefully gone over and thinned where necessary, was obtained 8,017 pounds of dry stem, and 12,388 pounds of dry branch bark, 74,000 pounds of dry bark—of which about one-fifth was stem bark, and four-fifths branch bark—were obtained by thinning and pruning the plant on the upper part of the Rishap spur, which was planted in 1869, the plants being set at distances of six feet apart. In the *succirubra* plantation, which was made in 1872, and in which the trees stand only four feet apart, giving 2,722 trees to the acre, a moderate thinning and pruning was made, the result of which was about 16,153 pounds of dry bark, composed, in round numbers, of one-fourth root bark and rather less than a fourth of stem bark, the remainder being branch bark. About eight acres of plantation at Rungbee over and before that alluded to "were cut down close to the ground, only a small proportion of trees being left standing." The trees cut on these eight acres yielded 6,400 pounds of dry stem bark and 3,781 pounds of dry branch bark, or a total equal to 1,272·5 pounds of dry bark per acre. "These figures do not, however, by any means show all the bark which has been collected from these trees since they were planted in 1867, for they have been, from time to time, thinned and pruned in years past."

A patch of 35 acres of trees near the site of the old Rishap hut, planted in 1866-7, and, therefore, about nine years old, have been entirely uprooted, yielding 41,374·28 pounds of dry root bark, 19,677·48 pounds of dry stem bark, 21,576·00 of dry branch bark, making a total of 82,627·76 pounds. "This is equal to 2,360·8 pounds of dry bark per acre, of which about a half is root bark containing eight per cent. of alkaloids, and nearly a fourth is stem bark, containing at least six per cent. of alkaloids. . . . Originally planted at distances of six by six feet apart, the trees, when two and a-half years old, were thinned, and 1,600 pounds of dry bark was thus obtained.

Shortly before the sitting of the Commission appointed to consider the subject of a disease which then (in the opinion of some) threatened the plantation with extinction, and when the plants were about three and a-half years old, each alternate row of them was cut down, and dry bark was thus obtained to the extent of 3 200 pounds. One of the witnesses who appeared before the Commission was the late Mr. W. G. McIvor, superintendent of the Government Cinchona Plantation on the Nilgiris, and in April, 1872, or shortly after his examination by the Commission, Mr. McIvor put on record his opinion that if cut down then (*i.e.*, in April, 1872), these thirty-five acres might (including the 4,800 pounds already taken from them), yield a total of about 273 pounds of dry bark per acre; but that, if allowed to remain uncut, a large proportion of the trees would be dead before a year should elapse. Mr. McIvor even went so far as to say that, in his opinion, more good bark would be got by cutting the trees then than could ever again be taken, bark from dead and dying trees being worthless. Some time after this opinion had been given, a further thinning (the third) of these trees was undertaken, which yielded 8,000 pounds of dry bark. Prior to uprootal, these thirty-five acres had, therefore, yielded 12,800 pounds of dry bark, or at the rate of about 365½ pounds per acre; at uprootal, as we have just seen, they yielded at the rate of 2,360½ pounds, bringing their total yield per acre up to 2,726 pounds of dry bark, or about ten times the quantity estimated by Mr. McIvor. Mr. McIvor was the most experienced cinchona cultivator of his day, and his opinion carried much weight. These thirty-five acres were about as much affected by the disease of which Mr. McIvor took so gloomy a view as any part of the plantation; it is therefore satisfactory to find that the ravages of any disease that has hitherto appeared amongst cinchonas need, after all, be but little dreaded.

With regard to the different modes of harvesting or collecting the bark, experience has been obtained for the first time in the system of uprooting, the method practised in the natural cinchona forests of South America. The root bark, according to the Government quinologist's analysis, gave about 8 per cent. of total alkaloids, and is, therefore, richer than the finest of the Indian stem bark, which rarely yields more than 7 per cent. In coppicing, moreover, a certain proportion of the stools fail to shoot —in fact die—and, as the bark of every part of a dead cinchona tree is quite destitute of alkaloid there is always a certain amount of bark lost in coppicing. From the experiments in uprooting, the fact seems to have been established that it is by no means a difficult or expensive process, "bark so taken having cost for collection about two and a-fourth pies per pound when green, as against one and three-fourths pies per pound for green bark taken by coppicing." Over and above the larger percentage of alkaloids obtained, the uprooting system has this advantage, that by it the ground is thoroughly turned over, so that it is thought it will be ready for replanting at once. Dr. King expresses his belief "that an almost complete coppicing, by which a minimum of standard trees is left (and that means a minimum of shade and of drip), is more likely to yield good results than a partial coppicing, by which only alternate plants or alternate rows of plants are cut. The shoots which follow a complete or nearly complete coppicing are in every case more healthy and vigorous, and in many cases more numerous also than any seen to rise from stools standing in shade. If the precaution of earthing up the stools be taken, the damage done to the young shoots by wind does not appear to be great. The cost of weeding and cultivating complete or nearly complete coppice, will be about the same as for seedlings planted from the nursery. Experience alone will show whether coppicing or uprooting will pay best, and it would be premature as yet to form an opinion as to their respective merits as modes of harvesting. With regard to the third method of harvesting which has been proposed, viz., decortication of living trees, former experience having shown that renewal of bark under moss is a failure in Sikhim, owing to the attacks of ants, no further experiments have been made by that method. Some trees which were partially stripped of their bark during the year 1874, have partially renewed it without the application of moss or straw, or other covering of any kind. The renewed bark, however, although now more than 18 months old, is still only about half as thick as the original bark." Though not hopeful of very favourable results from the method, Dr. King reports that he has given instructions that 300 healthy trees be submitted to it during the rainy season. It is estimated that the cost of production per pound of the dry bark amounts to about 5½d. 92,400 pounds of dry bark were made over during the year to the Government quinologist for conversion into cinchona febrifuge.

With regard to the present condition of the plantations, they are reported as being, on the whole, very encouraging. The nursery stock of red barks on the old plantation has been increased by 290,000, and 125,000 young plants have been provided for the new plantation at Sittong. These will be planted out, as far as possible, during the year. Of the yellow bark tree (*Cinchona calisaya*), 2,000 stock plants (kept under glass for purposes of propagation) have been added during the year. The seedlings of this species, of which 116,000 were returned last year, were not planted out, experience having shown that *calisaya* seed, however carefully it may be collected from only the varieties yielding good bark, produces an uncertain and mongrel offspring. *Cinchona pitayensis*, a species allied to *C. officinalis*, was introduced to the plantation about five years since, but the plants have all pined away. Dr. King says, "Regarding the other species in cultivation, I may remark that *officinalis* was long ago discovered to be unsuited to the climate of Sikhim. Though large numbers of plants still remain on the plantation of *C. micrantha* and *C. pahudiana*, the bark of both species is comparatively worthless; no effort has, therefore, been made to multiply either." The estimated crop of bark for the year ending March 31st next is given as 366,000 pounds. Dr. King's remarks on the "cinchona febrifuge," prepared by the Government quinologist, are of such importance and interest that they may well be given in his own words. He says that, "in most ordinary cases of malarious fever, it appears to be an efficient remedy. Powerful testimony to this effect is borne by the four physicians in and and about Calcutta, to whom, about eighteen months ago, a quantity was given for treatment and report. Coolies on the plantation often get fever by attending markets in the Terai, and they are invariably cured by a dose or two of this mixed alkaloid. In the neighbourhood of the Botanical Gardens at Calcutta fever of a bad type is very prevalent, and I have given the 'cinchona febrifuge' to garden coolies, and to villagers living near the garden, in the same doses as quinine, and with as unvarying good effect. It is probable that for very severe and critical cases of malarious fever, especially amongst Europeans, sulphate of quinine will long remain, in the estimation of the medical profession, as the best remedy; but everyone who has had much experience of India knows that bad cases of fever are more the exception than the rule, and that there is a simply incalculable amount of fever prevalent amongst the natives of the locality, which rarely takes the form of a violent or fatal attack, but which expends itself in a succession of attacks, each sufficient to incapacitate the sufferer from work for a time, and a repetition of which too often ultimately induces malarious cachexia and disease of the spleen. There appears to be ample medical evidence for believing that, for malarious fever of this ordinary type, the 'cinchona febrifuge' is a most efficient remedy. Everybody who knows much of rural life in this country must also be aware that at present the great majority of such attacks of fever receive no medical treatment whatever, or at least none of an efficient kind, and for the simple reason that no febrifuge is accessible to the sufferers. Quinine is a costly drug, quite beyond the means of a large proportion of the population. Moreover, it is not to be had, except at dispensaries and large bazaars in neighbourhoods where Europeans happen to be settled. It is no exaggeration whatever to say, to three-fourths of the population of India, quinine is simply unobtainable even by purchase. Its high price leads, moreover, to its extensive adulteration, and there is too much reason for believing that much of the substance sold in the bazaars as quinine consists partly, and some of it entirely, of other preparations. A febrifuge even less efficient than the 'cinchona febrifuge' would, if accessible to the vast fever-stricken population (and accessibility depends on cheapness), be an immense boon. It appears to be, therefore, a matter for congratulation that Government is now in possession of the means of throwing into the country next year several tons of an efficient febrifuge, and of year by year increasing the supply, and that too at an annually diminishing cost price per ounce."

Mr. Walter Hill's report on the Brisbane Botanic Garden, shows that many useful plants of tropical countries are suitable for acclimatisation in Australia. First, with regard to sugar, it seems that at present there are forty varieties of cane in the garden. There is a large and continuous demand in the colony for plants of varieties not subject as yet to disease, 98,000 plants having been distributed during the past year. With regard to tobacco, the seed of fifteen varieties have been received during the year, a portion of which have already been distributed, and a further supply will also be available for distribution next season to those persons engaged in tobacco cultivation in the colony, and it is expected that some of the varieties will prove to be well adapted to the soil and climate of Queensland. Of the ordinary commercial coffee (*Coffea arabica*) the experimental plantation is reported as healthy, and exhibiting "no appearance of the leaf disease (*Hemileia vastatrix*) which has proved so destructive in Ceylon and other parts of the world. Although the plant thrives well in this portion of the colony, the neighbourhood of Cardwell and the northern districts, more especially the sheltered ridges of the Herbert River and the Endeavour River will be found more suited to the profitable cultivation of this great commercial product. A very fine sample, both of the ordinary and pea-berry varieties, has been sent by a gentleman on tho Lower Herbert; the berries were picked and cured by aboriginal labour, and thirty acres will be put under crop during the forthcoming season." Of the Liberian coffee (*Coffea liberica*) some seeds have been received at Brisbane which have germinated, and the plants are now healthy and thriving, some of them having already been distributed.

The tea plantation is reported to be in a flourishing condition. Plants have been distributed to residents upon the Darling Downs and to persons in other parts of the colony. The tea, however, seems not to attract the attention it possibly might, if the skilled labour required in the manufacture of the crop could be obtained at a reasonable rate. Until such can be procured, although many parts of the colony are well adapted to the production of the teas of a superior class, its cultivation as an article of commerce is not likely to be undertaken upon a large scale. The Paraguay tea (*Ilex paraguayensis*) continues to thrive, thus proving that it is well adapted for cultivation in Queensland. The following are amongst other new or important economic plants introduced to the gardens during the year under review:—The balsam of Tolu (*Myroxylon toluifera*), the new tanning plant (*Balsamocarpon brevifolium*), the Sumatra and Penang rubber plant (*Urceola elastica*), the Siam gamboge (*Garcinia morella var pedicellata*), the edible acorn of China (*Quercus cornea*), &c. Many varieties, also, of the hardier descriptions of English fruits have been introduced and distributed for cultivation in various parts of the colony, besides which much attention has of late been given to grasses and fodder plants, with a view both of renovating deteriorated pastures and forming new ones. A great number of varieties have been, and are still, under trial; but of those which, up to the present time, Mr. Hill considers to have proved themselves most suited for cultivation, both as regards luxuriance of growth, power of withstanding drought, and value for grazing purposes, the following are selected:—Prairie grass (*Bromus Schraderi*), perennial rye grass (*Lolium perenne*), purple medick, alfalfa or lucerne (*Medicago sativa*) timothy or cat's-tail grass (*Phleum pratense*), tall fescue grass (*Festuca elatior*), yellow or golden oat grass (*Avena flavescens*), tall oat grass (*Avena elatior*), meadow fox-tail grass (*Alopecurus pratensis*), cocksfoot grass (*Dactylis glomerata*), sweet-scented vernal grass (*Anthoxanthum odoratum*), woolly or soft meadow grass (*Holcus lanatus*), besides the several kinds of clover (*Trifolium* spp.), lucerne (*Medicago* sp.), and sainfoin (*Hedysarum onobrychis*).

CORRESPONDENCE.

INDIAN TEA.

As the *Journal* containing the report of Mr. Burrell's very interesting paper on "Indian Tea" will probably find its way into the hands of some who are interested in tea planting, I should be glad of the opportunity of removing an impression which seems to prevail, more or less, amongst planters, as to the unwillingness of tea-dealers in this country to supply the public with Indian tea unmixed with that of China. The simple fact is, that even in China teas a judicious mixture is found to give more general satisfaction to consumers than one kind by itself, and the same remark applies more particularly to Indian teas, in consequence of the greater novelty and more striking character of the flavour. Self-interest would prove a sufficient incentive to induce retailers to supply pure Indian tea if the public were to ask for it, but in the absence of such exclusive demand the wisest course probably is to let the public taste adapt itself gradually. Besides, the present import is only sufficient to supply one consumer in every five, and, so long as it is all taken by the trade immediately on arrival, at prices which are admitted to be quite equal to if not higher than those ruling for China tea of similar quality, surely no prejudice can exist.

There is little doubt but that Indian tea is "the tea of the future," and if planters will aim at producing it in larger parcels—say, 200 to 300 chests of uniform quality, instead of the small lots of 10 to 20 chests manufactured now—and if, also, they be careful to maintain the standard of quality, they may fairly hope to supplant China tea in the English market as fast as they can produce an equal quantity to take its place.

D. F. Shillington.

February 5th.

VENTILATION OF ROOMS.

Although Mr. Thicke's paper referred to several other details connected with the interior arrangement, warming, &c., of houses, the discussion mainly turned upon the question of ventilation, which was not to be wondered at, considering its paramount importance.

It was debated not only what were the best means for securing the ventilation of rooms, but also what is meant by good ventilation; and I was sorry to hear it suggested, by at least one speaker, that ventilation, together with other sanitary improvements, should not be pressed upon the poorer classes, and that a plentiful admission of fresh air into a room could not be accomplished without creating draughts. I could not agree in that opinion, and there is abundant evidence in London to the contrary.

General Cotton referred, for instance, to a ward in St. George's Hospital, where an abundant supply of fresh air was admitted by means of vertical tubes, with great success. So, also, at the Throat and Ear Hospital, and numerous other places.

It has been proved by demonstration, over and over again, that air admitted on this principle, judiciously applied as regards the height and area of the tubes, not only keeps an apartment fresh and wholesome, but the inmates neither feel any draught nor is the temperature uncomfortably lowered; on the other hand, it is equable in all parts of the room, and, therefore, in a healthy condition.

I was glad to hear General Cotton's testimony on this point. I had some tubes fixed in my own dining-room, and many of my friends have tried them, and so great was the improvement effected that they would not now be without them on any account.

In considering the effect of various methods of ventilation, many people omitted to take into account counteracting influences, and especially the diffusion of gases, and so were led to erroneous conclusions.

The pressure of the column of air entering a room by means of upright tubes, about half the height of the room, or less, was neutralised, or nearly so, by the time it reached the ceiling, owing to the higher temperature inside, and was then gradually diffused throughout the room by mixing with the air already present there.

An improvement in the system exhibited to the meeting by the Ventilation Company, of Victoria-street, Westminster, was worthy of notice. It consisted chiefly in an arrangement for cleansing the air before it enters the upright tube, by means of a box fixed in the wall or air inlet, containing a trough of water, and furnished with deflecting plates which deflected the air on the water.

I have found this way effective in arresting dust and other dirty particles, which would otherwise find their way into the room.

The author of the paper proposed to introduce air through panels of wire gauze, fixed in doors and windows, in order to break the force of the current; but it had been found (as pointed out by one or two of the speakers) that both wire gauze and cotton wool get so soon choked with dirt as almost entirely to prevent the air passing through unless frequently cleaned. This fact points to the necessity in London and large towns of having such an arrangement as that exhibited for intercepting the dirt without interrupting the free inflow of the air.

With regard to extraction, it was found that in most cases the usual chimney opening or fire-place was sufficient, aided perhaps by an additional outlet, such as one of Bayle's Mica Flap Ventilators opening into the flue near the top of the room when there was a quantity of gas burnt. Even in summer time, when the fires are not alight, it was found that the air in a closed apartment is changed by means of these vertical tubes, and the tendency to down draughts in the chimney completely reversed.

It seems to me that those engaged in designing and building model lodging houses and workmen's cottages, could not do better than adopt this system of vertical tubes, which is the most simple, and at the same time the most efficient, method of ventilation by natural currents.

When the houses were building, omitting such a refinement as the water box or air purifier, and leaving holes in the brickwork for air inlets, these tubes might be put in at a cost not exceeding £5 for a six-room cottage, with means of regulating the supply, and this would represent the expense of laying on a constant service of fresh air to the inhabitants, the value of which, from a hygienic point of view, could hardly be exaggerated.

I should deprecate the idea of bringing air into rooms through the doors which open on to the staircase or passage, because, as was pointed out by the chairman (Dr. Richardson), amongst others, in all ordinary construction the staircase is a sort of stink trap, up which ascend and in which are imprisoned all the smells and gases that are generated or given off from the lower part of the house, and it is well known that the houses of the poorer classes do, as a rule, contain very disagreeable odours. It is also objectionable to admit cold air at a low level in a room as it causes chilling draughts.

It would be far better, whenever possible, to take air direct from the outside of the house.

J. Livesey.

GENERAL NOTES.

Prizes for Designs for a Dessert Service of Plate.—Four prizes of £100, £50, £30, and £20 respectively are offered through the Science and Art Department by Messrs. Watherston and Son, for the four best designs for a dessert service of plate, comprising a central plateau, four candelabra, four fruit dishes, four flower stands, and four salt cellars. The service, when manufactured, is to be of a total weight of 2,000 ounces of silver. The competition is limited to candidates—British born—who are, or have been, *bona-fide* students of Schools of Art recognised by the Science and Art Department, and who have since 1867 taken a third grade prize, or a higher prize in the national competition of that Department. The drawings and models of all competitors must be forwarded to the Department through the secretaries of the Schools of Art in which they are or have been students. The designs must bear a distinguishing motto, which with the competitor's name and address must be sent to the Department in a sealed envelope with the designs, on or before the 15th March, 1877. The awards will be made by the director for art, E. J. Poynter, R.A.

National Health Society.—The general annual meeting of the National Health Society, was held in the rooms of the society on the 29th ult., Mr. Ernest Hart in the chair. The report of the year's proceedings was presented. This set forth that courses of lectures had been given at mothers' meetings, working men's clubs, and at evening meetings of national schools, with the co-operation of the clergy and other local authorities. Lectures on special subjects of personal hygiene and laws of health had been delivered to the educated classes by Dr. Wilkes, F.R.S., Mr. W. Eassie, C.E., Miss F. Lees, Miss Miranda Hill, and others, who had freely given their services. The report expressed a hope that the large deputation to the Home Secretary, organised last April, and attended by Dr. Lyon Playfair, Cardinal Manning, and other gentlemen interested in the improvement of the London water supply, would very speedily see its wishes and the promises of Mr. Cross realised. Large numbers of sanitary tracts, handbills, and posters had been sold and distributed. A vote of thanks was passed to the committee for its services during the past year, and some names were added to the list. The auditor, Mr. Frederick Pope, and the secretary, Miss Lankester, also received a vote of thanks for their services.

The New Division of Constantinople.—It appears from an official publication lately issued by the Sublime Porte, that Constantinople and its suburbs is divided into twenty municipal districts, comprising both sides of the Bosphorus and the Princes Islands, from the entrance into the Black Sea, right down into the Sea of Marmora. The houses of eighteen of these districts surveyed give the following result:

Municipal districts.	Number of streets.	Number of houses.
No. 1	76	3,846
2	40	3,728
3	46	3,227
4	29	4,630
5	40	3,603
6	24	3,908
7	43	3,258
8	41	4,537
9	33	4,551
10	10	2,228
11	30	3,551
12	10	3,398
13	14	3,394
14	26	4,538
15	17	2,343
16	11	2,710
17	30	3,491
18	9	1,321
Total	529	62,262

It is a well-known fact that in the East each house is inhabited by a single family, whether poor or rich, except in the European quarters, where there is a large floating population, but there are on the other hand a number of uninhabited shops, and therefore taking the one to compensate for the other, and counting each house to be inhabited by ten people (which is far from being the case)—but this allowance is made in order to include the garrison of this place—therefore the number of inhabitants for the 18 districts would amount to 622,620. But adding to this the two remaining unimportant municipal districts, and allowing the same *pro rata* of population as for the others, we shall thus arrive at what may be considered the most probable number of inhabitants at Constantinople to be 691,800.

NOTICES.

PROCEEDINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday evenings, at 8 o'clock. The following arrangements have been made:—

February 14.—"Zinc White as Paint, and the Treatment of Iron for the Prevention of Corrosion," by Professor Barff, M.A.

February 21.—Lecture, by Sir John Lubbock, Bart., M.P., F.R.S., on "The Relations of Plants and Insects."

February 28.—"Middle Class Education in Holland," by John Yeats, Esq., LL.D., F.R.G.S.

March 7.—Lecture on "The Growth and Present Position of the Science of Mechanics," by Professor A. B. W. Kennedy, C.E.

March 14.—"The Treatment of Town Refuse and Sewage," by Prof. Ansted, F.R.S.

March 21.—Lecture on "Vital Air," by Dr. W. B. Richardson, F.R.S.

African Section.

Tuesday evenings, at 8 o'clock. The following arrangements have been made:—

February 13.—"Recent Explorations of the Lake Systems of Central Africa," by Robert James Mann, M.D., F.R.G.S., &c.

March 13.——"The Geographical and Commercial Character of the District between Mogador and Cape Juby, North-West Africa," by N. Giammal, Esq.

April 10.—"The Social State and Prospects of the South African Communities," by Robert Richards, Esq., of Grahamstown.

April 24.—"The Trade and Resources of Morocco," by Dr. Arthur Leared.

Indian Section.

Friday evenings, at 8 o'clock. The following arrangements have been made:—

February 16.—"Indian Railways," by Juland Danvers, Esq. The Right Hon. the Earl of Northbrook, G.C.S.I., will preside.

March 2.—"The Progress of Trade in Central Asia," by Sir T. Douglas Forsyth, C.B., K.C.S.I. Sir Rutherford Alcock, K.C.B., will preside.

March 16.—"The Native Indian Press," by Dr. George Birdwood, C.S.I. Andrew Cassels, Esq., will preside.

April 20.—"The Existing and Possible Commercial Communications between Persia and India," by Major-General Sir Frederick John Goldsmid, C.B., K.C.S.I.

May 4.—"Thaumato-dendra, or the Wonders of Trees," with illustrations from life, by Wm. Tayler, Esq.

Chemical Section.

Thursday evenings, at 8 o'clock. The following arrangements have been made:—

February 22.—"Spontaneous Combustion in Factories and Ships," by C. W. Vincent, Esq., F.R.S.E. Prof. F. A. Abel, F.R.S., Pres. Chem. Soc., will preside.

March 8.—"The Sizing of Cotton Goods," by W. Thompson, Esq., F.C.S., of Manchester.

April 12.—"The Cinchona Alkaloids; their Sources, Production, and Use," by Dr. B. H. Paul.

Science Lectures.

These will be given on the following Wednesday evenings, in place of the usual paper and discussion. The rules for admission will be the same as for the Cantor Lectures. Each member can admit one friend by giving the usual order from the book supplied at the commencement of the Session:—

February 21.—Sir John Lubbock, Bart., M.P., F.R.S., "The Relations of Plants and Insects."

March 7.—Professor A. B. W. Kennedy, C.E., "The Growth and Present Position of the Science of Mechanics."

March 21.—Dr. B. W. Richardson, F.R.S., "Vital Air."

April 18.—E. J. Reed, C.B., M.P., F.R.S., "The Modifications which Ships of War have Undergone during the last 20 Years."

May 2.—J. Baillie Hamilton, "New Musical Instruments."

May 16.—Professor W. K. Clifford, F.R.S.

MEETINGS FOR THE ENSUING WEEK.

Mon. ...Royal United Service Institution, Whitehall-yard, 8½ p.m. Major H. M. G. Geary, "The Employment of Boys in the Army."

Institute of Surveyors, 12, Great George-street, S.W., 8 p.m. Mr. G. J. Symons, "Rainfall, and its Relation to Civilised Life."

Royal Geographical, University of London, Burlington-gardens, W., 8½ p.m. Lieut.-General R. Strachey, "Scientific Geography." Introductory Lecture.

Medical, 11, Chandos-street, W., 8.30 p.m.

London Institution, Finsbury-circus, E.C., 5 p.m. Prof. Armstrong, "Modern Agriculture." (Lecture I.)

Social Science Association, 1. Adam-street, Adelphi, W.C., 8 p.m. Mr. R. Denny Urlin, "The Appointment of a Public Prosecutor."

Tues....**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m., (African Section.) Dr. Mann, "Recent Explorations of the Lake Systems of Central Africa."

Royal Institution, Albemarle-street, W., 3 p.m. Prof. Garrod, "The Human Form; its Structure in Relation to its Contour." (Lecture V.)

Medical and Chirurgical, 53, Berners-street, Oxford-street, W., 8½ p.m.

Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Discussion on "The Sewage Question."

Photographic, 5a, Pall-mall East, S.W., 8 p.m. Anniversary. Mr. H. Baden Pritchard, "Photography from a Holiday-maker's Point of View."

Anthropological Institute, 4, St. Martin's-place, W.C., 8 p.m.

Royal Colonial, 15, Strand, W.C., 8 p.m. Mr. J. Plummer, "The Colonies and the English Labouring Classes."

Wed....**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. Prof. Barff, "Zinc White as Paint, and the Treatment of Iron for the Prevention of Corrosion."

Graphic, University College, W.C., 8 p.m.

Royal Literary Fund, 10, John-street, Adelphi, W.C. 3 p.m.

Royal Horticultural, South Kensington, S.W., 1 p.m.

Thur....Royal, Burlington House, W., 8½ p.m.

Antiquaries, Burlington House, W., 8½ p.m.

Linnean, Burlington House, W., 8 p.m. 1. Dr. W. C. McIntosh, "*Anaitis rosea*, a New Example of the Phyllodocidæ." 2. Mr. H. N. Moseley, "Deep Sea Actinaria (Sea Anemones)." 3. Prof. Dickie, "Algæ from Rodriquez." 4. Mr. R. D. Fitzgerald, "Note on the Pouch of Marsupials."

Chemical, Burlington House, W., 8 p.m. 1. Dr. A. Dupré, "The Estimation of Urea by Means of Hypobromite." 2. Mr. T. Carnelly, "The Influence Exerted by Ammonium Sulphide in Preventing the Action of Various Solutions on Copper." 3. Mr. W. H. Watson, "An Experimental Enquiry as to the Changes which occur in the Composition of Waters from Wells near the Sea."

London Institution, Finsbury-circus, E.C., 7 p.m. Prof. Ella, "Second Musical Lecture."

Royal Institution, Albemarle-street, W., 3 p.m. Mr. William Pole, "Theory of Music." (Lecture I.)

Numismatic, 4, St. Martin's-place, W.C., 7 p.m.

Royal Society Club, Willis's Rooms, St. James's, S.W., 6 p.m.

Psychological, 11, Chandos-street, W., 8½ p.m.

Civil and Mechanical Engineers, 7, Westminster-chambers, S.W., 7 p.m. Mr. J. Love, "The Optical Expression of Stress."

Fri.......**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Indian Section.) Mr. Juland Danvers, "Indian Railways."

Geological, Burlington House, W., 1 p.m. Anniversary.

Royal United Service Institution, Whitehall-yard, 3 p.m. Major-General T. B. Collinson, "The Present Facilities for the Invasion of England, and for the Defence Thereof." (Part II.)

Royal Institution, Albemarle-street, W., 8 p.m., Weekly Meeting; 9 p.m. Prof. F. Gutherie, "Solid Water."

Philological, University College, W.C., 8 p.m.

Sat.......Trades' Guild of Learning and National Health Society (at the House of the Society of Arts), 8.30 p.m. Prof. W. H. Corfield, "The Laws of Health." Part II. (Lecture IV.)

Physical Science Schools, South Kensington, S.W., 3 p.m.

Royal Institution, Albemarle-street, W., 3 p.m. Mr. J. A. Symonds, "Florence and the Medici." (Lecture III.)

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JOURNAL OF THE SOCIETY OF ARTS.

No. 1,265. Vol. XXV.

FRIDAY, FEBRUARY 16, 1877.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

DOMESTIC ECONOMY.

With a view of aiding in the teaching of Domestic Economy in elementary schools, the Society of Arts will give three prizes for the best Syllabuses of a course of instruction in that subject.

Under the head of Domestic Economy are included (1) food, cookery, and clothing; (2) health, the management of the dwelling, and the sick room; (3) cottage expenditure and thrift.

The Syllabus should give in detail the heads of such instruction as can be taught in an ordinary elementary school; and should be accompanied by explanatory notes as to the manner of imparting the instruction, and the various requirements for conducting the classes efficiently.

The Prizes will be £30, £15, and £10.

The Society of Arts reserves the right of publishing the Prize Syllabuses, and also of withholding any or all the prizes if, in the opinion of the judges, the papers sent in are not of sufficient merit.

It is essential that the subject should be treated in a manner suitable for elementary schools, but long dissertations should be avoided. The Syllabus should, in fact, be a skeleton course of instruction, to be filled in by the teacher, with such notes and suggestions as the author has found practically useful. It should also be carefully framed with reference to the time and opportunities of instruction available in the elementary schools of the country.

The Syllabuses should be sent, neatly and legibly written on one side of the paper only, to the Secretary, Society of Arts, John-street, Adelphi, London, before the 15th April. Each Syllabus should be distinguished by a motto, the name and address of the writer being sent in a sealed envelope, with the same motto outside. Those papers to which prizes are not awarded will be returned to the writers on application.

DOMESTIC ECONOMY COMMITTEE.

The following have expressed their willingness to serve on this Committee:—

F. A. Abel, F.R.S.
Lord Aberdare.
I. Lowthian Bell, M.P., F.R.S.
J. Risdon Bennett, M.D., F.R.S., President Royal College of Physicians.
Edwin Brooke.
J. Brunlees.
Mrs. Buckton, Leeds.
Sir George Campbell, M.P., C.S.I.
A. Cassels.
Miss Chessar.
Lord Alfred Churchill.
Hyde Clarke.
Sir Henry Cole, K.C.B.
Maj.-Gen. Fred. C. Cotton, R.E., C.S.I.
Col. Du Cane, C.B., R.E.
Rev. J. Evans, Home and Colonial School Society.
Rev. J. P. Faunthorpe, Whitelands Train. Inst.
Hon. D. Fortescue.
C. J. Freake.
Mrs. Freake.
Capt. Douglas Galton, C.B. F.R.S.
Peter Graham.
Earl Granville, K.G.
Lord Hampton, F.R.S.
Ernest Hart.
William Hawes, F.G.S.
James Heywood, F.R.S.
Miss Kenrick, Edgbaston.
H. Reader Lack.
Miss Lankester, National Health Society.
Edwin Lawrence.
The Lord Mayor of London.
Sir John Lubbock, Bart., M.P., F.R.S.
B. Lucraft, School Board.
J. MacGregor, Sch. Board.
Mrs. Matthews, Edgbaston.
Vice - Admiral Erasmus Ommanney, C.B., F.R.S.
Admiral the Rt. Hon. Lord Clarence Paget, K.C.B.
Lady Rayleigh.
Sir Charles Reed, M.P., Chairman of School Board for London.
Rev. J. Rodgers, Sch. Board.
Dowager Lady Stanley of Alderley.
Miss Helen Taylor, School Board.
E. Carleton Tufnell.
T. R. Tufnell.
Mrs. Westlake, Sch. Board.
The Duke of Westminster.
Major-General F. Eardley-Wilmot, R.A., F.R.S.
J. A. Youl, C.M.G.

MUSEUMS COMMITTEE.

The following additional names have been received for addition to the list of this Committee:—

Bath	Jerom Murch, Mayor.
Beccles	J. D. Eastaugh.
Belfast	J. Preston, Mayor.
„	J. P. Corry, M.P.
„	William Johnston, M.P.
„	Sir Charles Lanyon, Chairman School of Art.
Birmingham	George Baker, Mayor.
Devonport	John W. Ryder, Mayor.
Faversham	John Andrew Anderson, jun., Mayor.
Huntingdon	F. J. Howson.
Ipswich	E. Packard, jun., Secretary Fine Arts Club.
Kidderminster..	T. Radford, Mayor.
Lymington	L. W. Lewis, Mayor.
Oswestry	W. H. Spaull, Mayor.
Saffron Walden	G. S. Gibson, Mayor.
Salford	The Mayor.
	Alderman Davies, Chairman Museum, Parks, and Libraries Committee.
Sheffield	Alderman Bragge, F.S.A., Chairman Free Libraries and Museums Committee, President School of Art.
„	School of Science and Art.
„	Eccleshall Working Men's Club.

Stephen Bourne.
John Corner.
S. Leigh Gregson.
R. M. Lawes.
James Price.

NATIONAL TRAINING SCHOOL FOR COOKERY.

The competition for Scholarships in this School having excited so much general interest among the members, and the scholars having been trained successfully and obtained employment, the Council have resolved to hold a second competition for more Scholarships, which will take place at the School of Cookery, according to the same rules which governed the first, namely:—

There will be five Scholarships, entitling the holders to free instruction in this School. These will be competed for at an early date at the School at South Kensington.

Qualified teachers are now urgently wanted for schools, and when they have obtained their diploma, they may earn from £1 to £2 weekly.

Candidates must not be under 18 or above 35 years of age. They must be sufficiently educated to perform the duties of an instructor in cookery after special training.

The candidates, before entering into the competition, will be required to sign a declaration that they will hold themselves at the disposal of the Committee to accept service as teachers, if required, in London or elsewhere.

The examination questions are intended to test the above, as well as the candidates' knowledge of the first principles of cookery, and the reasons on which they are based; to prove their acquaintance with the essentials of good cookery; and to discover what the candidate can cook, and in what manner.

Every member of the Society of Arts is privileged to nominate one candidate, and members desirous of doing so are requested to send in their nominations, in the following form, to the Secretary of the Society of Arts on or before 23rd February next.

NATIONAL TRAINING SCHOOL FOR COOKERY.

I, the undersigned Member of the Society of Arts, hereby nominate

Name ....
Age ....
Address ....

As a Candidate to compete for a Scholarship.

Member's Signature...................
Address ....
Date ....

Forms can be obtained on application to the Secretary.

CHEMICAL SECTION.

Thursday, February 8th, 1877; Ernest Hart in the chair.

The paper read was—

ON SOME PROCESSES OF NATURE'S HYGIENE (LEADING TO IMPROVEMENTS IN THE PRODUCTION OF ANTISEPTICS, DISINFECTANTS, AND ALBUMEN OF COMMERCE).

By Charles Thomas Kingzett, F.C.S., &c.

I propose this evening to bring before your notice some observations relating to a subject which has always commanded the earnest attention of this Society—that of the public health. And not alone has it attracted the attention of learned societies, it is part of the business of statesmen. You will remember that Lord Beaconsfield (then Mr. Disraeli), when at Glasgow, in 1874, said "Sanitas sanitatis, omnia sanitas." I would point out, at the onset, that the researches which have led to the improvements it will be my object to describe to you, were made in the domain of pure science, and were not contemplated in connection with ulterior objects. These latter have followed in their proper time, and have, at least in some measure, justified the work which preceded them. But not to dwell upon this matter, I would beg your audience as seriously in connection with the more scientific part of what I have to say as in connection with the practical results which will follow, for otherwise I cannot hope to gain your appreciation for these last.

It was soon after the discovery of oxygen, in 1774, that Van Marum, of Holland, observed that when electric sparks were passed through this gas it acquired a peculiar smell, and Cavallo went further than this, and found that the product also possessed great disinfecting powers.

In 1826, Dr. John Davy recognised the existence of a principle in the atmosphere which he considered to be identical with the foregoing; but our knowledge on all these matters was but slight until M. Schönbein, of Basle, established the existence of ozone, and investigated its properties more precisely. Since that time many chemists, including Andrews and Brodie, have worked upon this subject, and while during these various researches certain errors have escaped detection, they may be said to have established the true nature of ozone. Without entering into minute chemical considerations, it is sufficient to remind you that ozone is an allotropic modification of oxygen, with the molecular volume O_3, compared to oxygen, which is O_2.

In the year 1818 Thénard discovered peroxide of hydrogen, H_2O_2, a substance which, so far as its properties are concerned, admits with difficulty of being distinguished from ozone.

Meanwhile, Dr. Davy's observations regarding the presence of so-called ozone in the air were repeated again and again, and simultaneously the belief grew and intensified among men, that ozone, as it exists in the air, constitutes the great purifying influence in nature. It is, therefore, not surprising that various investigators have not only estimated, or endeavoured to estimate, the amount normally and abnormally present, but have also done this having regard to the intensity and direction of the wind, &c. Moreover, tables upon tables have been constructed, pretending to establish a relation between certain diseases and the absence of ozone from the air. In fact freedom from various zymotic diseases has been considered to stand in a sort of relation to the amount of ozone present in the air in certain places at certain times.

Nevertheless, the presence of ozone in the air has never been indisputably established, though there can be little doubt of its existence; but its amount certainly has never been correctly estimated; for, as before said, no method yet proposed is competent to distinguish between ozone and peroxide of hydrogen as they occur in the atmosphere.

But the public has faith in this old theory of health as preserved by ozone, and inasmuch as they are informed by their medical advisers that sea-air is associated with an unusually large amount of this substance, they migrate annually in the most methodical manner to various sea-side resorts; the more so, no doubt, on account of other charming associations inseparably connected with the sea-side.

It came to be commonly believed, in the process of time, that all slow oxidations were attended with the formation of ozone. Among such oxidations were included that of turpentine and the essential oils generally. Kosmann and Daubeny found that the green parts of plants also gave rise to the production of ozone, but not so in the case of the flowers. But it must be added that the real proof of the nature of this active principle was not forthcoming, for the methods of identification employed did not differentiate between peroxide of hydrogen and ozone. Personally, I have great reason to believe plants do not produce ozone, but peroxide of hydrogen. Having made myself acquainted with the whole history of these matters so briefly sketched here, and others, I some years ago commenced a research which had for its immediate object the elucidation of the nature of that active principle which is formed when turpentine and other oils and substances undergo atmospheric oxidation.*

In the first place, the following oils and other bodies were submitted to the action of air and oxygen: turpentine, caraway, bergamotte, eucalyptus, juniper, cubebs, lemon, chamomile, naphtha, and ether. Before you I have placed specimens of these and other oils, for which I am indebted to my friend Dr. Paul, Mr. Farries, of Burgoyne, Burbidge & Co., and to Messrs. Domeier and Co. It was found that from either of these sources oxygen was equally rapidly absorbed by these substances, and amounted, in the case of turpentine, to an enormous quantity, the time required to absorb a given amount being about sixty times as great in the shade of summer as in the sunshine. It was then necessary to prove how this oxygen was absorbed, and to investigate the nature of the bodies thus produced, for it is to be borne in mind that these oils do not absorb oxygen in the sense that water dissolves ammonia gas, or sugar, but it enters into combination with the essential oils, and forms new substances. In the meantime, however, it was proved beyond all doubt by my researches that these oils never produce ozone in this way, although this had long been thought to be the case. It would be taxing your energies, and if I may be pardoned for saying so, the abilities of some present, to enter into the technical details of these arguments. Chemists may study my publications which were read before the Chemical Society, and may satisfy themselves of the truth of my statements; taken as a body, I believe, chemists are already agreed upon their truth. Nevertheless, I may mention one fact. Soret found that turpentine was capable of absorbing the whole molecule of ozone, and, indeed, this fact was applied in the determination by Brodie and others of the molecular volume of this gas. This alone suffices to prove that turpentine cannot give rise to the formation of ozone, for there is in chemical science no instance where one and the same body can perform two functions under the same prevailing conditions, each the reverse of the other; such a property would negative all accepted doctrines of the nature of the chemical elements. But not content with this argument, I proceeded, in the second part of my researches, to ascertain the part played by oxygen and ozone when thus absorbed, and here again I must beg to be excused, for your own sakes, from entering into minute details, which involve deep questions in chemical science, and many technicalities. Suffice it to know that I established, by logical and chemical processes, the fact that an organic peroxide was formed, a peroxide which Sir B. C. Brodie attempted to prepare in another way, and the nature of this peroxide was ascertained by isolating and analysing the bodies which are produced from it by the action of water upon it. These substances are camphoric acid and peroxide of hydrogen, and their production from the assumed peroxide and that of the camphoric peroxide from turpentine and air may be expressed as follows:—

(1.)—$\overset{\text{Turpentine.}}{C_{10}H_{16}} + \overset{\text{Air.}}{O_5} = \overset{\text{Camphoric peroxide and water.}}{C_{10}H_{14}O_4 + H_2O}$

when air or oxygen is used, and—

(2.)—$3C_{10}H_{16} + 5O_3 = 3C_{10}H_{14}O_4 + 3H_2O_2$

when ozone is used.

(3.)—$\overset{\text{Camphoric peroxide.}}{C_{15}H_{14}O_4} + \overset{\text{Water.}}{2H_2O} = \overset{\text{Camphoric acid and peroxide of hydrogen.}}{C_{10}H_{16}O_4 + H_2O_2}$

Before you there are samples of camphoric acid and peroxide of hydrogen from other sources; and presently I propose to substantiate the identity of these substances with those produced from the oxidation of turpentine.

Having thus worked out the nature of these changes and others, I wished to clench the nail by further researches, and to do this I operated as follows:—For many years the various essential oils have been regarded as isomeric forms of the same principle, or rather as bodies containing this form of principle. If this be so, then I argued that they might also be presumed to give similar results to those obtained by working upon turpentine, and this constituted the third part of my investigation. For this purpose I abstained from using the oils themselves, as they are but too often adulterated with turpentine, the presence of which would impoverish my inferences, so I obtained or isolated from the oils the pure terpenes, as they are called, themselves, and used them. I this way I worked upon—

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* *Journal Chemical Society*, June, 1874, March, 1875; *Chemical News*, vol. 32, p. 138, and vol. 34, p. 127; *Moniteur Scientifique*, November, 1875, February, 1876, &c.

Hesperidene	the terpene	of oil of	orange.
Myristicene	„	„	nutmeg.
Wormwood	„	„	wormwood.

And it was established that when these substances were submitted to the action of oxygen or air and the product treated with water, or when oxidised in the presence of water (which amounts to the same thing) peroxide of hydrogen was invariably obtained.

Now in the meantime Dr. C. R. A. Wright had been carrying out researches upon the various essential oils in other directions, and he had found that all these forms of terpene gave, by the application of certain processes, a body called cymene ($C_{10}H_{14}$), and that the cymene from all sources was identical, inasmuch as it furnishes upon oxidation with nitric acid, or potassic dichromate and sulphuric acid, identical products.

Here, therefore, was an opportunity of testing the truth of my conclusions, and I found that cymene from every source gave by the atmospheric process of oxidation in the presence of water, peroxide of hydrogen. In this way Wright's researches were confirmed and my own too, for it was thus established that all essential oils furnish this peroxide of hydrogen by virtue of this nucleus, which all of them having the formula $C_{10}H_{16}$ contain. I further substantiated this truth by showing that other modifications having this formula, × by 1·5 or $C_{15}H_{24}$, would not give peroxide of hydrogen on oxidation, thus also showing that they do not contain a nucleus of cymene $C_{10}H_{14}$, a result since corroborated by Wright, who failed to obtain cymene from a body of this formula derived from oil of cloves by Church.

In the fourth part of my researches, which were communicated to the British Association and Pharmaceutical Conferences at Glasgow (1876), I returned to a study of the exact conditions attending the oxidation of turpentine by means of air, and now I operated conjointly with my friend, Mr. Maximilian Zingler. We worked upon no less than fifty gallons of turpentine, and confirmed all the conclusions drawn from my previously conducted researches; but, before proceeding to inform you of some other results flowing from these experiments, allow me to state that when turpentine is oxidised by air, other substances besides those already enumerated are also formed, for hydrocarbons present a number of points from which oxidation may start. Camphor and a small quantity of acetic acid are also formed in this way, besides much resinous matter. I must now direct your attention to some natural processes occurring in pine and eucalyptus and other forests, and leave for a time the matters which have hitherto commanded our attention.

For many years a health-preserving influence has been ascribed in various districts to the presence of pine forests, and more especially of late years the Australian eucalyptus gum tree has enjoyed a like reputation. I am indebted to the kindness of Prof. Bentley for the eucalyptus plant which is exhibited. Of course it will be understood that there are many varieties of eucalyptus, but for our purposes we may speak of all as one.

Mr. R. D. Glover* relates that by planting the eucalyptus in the cloisters attached to an old monastic institution in the Campagna, the place was rid of the pestilent malaria which had hitherto rendered it desolate and uninhabited. Mr. Glover also brought from the monks residing there the samples of oil secreted by these trees, and also an alcoholic tincture of the wood, used as a medicine in fevers, &c. These were sent to Dr. Paul, who has placed them at my disposal. Similar evidence is forthcoming from places in the vicinity of the Douro in Spain.

On the 30th of April last, Dr. Fedeli presented a paper, on the properties of the *Eucalyptus globulus*, to the Roman Academy of Medicine,† and adduced much stronger evidence, showing that the plant possessed powerful virtues as a febrifuge. Wherever the plant has been cultivated, endemic malaria has henceforth disappeared. Dr. Fedeli also described the curative powers of various preparations made from the plant, notably the alcoholic tincture.

Since Dr. Fedeli's paper was published, the Italian Government has supplied landholders with large quantities of slips of the tree, for forming plantations in all malarious districts. It has been difficult to understand these virtues of the eucalyptus, but my recent researches on the oxidation of essential oils have led to an explanation as interesting as it is simple.

The various species of pine or fir tree have a wide geographical distribution, and the reason in nature for this will be seen immediately. All these trees secrete oils consisting originally of hydrocarbons, known in science as terpenes; but for our present considerations they may be collectively and individually regarded as turpentine. Turpentine is, indeed, distilled largely from the oily and resinous matters formed in these trees, while oil of eucalyptus has been shown by A. Faust and J. Homeyer‡ to consist mainly of a terpene and cymene ($C_{10}H_{16}$ and $C_{10}H_{14}$).

Now, if these naturally-secreted oils be allowed to remain in the tree, they volatilise in great measure, and undergo oxidation in the atmosphere. Some part, however, is polymerised and oxidised by the air while yet in the tree, and thus are produced those resinified substances and camphors which generally accompany the natural oils.

Returning for a moment to my investigations, I found that when turpentine was exposed to a current of air in the presence of water, and especially at summer temperatures, oxygen was absorbed, part of the oil resinified, and the rest was oxidised into a compound unstable in the presence of water, and splitting up thereby into peroxide of hydrogen and camphoric acid.

I now propose to prove to you, in an experimental way, that peroxide of hydrogen and camphoric acid are produced in this way, by showing you that this solution gives the re-actions characteristic of these substances. Here is a mixture of potassic iodide and starch, and on adding peroxide of hydrogen to this, iodine is liberated, and combines with the starch, forming this blue compound. In this second vessel there is contained a solution of ferric chloride, and you observe that camphoric acid causes, on addition, a precipitate of camphorate of iron. On now repeating these experiments with the aqueous solution obtained by oxidising turpentine over water, you observe similar results are obtained. (Experiments performed).

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* *Pharm. Journ.*, February 5, 1876.

† *Pharm. Journ.*, May 13, 1876.

‡ *Ber. Deutsch. Chem. Ges.*, 1874 (1429-1430).

Now peroxide of hydrogen has been acknowledged for a long time to be one of the most powerful disinfectants known to chemists, but its mode of preparation has been so expensive in the past that it could not be used for sanitary purposes. But as regards its efficacy in this respect medical and chemical literature abounds with the proofs. In this direction, the name of Dr. Day, of Geelong, deserves especial mention.

Lately, salicylic acid (sample exhibited) has been recognised as a powerful antiseptic (not disinfectant), but its slight solubility in water and certain other properties, especially its price, have militated against its large employment. It is curious to know that camphoric acid, which is allied chemically in certain respects to salicylic acid has also similar and equal powers of preservation,[*] while it is more soluble in water; it is also expensive as made in the ordinary way. But by the process I have indicated it is obtained side by side with peroxide of hydrogen in the state of a solution having a pleasant aromatic odour, and which, be it remembered, is both an antiseptic and a disinfectant.

That this is so, is proved by the series of experiments which I communicated to the British Association at Glasgow, and which have been published in the fourth part of my researches.

These experiments which I here reproduce were made upon a solution worked out by Mr. Zingler and myself, as presently to be described. For the time it is enough to remember that it is the watery solution which results, when turpentine is submitted to aerial oxidation, in the presence of water. Side by side are given experiments made with camphoric acid and peroxide of hydrogen from normal sources, and the whole in comparison with some made upon salicylic acid as a standard. The experiments upon camphoric acid and peroxide of hydrogen were conducted to prove that it is to these substances, contained in our new solution made from turpentine, the value it has as an antiseptic and disinfectant is due.

Experiments with this New Solution.

Article experimented upon.	Antiseptic used.	Result.	With equal vols. of Water and *no* Antiseptic.
Egg Albumen. 50 c.c. containing 10 c.c. white of egg in each case.	5 c.c. Neutralised by soda = 10 per cent.	Observed 24 days. Still fresh as at first.	Began to stink on 2nd day after.
Must from Muscatel Grapes. 50 c.c. taken in each experiment.	10 c.c. Neutral Antiseptic = 20 per cent.	No fermentation even after days.	Soon fermented at 40° c., giving alcohol.
Milk. 200 c.c. in each case.	10 c.c. Neutral Antiseptic = 5 per cent.	Faintly acid on 5th day after. Solid on 7th day.	Solid and sour on 3rd day after.
Urine. 60 c.c. in each case.	10 c.c. Antiseptic = 16 per cent.	Unchanged after 7 days. No longer observed.	Bad smell 2nd day. Stank on 3rd day.
Brain matter. 10 grms. in each case.	10 c.c. Antiseptic.	Kept fresh 15 days. No longer observed.	Stank on 3rd day after
Milk. 100 c.c. in each case.	10 c.c. Antiseptic = 10 per cent.	Liquid, and sweet for 9 days.	Sour and solid on the 2nd day after.
Flour paste. 100 c.c. in each case.	10 c.c. Antiseptic = 10 per cent.	Fresh after 19 days. No longer observed.	Stank on the 3rd day.
Milk. 160 c.c. in each case.	10 c.c. Antiseptic = 6 per cent.	Solid and sour after 7 days.	Bad on the 2nd day. Very bad on 3rd day.
Bitter Beer. 160 c.c. in each case.	10 c.c. Antiseptic = 6 per cent.	Still good and unchanged on 7th day. No longer tested.	Thin films on 2nd day. Fungus over surface on the 3rd day.

All the foregoing experiments were made during October and November, 1875.

Those now to be given were made during June, July, and August, 1876. The antiseptic solution employed was not so strong as that used above.

	With 3·5 c.c. Antiseptic = 10 per cent.	With 1·75 c.c. Antiseptic = 5 per cent.	With 4 c.c. Neutral Antiseptic = 11 per cent.
White of Egg. 35 c.c. in each case.	Kept fresh for 35 days; then mould appeared. No smell.	Fresh for 21 days; then mould appeared. No smell.	Fresh for 35 days; then mould appeared. No smell.

The only other alteration in each case was a slight darkening to brown in the colour of the albumen. But after each experiment the albumen had still its coagulable character and was not otherwise changed.

After dipping in the same solution, brain matter also kept fresh, whereas without such treatment it stank on the next day.

Milk was also preserved for a much longer period than without, but not for so long a period as in the winter months.

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[*] *Pharm. Journ.*, Sept. 23rd, 1876; and *Chem. News*, Sept. 22nd and 29th, 1876.

Beer was also thoroughly preserved for a number of days, as long as observed; so also was blood serum for more than a twelvemonth. Stinking water recovered and remained good with it for months.

In conclusion, I would only add that I have never examined seriously the influence of less per-centages than those detailed, but there can be no doubt that much less quantities could be used in many cases with the same efforts as those described. In fact this would be necessary with articles of food on account of the aromatic odour and peculiar taste of the solution.

The experiments that follow next were conducted in order to ascertain to which constituents of my solution the antiseptic and disinfecting character is to be ascribed. They are as follows:—

Camphoric Acid Experiments.

0·3 grm. of the acid in water was sufficient to preserve 400 c.c. milk unchanged for seven days. After that a skin appeared and a cheesy taste. But it did not go solid and sour till the eleventh day.

0·1 grm. camphoric acid kept 50 c.c. of flour paste fresh for eleven days. On the twelfth day it became sour.

0·1 grm. camphoric acid preserved 50 c.c. grape juice in a warm oven from fermentation permanently so far as could be observed.

0·1 grm. camphoric acid kept 15 c.c. egg albumen and 10 c.c. water fresh for twenty-one days. Became mouldy afterwards.

0.1 grm. camphoric acid preserved 200 c.c. bitter beer unaltered for eleven days in an open vessel. It afterwards became covered with fungus.

Peroxide of Hydrogen Experiments.

The strength of the solution used was that of Robbin's 10 volume solution.

10 c.c. preserved 400 c.c. milk for six days, meanwhile oxygen was slowly evolved; thick and sour on the eleventh day.

5 c.c. preserved 47 c.c. grape must from fermentation for some twenty-four hours, then bubbles of oxygen were liberated; finally it had an odour like apples.

5 c.c. preserved 15 c.c. albumen (egg) + 10 c.c. water fresh for very many days.

5 c.c. preserved 400 c.c. bitter beer unaltered for twenty-six days; then sour; fungus did not appear.

5 c.c. preserved 30 c.c. flour paste for six days; afterwards went bad.

Experiments with Salicylic Acid.

0·1 grm. preserved 100 c.c. bitter beer for twenty-five days, but gave to it a most peculiar taste—spirituous, bitter, sweet. No longer observed.

0·1 grm. preserved 100 c.c. milk for four days. On the fifth it was sour and cheesy, and on the seventh it stank.

0·1 grm. preserved 50 c.c. flour paste for a number of days, but acquired on the fourth day a very stale odour.

0·1 grm. preserved 23 c.c. egg albumen, and 12 c.c. fresh water for four days. On the fifth it stank.

These experiments, as also those with camphoric acid and peroxide of hydrogen, were all conducted during October, November, and December, 1875.

If these tables be studied carefully, it will be seen that our solution, which we have named "Sanitas," (sample shown) possesses a power of preservation and disinfection superior to that of its own components, taken singly, and to that of any other known antiseptic or disinfectant. The presence of camphor and other bodies in the solution under description, is likewise conducive towards securing the results sought for.

These considerations have led me to conclude that the health of districts where the pine or eucalyptus abounds arises from the influences excited by the peroxide of hydrogen and camphoric acid produced naturally by these trees, and, in short, the process I have indicated is but the repetition in the laboratory of what must occur in every individual tree.

This brings me to one other consideration. It has been observed that wooden hospitals are particularly efficacious as inducing rapid convalescence; and here again the fact admits only of explanation by a knowledge of my researches. The resinous and turpentine-like bodies existing in the wood, under ordinary atmospheric conditions, give rise to peroxide of hydrogen and camphoric acid, two substances, the one of which I have proved to be a most powerful disinfectant, and the second an equally strong antiseptic.

Around the researches I have described to you, there are presented many matters of more immediate scientific value, as for instance, the following. The ethers give rise by atmospheric oxidation to the production of peroxide of hydrogen, and I have submitted this as a proof of the existence of hydroxyl in compounds, and in fact, as amounting to the actual isolation of that radicle. I do not propose to enter here into these matters, but will pass on now to describe the manner in which my friend Mr. Zingler and I have conducted on a large scale the oxidation of turpentine, with the view of obtaining a product which shall have a commercial value in sanitary science. In doing this, we imitate nature exactly, and in imitating nature we are helped by it, for the pine tree furnishes us with the substance with which we start—turpentine.

Three earthenware cylinders, made by Messrs. Doulton and Watts, capable of holding many gallons, and each provided with two necks, a mouth for charging, and and taps for discharging, were connected together by means of iron pipes. The first two were charged with mechanical mixtures of turpentine and water, and the third contained a small volume of water only. The first two of these vessels were placed in butts made from wooden casks by sawing them through the middle, so that by filling these tubs with water, which could be kept at any temperature below 100° C. by means of steam, the mixture of turpentine and water admitted of heating. The temperature which we have found best to employ is about 50 to 60° C. Through the series of vessels a current of air is now blown by means of a small air engine, and before the air passes into the mixture contained in the vessel I have described, it circulates through an iron box kept warm by immersion in a tub of hot water, so that the air enters the other vessels in a warm state. In this way the turpentine absorbs oxygen from the air and gives rise to the production of camphor, camphoric acid, and peroxide of hydrogen, all of which dissolve in the water beneath, while another part of the turpentine becomes gradually converted with a resinous-like mass which finally sinks through the water if the operation be allowed to go so far. Any turpentine which is carried over by the hot air from the first and second oxidisers is condensed by the cold water in the third vessel, or condenser as we have termed it, and may be returned from time to time to the oxidisers. Here I have what may be regarded as a model of one such vessel as I have described, and if I blow into it, you will have a good appreciation of the process itself.

We have found that there are various conditions to be observed to ensure the greatest success, but these now being known, the whole process is as simple and perhaps as beautiful as a process well can be. Blowing is generally carried on for about 40 hours to a batch, and we prefer to stop the operation when the residual turpentine has acquired a density of about ·950. The progress of the oxidation may be readily ascertained by drawing off samples from time to time, and determining the amount of peroxide of hydrogen, which serves also as a criterion of the amounts of the other products which are formed.

The per-centage of each constituent, and the strength of the whole mixture, are matters entirely under the control of the producer, but we have found that a solution containing about 367 grains of camphoric and acetic acids. and 323 grains of peroxide of hydrogen to the gallon, is one amply strong enough for every conceivable purpose to which the solution may be applied.

Such a solution is capable of evolving one and a half or three times its volume of nascent oxygen, according as one or both atoms of oxygen in the peroxide of hydrogen are affected.

This power to evolve oxygen I can show you experimentally. These are solutions of sanitas, and one of peroxide of hydrogen, and you observe that on adding animal charcoal to them, they both evolve gas—that gas is oxygen in a nascent state.

Its other characters may be given in a few words; it is an aqueous solution containing no oil of turpentine, but small quantities of camphoric peroxide, which slowly becomes resolved into camphoric acid and peroxide of hydrogen, thus increasing the total amounts of these substances which are present as such. It also contains much camphor and some other substances less well defined. It appears to be non-poisonous, and is absolutely without harm to textile, linen, or other fabrics; it does not injure carpets or furniture when applied to them, and it is slowly but perfectly volatile. It is almost superfluous to state we (Mr. Zingler and I) have patented its production and its imitation from other sources, in this country and abroad, and we propose to use it, to be brief, for all purposes where antiseptics and disinfectants may be used—in private houses, public hospitals, urinals, and for use in watering roads and streets.

We have evidence regarding its value in the hands of the physician as a remedy for fever (by cold-sponging the skin), and in cases of scarlet fever, small-pox, &c., but we should be grateful if the medical world would place it upon severe trial. I believe that every hope will be realised from its employment. We certainly have carbolic acid in use, but this is a poisonous and caustic agent, and is only an antiseptic. Permanganate of potash, from its oxidising properties, has its uses, but it is destructive in its nature, and is not an antiseptic.

Salicylic acid is but slightly soluble in water, and beyond its expense is also only an antiseptic. Our solution—sanitas—combines all these powers, and is easy to make, and cheap to produce, being, moreover, a pleasant aromatic liquid,

Whatever be the nature of disease, and, of course, to a large extent, it must vary with the kind of disease, it cannot be denied that there are chemical substances that are often powerful both to avert and to cure disease, and in this list I venture to place the solution upon which I have the honour to address you.

With your kind permission, I will now pass on to another matter, which follows naturally from what has gone before.

Everyone knows that albumen is largely used for printing and other purposes, and that, owing to the superior nature of egg albumen, it is preferred to the blood albumen of commerce (samples exhibited). Without entering into other considerations, it may be laid down as a round statement that in this way a large amount of food is withdrawn from the market, and it has for years been a matter of desire to prepare a blood albumen of a whiteness and quality comparable to egg albumen.

Many attempts have been made in this direction. Thus, some have attempted to do this by passing a stream of ozonised air through defibrinated blood, before evaporating it down to get the seralbumen from it. Others have recommended the use of peroxide of hydrogen, which, however, is of course far too expensive a re-agent to employ; while others yet have mixed turpentine with the crude solution, and allowed it to stand, with some stirring. But none of these or other plans have succeeded, and yet how nearly they have approached success, as it appears now! It remained, however, for Mr. Zingler and myself to consummate this desired object, which we were enabled to do as follows:—

The process is not only applicable to defibrinated blood, but also to any solution of albumen or other matter which requires bleaching. In the case of blood albumen, it is carried out by mixing the defibrinated blood with a certain percentage of turpentine, and blowing air through the mixture at a temperature below, we will say, 40° C. In short the process is identical with that above described for making "Sanitas;" this latter solution indeed may be used for the same purpose by adding it to the albumen solution. On account of the dilution thus effected, however, we prefer to mix turpentine or other hydrocarbon with the blood, and to pass a current of air through the mixture; in this way the turpentine is oxidised into the same products as when water only is present, and the peroxide of hydrogen thus formed *in situ* decolorises the blood solution. It then only remains after this operation, which takes but a few hours and only about 10 per cent. of turpentine, to draw off the clear solution of albumen, which is ready to use for printing and other purposes. In this way, however, the albumen undergoes some change, not profound by any means, but to this extent, that whereas previously the albumen admitted of drying and retaining its solubility in water, this is no longer the case. This, however, is no disadvantage, but, on the contrary, an improvement. The only reason why hitherto albumen of commerce has taken a dry form, has consisted in its proneness to putrefaction in the state of solution, and so the matter of evaporation to dryness has been an expense with little advantage in any way. This is not the case with our product, which will keep any length of time thoroughly well in the state of solution, and, moreover, as when once dry it does not dissolve in water, it admits of use for fixing colours which hitherto have had a limited use by reason of their nonfastness. I should state that we have secured Letters Patent also for these processes and their various purposes.

Here is a specimen of our product, which formed a part of the very first batch we made on a large scale—it was made last September, and nothing has been added to, or taken from it since; it is quite good and fresh, and by this experiment we see that it has not lost its power of coagulation. You observe, on warming, it coagulates to a solid white mass.

In drawing towards the close of this lecture, I am conscious that many matters have been but briefly described, which admit, and perhaps merit treatment at once more exhaustive and equally interesting, but it is impossible to condense into the space of one short hour so much matter.

I would add, however, that people are too much inclined to cross-examine scientific men, and to apply the *cui bono* test to science. It is sometimes difficult to reply to such questions and meet such tests, and it is therefore greater matter of pleasure to us in this particular case that we can do so, for the scientific researches which have led to the practical issues I have brought before your notice, were commenced more than five years ago, with no other originating motive than that which comes through the desire for truth. Imperceptibly, however, they have led by logical sequences to industrial advancements, and I would invite those around me to place their faith not in that so-called science which but proclaims its meaning and vaunts its praises, but in the science which accomplishes.

Returning for one moment to the process for making the new antiseptic and disinfectant I have described, it may be said to present the first instance on record in which a natural process of atmospheric purification has been imitated to perfection, until, in fact, there can be repeated on a commercial scale that which in pine and eucalyptus forests constitutes one of the most efficacious processes of nature's hygiene.

Before concluding, I would draw your attention to a matter which is illustrative of the treatment too often experienced by men of science at the hands of those who call themselves members of the brotherhood.

On the table before you there is a sample of an article now on sale under the name of "Terebene." Terebene is turpentine which has been polymerised, that is, transformed by a process which we cannot explain, into a modification which is identical in composition, but different in constitution, to the original turpentine. It has been changed into a form which does not admit of atmospheric oxidation nearly so readily as common oil of turpentine, and therefore it can have far less value even than that substance for any antiseptic or disinfecting purposes—purposes which are in direct proportion to the possible power of producing camphoric acid and peroxide of hydrogen by aerial oxidation. Yet Dr. Bond, of Bristol, has, beyond laying claim to this article which, if it be the terebene of chemists, has been known for years, stated that it forms ozone by exposure to the air; vaunted its powers as an antiseptic and disinfectant; and even has gone so far as to question whether our "Sanitas" is anything else than his "Terebene" under a new name.

In view of what I have already told you, I may simply add that in such a case I could not have dared to beg your attention during the last hour. Nevertheless, I am prepared to prove to you on this spot that Dr. Bond is in great error. Here is a sample of his "Terebene" and here is one of "Sanitas." You see "Sanitas" is a watery solution, whereas "Terebene" is an oil and floats on water. This "Terebene" is combustible, you observe, and that it does not form ozone must be patent from what has gone before. If it formed anything it would be peroxide of hydrogen (H_2 O_2), and I shall show you that it has even this power in a less degree than ordinary turpentine.

At the commencement of the lecture I took two dishes, and charged the one with a small quantity of turpentine, and the other with an equal amount of "Terebene" as sold under Dr. Bond's name. Over each dish I then placed in your presence these papers soaked in potassic iodide and starch; the one which has been over the turpentine is, you observe, coloured deeply, whereas the other, which has been over the "Terebene," is not coloured at all, and as the colour when produced is caused by the production of peroxide of hydrogen, therefore the "Terebene" has formed none, while the turpentine has given rise to a considerable amount.

DISCUSSION.

Dr. Wright said Mr. Kingzett stated in the early part of the paper that there was no instance on record of one and the same body performing two functions the reverse of each other, but he would suggest that there were some chemical reactions which admitted of being inverted by a modification of the circumstances, such as the temperature or pressure. For example, when steam was passed over heated metallic iron, the iron became oxidised, and hydrogen was liberated; but at exactly the same temperature, by merely altering the relative bulks, by passing hydrogen over the oxide of iron produced in the previous experiment, the reverse action took place, the iron was reconverted into the metallic state, and steam was generated. Other instances of a similar kind were familiar to chemists. Respecting the bodies known as terpenes, there were various theoretical questions connected with the relationships of these bodies to one another, which he would not enter upon, but one thing had certainly been made evident, viz., that all these bodies were intimately related to the hydrocarbon known as cymene. If oil of turpentine was submitted to the action of sulphuric acid, a change was produced which might be of three kinds. If the action took place gently, the turpentine was lowered in its boiling point a few degrees, and the product was that known to scientific chemists as terebene. If the action took place more strenuously, carbonisation took place, and instead of getting terebene boiling at a lower temperature than the original substance, a polymeric body, sometimes spoken of as colophene, was produced, boiling at about 250°, and expressed by double the formula of terebene proper. He should like to know if Mr. Kingzett had experimented with the pure terebene of chemists, or with the material which had been exhibited under that name, which he thought might be really colophene, possessing a much higher molecular formula, and a higher boiling point, and incapable of generating peroxide of hydrogen by exposure to atmospheric oxygen. With reference to the use of ozone in acting directly upon organic substances, there could be little doubt that it did possess this power, for it had been shown, he believed, in that room, that air charged with ozone possessed the power of bleaching syrups, and machinery for this purpose had been introduced, though he could not say whether it had proved commercially successful; and it was quite certain that ozone produced by electrification had a considerable effect on germ life. Apropos of ozone, he might say he had seen at the seaside advertisements of ozone baths, which he found were prepared by collecting sea-weed, and macerating it in hot water, whereby a mucilaginous mess was produced, into which the unfortunate patient was required to plunge. He had examined some bottles of this sea-weed jelly, which was sold under the name of ozone fluid, for preparing such baths, but was unable to detect either ozone or peroxide of hydrogen, and but very little iodine. He should like to know if Mr. Kingzett had experimented with fusel oil, to see if it was capable of undergoing this oxidation. Some years ago, in connection with a Chancery suit to stop some works for the purification of wool by means of fusel oil, on the ground that evil odours were produced, which some of the witnesses said gave rise to typhoid fever scarlatina, and other epidemics, he made a large number of experiments, which led him to the conclusion that fusel oil was a powerful disinfectant, and that, even in a dilute solution, it was very little inferior to carbolic acid in preventing the decomposition of putrescible fluids. He quite agreed with Mr. Kingzett's remarks as to the value of pure scientific research in producing practical results, which were often quite unexpected. As examples of this truth, must be mentioned Mr. Perkin's researches into aniline and its reactions, which had led to the development of a very large industry, and also the process by which alizarine, the colouring matter of madder, was now produced from coal tar. The chemical changes on which this process depended were originally worked out as pure questions for scientific investigation. He thought, therefore, the encouragement of research by Government grants would be a very good investment on the part of the country, and would aid in developing its resources very largely.

Dr. Thudichum was very glad to hear of a new and powerful antiseptic, but he should like a little more precise information as to the power of this new solution as a disinfectant. In considering what was a disinfectant, the first question was what was an infectant, and here you came at once to the great problem of the causes of disease. This question had been very much discussed, and the medical profession were much divided upon it. He would not enter upon that field of inquiry, but would address himself to more practical considerations. Supposing he were a person having all the premonitory symptoms of small-pox, how would he have to apply this particular disinfectant? Had any experiments been made which defined how it could be beneficially used in such a case? To take another illustration, about 100,000 people in the most vigorous years of life were annually attacked by typhoid fever, 15,000 to 20,000 of these died; now supposing he had partaken of milk which was tainted with the virus of typhoid fever, in what manner was he to apply this disinfectant, either to the milk, or to himself, if he had unfortunately swallowed any of it. He hoped some experiments would be made to show if this fluid had any power of killing these disease-causes which they knew to exist, though they had no knowledge as to their nature. During the last twenty years he had met with a number of articles which were put forward as disinfectants, but unfortunately he had always found them to be merely deodorants, and there was great confusion in the public mind between these two things, the stink and the disease-cause. He feared that this distinction between destroying a smell and killing a disease-cause had not been sufficiently attended to in this case. At the same time he was much pleased with the paper, as it called attention to a very important subject, and when many minds were at work upon it, possibly the great desideratum of a real disinfectant might be discovered. Phenol, or carbolic acid, had been very much vaunted as a valuable agent in cholera, typhoid fever, and other diseases, as ensuring the death of all infective matter, but what was the fact with regard to it. A physician had taken some of the cowpox virus, and gradually added phenol to it, but could not destroy its activity until he had added more than two per cent. This proved that carbolic acid was not a disinfectant at all. He would not on that account, however, too quickly reject any fresh agent which was brought forward, but on the contrary, he hoped it would be largly experimented with, and that they might soon hear of its complete success. He had seen large numbers of the eucalyptus planted in the south of Spain, but the beneficial action which was supposed to take place was probably that of sucking up the superabundant moisture from the ground, thereby destroying the malaria. It did not follow that because it had one action it had not another also, but he was not aware that the supposed medicinal action of the tree itself had been confirmed by the experience of the profession; the alkaloids derived from it had not proved so valuable a febrifuge as was expected.

Mr. Witling asked if the sunflower, which was said to have a productive influence against miasma, owed that property to the presence of terpenes?

Dr. Dupre inquired if any experiments had been made to show the comparative value of this new solution and sulphurous acid, which he believed was the only body which had actually been proved to be both a deodoriser and disinfectant. Dr. Sanderson had made many experiments to prove that sulphurous acid did really kill disease germs; but he (Dr. Duprè) had long ago come to the conclusion that the only effective disinfectant was fire. It was a great mistake to attempt to disinfect anything by the addition of fluids, because, as a little calculation would show, the amount required in order to be effectual must be enormous, and the cost would be in proportion. Sulphurous acid could be produced in large quantities, and at a moderate cost, by burning bisulphide of carbon.

Dr. Hake said the most remarkable characteristic of this new solution was that it contained two useful bodies, camphoric acid and peroxide of hydrogen, the first being acknowledged to have antiseptic properties, whilst the other was a powerful oxidising agent. Although it was quite true that sufficient distinction was not made between deodorants and disinfectants, it was admitted on all hands that deodorisers were very desirable, for disagreeable odours often produced headache, and were not at all conducive to health. It remained to be seen whether the "Sanitas" was a true disinfectant, but even if it were only a powerful deodorant it would be very valuable.

Mr. Friswell asked if the blood-albumen produced by the new process had been tried for photographic purposes? Owing to the large number of eggs annually used in the preparation of albumenised paper, many attempts had been made to use blood-albumen, but hitherto without success, as it had proved impossible to get it sufficiently transparent and free from colour.

Mr. Page said that Dr. Sanderson's researches on infective and putrefactive matters showed that one of the most powerful disinfecting substances was chlorine, as well as sulphurous acid. He was quite satisfied that carbolic acid was nowhere in comparison with either of these two substances, both of which were of a gaseous nature, and probably that had a great deal to do with it. It seemed pretty clear that if you put a solid substance in a room, or in contact with a putrescible liquid, it could not have anything like the effect which a gaseous body would. Possibly the liberation of oxygen by the peroxide of hydrogen in Mr. Kingzett's solution might account for its powerful action on putrescible matter. With regard to the albumen, he should like to know whether the material operated upon was defibrinated blood, produced by whipping freshly-drawn blood, or the serum which remained after it had been allowed to settle. He suggested that some of this new disinfectant should be sent to the large hospitals in order that the physicians should be able to give the results of their practical experience with it.

Dr. Thudichum said he had made many experiments with sulphurous acid, but found that its antiseptic effects did not last more than three days. At Xeres he had seen many thousands of casks of sherry impregnated with this acid, but the only result was that, whereas wine not so treated began to ferment immediately after it was put into the cask, when this process was employed it did not begin to ferment for three days. In a memorandum, published by the Medical Department of the Privy Council, the value of the various disinfectants, deodorants, and antiseptics was clearly stated, and their character described. Chlorine had long been said to be the very best disinfectant, in fact, the only certain one. Sulphurous acid had been quite put aside as a disinfectant, and as a deodorant it only had a temporary action. Its disinfecting power consisted in the formation of a little ozone immediately it was made, but it soon wore off, and it had then no influence in retarding any so-called fermentation.

Mr. Page suggested that the evanescent character of sulphurous acid as a disinfectant was due to the fact that it rapidly oxidised, and became sulphuric acid, when it was quite inactive.

The Chairman, in proposing a vote of thanks to Mr. Kingzett, said he had no doubt that important scientific as well as commercial results would follow from his interesting paper, and the discussion which had followed. He could not presume to express any opinion on the chemical merits of the paper, but with reference to the practical application of this product for the purposes of deodorising and disinfection, he might say a few words. In the first place it was a most dangerous notion to suppose that merely getting rid of a bad smell was a good thing; and he thought Dr. Hake would do well to reconsider the matter. Most people remembered the history of the expedition to the Niger; when the earliest expedition of Englishmen sailed up that river they were laid low with the most fatal form of yellow fever, the fever being associated with putrefying vegetation, and the bad stenches which arose from the generation of sulphuretted hydrogen, Prof. Daniell, of King's College, supplied the next expedition with the means of decomposing sulphuretted hydrogen. This they did, and abated the stink, but did nothing to destroy the dangerous agents which were produced by the same cause which gave rise to the stink, and the consequence was, that although they deodorised the place, they left all the sources of disease still active, and hence the expedition was struck down to a man. In other words, the stink was almost invariably the sentinel of the evil, and in destroying the bad odour without destroying the source of disease, you destroyed the sentinel which gave notice of the danger. Therefore, if this solution should prove to be only a deodorant it might be worse than useless; but he thought there was good reason to hope that it might prove to be what Mr. Kingzett claimed for it—a true disinfectant. What they had reason to suppose with regard to disinfectants was, that they acted largely as destructive agents by splitting up the compounds which gave rise to disease, and if this peroxide of hydrogen had an action in splitting up these compounds, they might expect it to prove, in some measure, a real disinfectant. On the other hand, the whole history of efforts of this sort showed the extreme difficulty of anything like aerial disinfection; in fact, he considered it impossible. To attempt to disinfect a room in such a way you must make it perfectly uninhabitable; you must close the room, and fill it with such a volume of the gas with which you were to operate as rendered the atmosphere unbearable. Anything of this kind, therefore, was a mere pretence, and it had been condemned accordingly, so much so that, after a series of experiments by Mr. Wanklyn, he came to the conclusion that the only satisfactory way of disinfecting a house was to burn it down. As to the inference which might be drawn from what they knew of the purifying action of eucalyptus groves, he thought Dr. Thudichum had very fairly pointed out a certain source of fallacy. So far as they knew of its hygienic action, which undoubtedly had been very considerable, it was due apparently to the trees changing the water-logged condition of the ground, the rapid growth of the trees drying up the soil which previously favoured the growth of those low forms of *algæ*, which were apparently connected with miasmatic disease. They were accustomed to connect ideas of health with the balsamic airs which passed through the pine groves, and the odours which proceeded from them, and great effects had been ascribed to houses built of pine boards; and he remembered very well that Mr. Day, of Geelong, who drew attention to the value of peroxide of hydrogen, and strongly recommended it as an antispetic and disinfectant, said he had made medical experiments of the kind, and that he had found valuable results from the use of wards built of fresh pine logs. But here again there were endless sources of fallacy, because one would need to know the amount of ventilation, the construction of the hospital, and a large number of other conditions of which we were ignorant. He would be a bold man who would say that in the midst of the densest possible pine wood, with the most balsamic atmosphere, with oxidation of turpentine, the production of peroxide of hydrogen, and all the other conditions of which mention had been made, that it would not be possible for an unvaccinated person to take the small-pox. He did not make these remarks to throw any doubt on the value of Mr. Kingzett's experiments; on the contrary, he thought anyone who brought forward a powerful agent of the ozone character rendered great service, but in the hope that he would pursue his researches further, and endeavour to give precision to his results, and especially that this body might turn out to be a true disinfectant.

The vote of thanks having been unanimously passed,

Mr. Kingzett replied *seriatim* to the various remarks which had been made. He said one of the best features in a discussion was that a number of gentlemen gave utterance to totally opposed opinions, and it remained for the lecturer to give his decision and have it all his own way. Dr. Wright pointed out that, under certain circumstances, you might have two actions referable to the same conditions as occurring between two substances. In the instance he cited, the only difference was the difference in the respective quantities of the substances; but his words in the paper were—"That there was no instance known to chemical science where, the conditions remaining the same, you could get two reactions the reverse of each other." Now, in the case alluded to, the difference in the conditions was a difference of bulk, and the influence of mass on combination was an appreciated fact. It had been known, for at least fifty years, that when turpentine was treated with sulphuric acid it underwent some change, and you got a body representing 2 of turpentine, $C_{20} H_{32}$. Under other conditions, you got a body which fell a few degrees below turpentine in its boiling point. If the body he had produced was obtained from turpentine by the action of sulphuric acid, it must be a mixture of everything which could be obtained in that way, because it would be produced without observing definite conditions. He was emphatic in his observations regarding it, because he had proved that it was not powerful to produce peroxide of hydrogen by oxidation, and, therefore, it could be of no value either as an antiseptic or disinfectant. With regard to fusel oil. he had made experiments some six years ago, and found that peroxide of hydrogen was formed, but was doubtful whether it was due to amylic alcohol, because in a series of experiments on the alcohols he had never obtained peroxide of hydrogen by this process, and he therefore thought it was probably owing to the presence of some accidental impurity. Dr. Thudichum's observations, if taken literally and applied absolutely, would take from us all the means we have at present either of preventing or curing disease. It was quite true that we know but little of disease, but why did the anatomist, when he dropped his dissecting knife on his hand, immediately put into the wound a solution of permanganate of potash, if it was not a disinfectant? The anatomist had faith in its action, and trusted that after using it the flesh would not be subject to any morbid process. And not only so, but why did the physician use carbolic acid in cases of small-pox, and direct his patients to hang up sheets dipped in a 10 per cent. solution; and why were patients with scarlet fever told to gargle with a solution of the same substance if it was of no use? He ventured to think no one would ever entertain the idea of using sulphurous acid or chlorine in their houses. The latter would entirely spoil any coloured articles in the room, and injure the inhabitants as well, and the same would apply to sulphurous acid. Nor were they so cheap as Dr. Dupré seemed to think. Bisulphide of carbon was rather costly, and was not quite free from unpleasant odour. The fact was there were certain diseases around us, though we knew very little of their nature, and the question for the physician was, how to stop their progress, and cure those already suffering. It had been proved beyond a doubt that whether these reagents destroyed disease germs or not, they at least stopped disease in some cases and cured it in others. Assuming for the moment that certain diseases were caused by vegetable or animal forms (an opinion which he did not endorse), and that these low forms of life were albuminous in their nature, when a solution of phenol came in contact with them, it would tend to coagulate the albumen, and thus its disinfecting action might be explained. Liebig entertained the idea that in endemic diseases a man was subject to the disease in the proportion in which there existed in his body a certain soil; if he had certain substances in certain proportions, he had all the conditions for assimilating the disease. He looked upon it, in some degree, as a chemical equation. If we had a mass of albumen undergoing decomposition or putrefaction, what did we know of it? In the first place, that we had present a body of whose chemistry they knew very little; by and by, it was exposed to the air, and certain germs, bacteria and so forth, made their appearance. The decomposing substance gave off an offensive smell, and the physician was the first to tell you that, if it was not removed, you would take some disease. Now, if you could apply to that albumen, before it had undergone decomposition, some re-agent which would prevent that process, or stop its going further, you had something which would act both as an antiseptic and as a true disinfectant taking those words in their ordinary acceptation. It was all very well to ask you to be precise, and to get a bottle full of these disease germs, and he should be glad if he could do so, but he did not know where to find this disease matter, nor had he ever met any one who could put him in the way of doing so. He should be most happy if medical men would place this solution on the most severe trial, but there was the strongest evidence at present for believing that it would prove a true antiseptic and disinfectant. Dr. Day, of Geelong, had used peroxide of hydrogen on a very large scale; in certain forms of fever he had sponged the skin with it, and also applied it internally with good results. Other medical men had also spoken highly of it, but hitherto it had not been cheap enough to be used on a large scale. By this process, however, it could be obtained cheaply. He had recently obtained some evidence regarding the action of this solution in certain forms of disease, for instance in rheumatism it had been found very beneficial, and there were those in that hall who could testify to this fact. Dr. Dupré said that the only real disinfectant was fire, and no doubt that was true theoretically; but it was quite impracticable to apply such a theory. Dr. Dupré had reported in favour of wooden hospitals, and stated that the good results were believed to be due to the presence of turpentine and like bodies; in fact, Dr. Dupré had accepted on that occasion his (the speaker's) researches as explanatory of the facts. Mr. Page pointed out that they might expect better results from a gaseous antiseptic than from a solid or liquid, which was no doubt correct, but a gas was an unwieldy thing to supply, and as "Sanitas" was volatile it possessed in some great measure the characters of a gas. He could not say that albumen prepared by his process had been tried for photographic purpose, but he believed it would answer very well. It had been used for coating violins and articles of furniture, and was found to give a beautiful gloss, and in the case of violins to improve the *timbre*. Either the serum or defibrinated blood might be used, but of course it was more advantageous, if time allowed, to employ the article which required less purification. He did not know if the sunflower secreted turpentine, but in all probability it did secrete some such body, the oxidation of which led to the good results attributed to it. Dr. Thudichum attributed the good effects of the eucalyptus groves to their power of assimilating large quantities of water; but if you imagined a district with a rainfall of 60 inches per annum, you would want a very large forest to take up the water. While they knew nothing about disease germs, he did not think they were justified in saying that the presence of a certain amount of water was favourable to their growth; and while they had more precise facts he should be inclined to accept them rather than such indefinite notions. They knew that these trees, in growing, secreted large quantities of these oils, which were known to have a certain composition. These were known to undergo certain oxidations, and to produce by that oxidation certain bodies which, in their turn, were known to have certain characters as antiseptics and disinfectants, again using those words in their ordinary meaning. He thought, therefore, it was more reasonable to suppose that such forests exercised their influence owing to these causes, than from indefinite processes, about which they knew very little indeed.

AFRICAN SECTION.

Tuesday, February 13th, 1877; Captain Toynbee, R.N., in the chair.

The Chairman, in introducing Dr. Mann, remarked on the great and growing importance attaching to African exploration, and added that at the meeting of the Royal Geographical Society, on the previous evening, the last letter read was from a party of explorers who had lately visited a city never before explored, of which Dr. Mann would speak in the course of his paper.

The paper read was—

RECENT EXPLORATIONS OF THE LAKE SYSTEMS OF CENTRAL AFRICA.

By Robert James Mann, M.D., F.R.G.S., &c.

In his recent communication to the Society, Commander Cameron alluded to Speke's apt description of Africa as resembling a vast dish turned upside down, with its sloping sea-coast range ascending to a mountainous ridge only a moderate distance from the shore, and with its slight descent inwards from that ridge to the central plateau, which is thus in its turn a shallow basin lifted bodily up by the sloping edge to a considerable height above the sea. The great rivers of Africa arise from this central plateau, or inner basin, and have to break their way through gaps in the outer mountain ranges, or basin-rim, before they can make their way to the sea—some to the north, some to the east, and some to the west. The largest of these African rivers, as is well known, are the Nile, which flows into the eastern end of the Mediterranean Sea; the Zambesi, which opens into the Mozambique Channel of the Indian Ocean; and the Orange River, the Congo, and the Niger, which find their way into the Atlantic, with perhaps the addition of the Ogowe, or Ogovai, which in the light of concurrent exploration may hereafter have to be admitted into the group. Of these mighty rivers, however, the Nile, the Zambesi, and the Congo alone have to do with what can properly be spoken of as Central Africa. The Orange River belongs rather to the slopes of the extreme southern rim of the basin, and the Niger very much to the southern part of the great western shoulder that projects out to the north of the Gulf of Guinea. It is to the water-sheds of the valleys of the Nile, the Zambesi, and the Congo, that the present communication is, therefore, to be understood chiefly to refer.

It is only within recent years since it has been found possible to extend the explorations of civilised travellers into the deep recesses of the great inner African basin, that it has become apparent there is a series of enormous lakes, not inferior in size to the great lakes of North America, which are met with in various directions in the sinuous course of the great rivers, and which are stumbled upon under the aspect of veritable inland seas. Just at the present time great public interest is attached to these central African lakes, first, on account of the relation which they bear to some of the most gallant actions and stirring adventures of recent explorers; and secondly, because the notion is gradually developing amongst the best informed geographers that these inland lakes, and the great systems of rivers which are connected with them, will really form in the end the main trade routes by which the interior of this densely-peopled continent will be reached. There is, nevertheless, so much intricacy in the general relations of these as yet but imperfectly explored regions, and so much need to go to different sources for information regarding each of them, that it becomes necessary at frequent intervals to take stock of the knowledge which has been acquired concerning them. Such a general review of what is at this time known of the lake systems and river valleys of Central Africa, under the light cast by a brilliant series of recent explorations, is the object of this memoir.

It will be in the memory of most that, in the year 1856, Lieut. Speke, a young officer of the Indian army, who had won laurels in the campaigns of Lord Gough, joined Lieut. Burton to explore the Somali country on the Gulf of Aden, and that at the beginning of the following year those two explorers started from Zanzibar to visit the "Mountains of the Moon," and to seek a large inland sea which was believed to exist in that part of Africa, and which was reputed to be as large as the Caspian sea. They made their way, first, to Cazé, a trading settlement of the Arabs, in what was then called "The Land of the Moon," in lat. 5° S, and long. 33° E, and from that proceeded on 150 miles further to the west, until they came in sight of a vast sheet of water, which proved to be the Lake Tanganyika. They then descended to the lake, and by the help of a canoe reached Kawele, the capital of Ujiji, which was found to be also an Arab trading settlement. From this Speke crossed the lake to Kasenge, another trade depot on the western shore, and effected some limited explorations of the coast of the great sheet of water. The Arab sheik Snay here told Speke of another large inland sea, which he affirmed he had himself been to, some distance further to the north. At the beginning of July, 1857, the young traveller started with another party of about forty followers in search of this sea, and at the end of the month he came in sight of it, four miles off, from high ground on which he stood. He found that this new sheet of water was known to the Arabs under the name "Ukerewe Sea." He, however, at once made it an object of English reverence and interest by calling it "Victoria Nyanza," the name by which it is still known; and from the first instant that he looked upon its southern extremity he came to the conclusion that it was the head water, or source, of the river Nile. He descended to the lake, and found that its surface was 4,000 feet above the sea, and he then rejoined Burton, who had been left disabled by illness at Cazé, and both returned to England shortly afterwards.

In the following year, Captain Speke was joined by an old Indian comrade, who is fortunately still amongst us, Captain Grant, and they started by the Zanzibar route again to revisit the Victoria Nyanza, and to track it downwards to the Nile. They reached first the old station of Cazé, in the Land of the Moon (now Unyanyembe) and a few months afterwards Speke once again stood on the shores of the Victoria Nyanza. It is a noteworthy fact that even at this time this sagacious traveller affirmed his conviction that the Mountains of the Moon, some spurs of which he conceived he had been engaged with, gave rise in themselves to the waters of the Nile, the Zambesi, and the Congo.

Having spent some time on the borders of the lake, Speke set his face northwards, skirted its shores to the west, and, traversing a jungle covered country, reached the course of the Nile below the lake. He then traced this river upwards to its outlet from the Victoria Nyanza by the Ripon Falls. The journey was afterwards continued northwards along the Nile, and on the 15th of February, 1863, the travellers reached Gondokoro, and, to their unspeakable delight, there encountered Baker, who, with his wife, had just completed his exploration of the sources of the Blue Nile in Abyssinia, and was then on his way to the south, on the look-out for Speke and Grant, of whom nothing had been heard for three years.

After a few days rest at Gondokoro, Grant and Speke proceeded by boat down the Nile. But Baker took up the thread of further exploration on his own account. He had heard from Speke that another large sheet of water, called the Luta Nzige, was spoken of by the Arab traders as existing to the west of the Victoria Nyanza, and he conceived that, too, must have to do with the upper waters of the Nile. His recent investigations had pretty well settled the question that the Blue Nile was the stream which carried down from the highlands of Abyssinia the annual tribute of the overflow of the Nile, and he now resolved that he would get to the bottom of the mystery of those upper sources of the White Nile which appeared to be concerned in yielding the ordinary and every-day downflow of the great river. In the beginning of the year 1864 he, therefore, still accompanied by his wife, started, with a small number of attendants and some riding oxen, for Kamrasi's territory, along the route which had recently been traversed by Speke. After three months' struggle with almost inconceivable difficulties, the intrepid travellers at length reached the summit of a hill some distance to the west of the track passed over by Speke, from which elevation their eyes were gladdened by the broad water of their search. Another vast inland sea, with a boundless horizon to the south-west, and with lofty mountains engirdling it to the west, was there spread out before their gaze. This was the vast lake which was, by the happy thought of its discoverer, so auspiciously associated with the previous discovery of Speke, under the name of the Albert Nyanza. After an adventurous voyage from Vacovia, where he first touched the lake, in rude canoes, the explorer at length made his way to the mouth of a large river near at the north-eastern shoulder of the lake, with the large native Town of Magungo standing just above. The stream here unmistakeably came into the lake from the east. Ascending, therefore, this stream for about 18 miles, he had the delight to see before him a broad white sheet of foam, 120 feet high, coming from the direction of the Victoria Lake, and descending by this plunge into the newly discovered basin of the Albert Nyanza, to proceed thence with its waters out at the northern extremity of the lower lake, and *en route* for the main channel of the White Nile at Gondokoro some 150 miles below. From this spot the Bakers, again with great privation and difficulty, made their way to the capital of Kamrasi, the chief of Unyoro, where they had to stay for several months. And they then returned through Shoa to Gondokoro and Khartoum, which they finally reached in the month of May, 1865. The adventurous journey was then completed by crossing the desert from Berber to the coast of the Red Sea, where the travellers found a sea passage to Suez. It was for this, the most wonderful of his journeys, that the gallant traveller became Sir Samuel Baker on his return to England.

The more recent work of Sir Samuel Baker, in the service of the Khedive, in the attempt to establish steam communication with the waters of the Upper Nile and of the upper lakes, and of the continuation of the same enterprise to the present time under the command of his distinguished successor, Colonel Gordon, will not need further notice in this place, except for the purpose of mentioning the explorations and surveys of these noble lakes which have followed as a consequence. As recently as March last, Signor Romolo Gessi, under the command of Colonel Gordon, sailed with two iron boats from Dufli, in latitude 3° 30′ North on the Upper Nile, and about 90 miles above Gondokoro, and reached the lake after a voyage of 164 miles through a broad, deep, and easily navigable river, passing through a land densely occupied with inhabitants, and of great natural fertility. He then, after a somewhat adventurous navigation, passed on to Magungo, and the Murchison Falls, and afterwards returned to the lake, and completed a careful survey quite to its southern extremity, stopping for a brief interval at Vacovia, where Baker had his first sight of the lake by the way. The southern end of the lake was found to be very shallow, and completely choked up with a dense and impenetrable tangle of vegetation; and the natives assured the explorers that there was no river beyond this obstacle. A stream called Missisi, came over a waterfall from the east into a small estuary opening out of the lake. On the western side the mountains descended by almost sheer precipices, and without any material break into the water. The lake was found to be 141 miles long, and 60 miles wide. At the end of July, a ten-horse power steamer, 50 feet long, which had been put together at Dufli after the departure of Signor Gessi, entered the lake and crossed to Magungo, at the entrance of the Victoria Nile; and in consequence of this success, it is now in contemplation to launch a small steamer also upon the intermediate section of the Victoria Nile, where it is navigable between Foweira and Urondogani, and a sister vessel upon the Victoria Nyanza itself above the Ripon Falls. In the meantime, the entire route between Magungo and the Ripon Falls, including the recent discovery of the small intermediate Lake Masanga, has been carefully examined by Lieut.-Colonel Long, by Signor Gessi and Colonel Gordon. The whole route of the Nile between Khartoum and the Albert Nyanza has also been more carefully surveyed and mapped. Central military stations of the Egyptian Government have been established at Dufli, Fatiko, and Foweira, and it is said that the cost of the occupation of this remote region is already covered by a revenue of something like £60,000 a year, derived from the barter of ivory, and from the general improvement of trade.

In the meantime Mr. Stanley, the energetic American traveller, had been performing the same good service for the sister lake that Signor Gessi has accomplished for the Albert Nyanza. At the end of 1874, Mr. Stanley, having landed at Zanzibar, and reached Mpwapa, in Usegara, by the usual Ujiji route, struck off northwards through

Ugogo, crossed the lofty table land, 4,500 ft. high, which there forms the ultimate southward barrier of the Nile water-shed, and then came upon the head streams of the river Leewumbu, which appears to be the true southern source of the Nile, and which, after a course of 350 miles, empties itself into the Victoria Nyanza as the river Shimeeyu. He had with him a large but light boat, and in the month of March, 1875, after sundry exciting adventures, he reached the southern shore of the Victoria Nyanza at Kagehyi, a little east of Muanza, the station from which Speke had first caught sight of the great sheet of water. Mr. Stanley now put his boat together, and launched it upon the lake, and then proceeded to execute a deliberate survey of its coasts, through an extent of 1,000 miles, omitting only the shores of Uzinza at its south-western side. He was very hospitably received by the Chief Mtesa, at his great town of Ulagalla on the northern shores of the lake, near the outlet of the Victoria Nile. He describes this chief as a powerful potentate, ruling over a territory 360 miles long and 50 miles wide, containing some two millions of inhabitants, and stretching half round the lake on its northern and southern sides. This Mtesa was the same man who had been visited, when he was only 25 years of age, by Speke, and who was then found to be a cruel young savage and despot. In 1875, at the time of Stanley's visit, he was, however, transformed into a staid, amiable, and intelligent ruler, clad in the Arab dress, a convert to the Mahommedan faith, and eager for extended intercourse with civilised men. One part of the entertainment which he provided for his guests was a naval review on the lake, consisting of a squadron of 84 canoes, manned with a crew of from 30 to 40 in each. Mr. Stanley found the height of the surface of the lake to be 3,800 feet above the sea. The deepest sounding that he was able to make gave a bottom at 275 feet.

We are now in a position, through the successful issue of these expeditions, definitely to understand the watershed of the Nile. The extreme southern source of the great river lies in the feeders of the River Leewumbu, in about 5° south latitude. The Leewumbu, after a northward course of some 370 miles, empties itself into the Victoria Nyanza at its southern end. The Victoria Nyanza sends its waters over the Ripon Falls at its northern extremity into the Victoria Nile, which enters the Albert Nyanza near to its northern end, over the Murchison Falls, and then with its waters flows north into the White Nile, to follow a further course, of not less than 3,000 miles, through Egypt to the Mediterranean. The Albert Nyanza appears to be little more than a backwater, which has to be filled up from the Victoria Nile before the water can flow on, past Fashora, into the White Nile. The White Nile, where it issues from its mouth in the Albert Nyanza, has scarcely a larger body of water in its stream than that which glides over the Murchison Falls on its way to the Albert Lake. The water which issues from this outlet of the Albert and Victoria Lakes seems to be the chief source of the steady supply of the river. The periodical and seasonal rise of the Nile, on the other hand, as has been already remarked, appears to come principally down the Blue Nile from the mountainous region of Abyssinia. The Blue Nile joins the White at Khartoum, about half the distance between the Albert Nyanza and the sea. The high mountain plateau which forms the southern barrier of the Nile watershed—and which was traversed by Mr. Stanley on his journey between Ugogo and the Leewumbu—lies, it will be observed, in the region which was once held to be the Mountains of the Moon. In an old map by Abul Hassan, of the date of A.D. 1008, the Nile is represented as flowing out of a lake, which is called "Lacus Kura Kavar;" and in that map the Mountains of the Moon are shown in latitude 7° south, which would be further south than the route which connects Zanzibar with Unyanyembè. These mountains were at that time conceived to run east and west. The real position of the great mountains of this district is, however, a chain running north and south, about midway between the Victoria Nyanza and the Indian Ocean. The snow-clad peaks of the mighty Kilimanjaro and Kœnia—of which one, at least, is above 20,000 ft. high—were there found, in 1852, by Mr. Rebmann and Dr. Krapf, and Kilimanjaro was there climbed to the limits of eternal snow by Mr. Charles New, in 1871, and was described by him as being finished above by a magnificent snow-dome, "as smooth in outline as the edge of the moon." This snow-clad mountain stands about 250 miles, and nearly due east, from Kagehyi, the point at which Stanley launched his boat upon the Victoria Nyanza, and is within three degrees of the equator, notwithstanding its vast dome of snow. Mount Kœnia, which is also snow-clad, is not more than seventy-five miles from the equatorial line. Dr. Beke believes that these mountains, which enjoy the distinction of being the highest in Africa, are in reality a continuation southwards from the mountain system of Abyssinia. However this may be, there can be no doubt that some of the snows of these mountains pay tribute to the great lake sources of the Nile.

The next section of the watershed history of Central Africa, which has now to be glanced at, can in no other way be so advantageously introduced as by a brief reference to the work of the great African traveller, Dr. Livingstone, who has so recently been removed from the scene of his adventurous labours. In the month of June, 1849, this intrepid explorer started from the mission-station of Kolobeng, about one thousand miles inland from Algoa Bay, on his first great expedition. He crossed the Kalahari desert towards the north, and descended the river Zouga in native canoes, until he reached the shores of the Lake Ngami, near the 20th parallel of the south latitude. Two years subsequently, he again turned his face from Kolobeng towards the north, accompanied by his wife and family, and this time reached the Chobe river, a tributary of the Zambesi, a little further towards the east, and having descended its stream some distance, struck across an intervening stretch of desert and swamp, and so reached for the first time the banks of the great Zambesi itself. Having returned to Kolobeng, and visited Cape Town, he next made his way to Linyanti, the capital of the Makololo, and, after some incidental exploration, descended the Chobe, and then ascended the Leeambye and the Leeba, and by the help of a pack-ox passed on northwards through the interior plains, nearly to the parallel of 7° south latitude, and then turned westwards, until he reached St. Paul de Loanda at the end of May, 1854. This journey was undertaken with the idea of opening out a profitable market of ivory for Sekeletu, the friendly chief of the Makololo, whom he was endeavouring to interest in his plans for the introduction of civilisation into Central Africa. Returning to Linyanti by the Leeba and Leeambye, he next descended the Chobe, visited the great Victoria Falls on the Zambesi, crossed the Kafue River, and passed on to the Portuguese settlement of Tete, on the Zambesi, and afterwards descended that river to its mouth at Quilimane, which he reached in the month of May, 1856. This was the famous march of Livingstone across Africa. He first turned off from Linyanti to Loanda on the Atlantic, and then returning to Linyanti, turned off from it to Quilimane on the Indian Ocean. At the end of that year Dr. Livingstone was in England.

Upon his return to Africa in 1858 Livingstone took out with him a small steam launch, with the intention of prosecuting with it his explorations on the water of the Zambesi. He was engaged in this work during the next six years, during which time the waters of the Shire, a northern tributary of the Zambesi, were ascended from Quilimane, Lake Nyassa was entered from this river, and partially explored, and the Rovuma was entered from the sea. It was at this period also that the lamentable death of Bishop Mackenzie, near Chibisa occurred, the Oxford and Cambridge Mission under the Bishop having been closely associated with the proceedings of Livingstone. In the early part of 1864, Livingstone made his adventurous voyage across the Indian Ocean in the little steam launch, the *Lady Nyassa*, which had only been intended for the Zambesi and the Nyassa Lake.

Dr. Livingstone now completed his preparations for his next expedition at Bombay, and in 1866 landed once again in Africa—in Mikandany Bay, near the mouth of the Rovuma, and a little north of Cape Delgado—with 13 sepoys from India, and with a good equipment of camels, buffaloes, mules, and asses, and then adding a large train of native porters to his following, he advanced first to the shores of the lake of Nyassa, to which the Rovuma makes a near approach, and afterwards passed round its southern end to the district of Cazembe. At the beginning of 1867 he was on the shores of lake Lohemba, after that at the lake Mocoro, and in July, 1868, he discovered, and partly explored, the great lake Bemba, or Bangweolo. In the beginning of the year 1869 he was very ill, and records that he had, at that time, lost all count of the days, both of weeks and of months, and in March, 1869, he reached Ujiji, on the eastern shore of the Lake Tanganyika, in almost an exhausted state. After recruiting his strength at Ujiji he, however, nevertheless, started off yet again, with a party of Arab traders, to visit the country of the Manyuema to the north-west of the Tanganyika, and spent almost two long years wandering about that district in search of what he believed would prove to be the sources of the Nile. It was at this part of his expedition that he discovered the large river Lualaba, Lake Lincoln upon the Luwembi river, and Lake Kumolondo, or Lanji, and that he visited Nyangwé, upon one of the wide lower stretches of the Lualaba. It was here, also, that he made his acquaintance with the Soko, a new species of gorilla. He spoke of the Luvwa river, which runs out of Lake Moero, as the Lualaba, which, however, in reality joins it lower down, near the Lake Lanji. At the end of July, 1871, he started from the Manyuema country, on his return to Ujiji, which he reached, after almost incredible dangers and hardships, entirely destitute, and reduced almost to a skeleton, on the 23rd of October, and five days afterwards was there found by Stanley, who was at that time on his way up from Zanzibar to seek news of his fate after his five years' disappearance in the wilderness. He soon afterwards made an excursion with Stanley to the north-east coast of the Tanganyika, to ascertain whether some river might not be found there, flowing out towards the Victoria Nyanza, and the Nile. He then rested in Unyanyembe, until Stanley could send him up succour and supplies from Zanzibar, and at the end of August he started once more to make his way round the south shores of Tanganyika and Bangweolo, his object being to make more intimate acquaintance with the lakes of Cazembe and Urua. He was at this time convinced that he should find in that region four separate lakes, each feeding a distinct river, and that these would prove to be at once the sources of the Nile, and the fountains of the old historian Herodotus. The intrepid and indefatigable traveller's work was, however, now near to its end. When he reached the flooded and swampy shore of Lake Bangweolo, his health was so broken, and his strength so nearly gone, that he had to be carried along his route by his men. At the end of April, in a solitary hut near to the small native village of Ilala, on the southern shore of the lake, he knelt down one day by his bedside, and buried his head in his hands, resting upon his pillow, and in this position was shortly afterwards found by his attendants stiff and cold. In that solitary hut on the shores of the Bangweolo, and in that quiet and merciful way, the great traveller ended his labours. His remains, however, were not left in the wilderness. It will be familar to all how they were brought reverently and gently down to Zanzibar by his devoted attendants, headed by Jacob Wainwright and Chumah, the latter a native dependent and friend, whom he had rescued from slavery at the time of his early explorations, some twenty years before. The body, it will be remembered, found its last resting place in Westminster Abbey on the 18th of April, 1873.

But at the time when Livingstone was met by Mr. Stanley at Ujiji, another search expedition had been organised, under the auspices of the Royal Geographical Society of London, and as soon as the welcome news of the success of Stanley was known, this search expedition was turned into an expedition of succour and supply, and happily placed under the command of Lieutenant Cameron, a naval officer, who had acquired his first acquaintance with Africa by a prolonged service on the Zanzibar Coast. Lieutenant Cameron landed at the beginning of 1873 at Bagamayo, on the main land, immediately opposite to Zanzibar, and shortly afterwards started with a retinue of 240 men, and 22 donkeys. Three other white men were associated with Cameron—Dr. Dillon and Lieutenant Murphy (two old messmates), and Robert Moffat, a nephew of Livingstone's, who had left Natal to join in the search for his uncle. The first object of the journey was to reach Ujiji, on the east shore of Lake Tanganyika, by the now well-known route which had already been used by Speke and by Stanley. When a short distance on in this route Cameron was joined by Murphy with the sad news that Moffat had died of fever on his way up. Murphy himself was at the time nearly disabled by illness. The expedition, nevertheless, made its way on, for some part of the distance in the company of a trading caravan of 500 men, until it reached Unyanyembe, a station 480 miles from Zanzibar, and 180 miles from Tanganyika. It was delayed here some time by the serious illness of Cameron, Dillon, and Murphy, and, unfortunately, also by the wholesale desertion of the men, until, in October, Jacob Wainwright came in, on the way to the coast, with the body of Dr. Livingstone, and with the first sad intimation that human aid could no longer be of any avail for the great traveller. Dillon and Murphy returned with the body towards the coast, but Dillon died within two days of leaving Tanganyika. Lieutenant Cameron, in the meantime, resolved that he would now take up the thread of Livingstone's discoveries himself; and, on the 9th of November, started for the Tanganyika, with 100 native servants, but without a single white companion. He reached Kawélé, the capital of Ujiji, on Lake Tanganyika, on the 18th of February following (1874). The traveller was kindly received by the Arab traders, of whom there were several residing at this place, and succeeded in recovering various valuable relics of Livingstone, for subsequent transmission home. He then made an exploring expedition all round the southern extremity of the lake, in two boats which he procured from the Arabs, crossing ninety-six rivers by the way, which were all streams flowing into the lake. But he found one river—the Lukuga—on the western side, which appeared to him to have a sluggish current westwards out of the lakes, and which he traversed for some miles until he was finally stopped by a barrier of impenetrable vegetation that stretched quite across from bank to bank. From the information which he gleaned from the natives, he was led to the conclusion that this river Lukuga joins the Luvwa below Lake Moero, on its way down to its confluence with the Lualaba, and Commander Cameron accordingly believes that it is the proper outlet of the lake. It flows, however, very sluggishly, and through nearly a dead level; and further examination of its course is, perhaps, therefore required before this question of the lake outlets can be held to have been incontrovertibly settled. Some geographers, who think that Commander Cameron is right in connecting Lake Tanganyika with the river system of the Lualaba, nevertheless hold that its chief connection with that river will yet probably be found in a large stream flowing out from the as yet unexplored north-western course of the lake, some distance above the Lukuga.

Commander Cameron, having returned to Kawélé from his survey of the southern half of the lake, now sent down his charts and his Livingstone relics to Zanzibar, and then crossed the lake to Kasengé, a known Arab station on the western side, [illegible] thence shaped his course to the north-west [illegible]ngwè, 300 miles off in that direction, and situated upon the large river Lualaba. It was at this place that Livingstone had found the great river flowing west with a full stream many yards wide, and Cameron's object now was to endeavour to get boats at this place, and to descend the stream, as he had no doubt he should then finally emerge in the Congo. He first passed through the territory of Uguhha, which is a tributary of the great empire of Urua still further to the west, and from that entered the country of Manyuema, where Livingstone had sojourned so long, and which is especially interesting, as being occupied by a series of small independent tribes, living in well-built houses, neatly arranged as villages. The people of this districts are skilful workers in copper and iron, both of which metals they get from the ore by reduction. But the interest which attaches to their mechanical skill is considerably impaired by the unfortunate fact that they are cannibals. Both Dr. Livingstone and Commander Cameron agree in affirming this. Cameron's route, in the first instance, lay through the mountains of Bambarre, amidst gullies filled with enormous trees, and with grass twelve feet high. He then descended to the Lualaba at Kumbwi, and was carried upon it in a boat to Nyangwé.

Commander Cameron found Nyangwé to be a a large settlement of Arab traders, with a well attended and lively market held every fourth day. The river proved to be 1,020 yards wide, and was full of crocodiles and sea-cows. Cowrie shells were the only currency. A white-headed Arab, named Hamed ibn Salim, here exhibited a house, which he said he had lent to Livingstone. From many individuals Cameron, in this place heard the same tale, that the great river flows down westwards to a lake called Sankorra, and that upon that lake there are large boats with sails, holding, some of them, 200 men, who wear the garments of civilisation. The lake was said to be 15 days' sail down the river, and it now unavoidably became the goal of the ardent traveller's desire, as Nyangwé is not more than 700 miles from Tuckey's highest point in his ascent of the Congo in 1816. His passage by the river was, however, summarily refused by a chief through whose territory it would be necessary to pass, and in this emergency a trader, named Hamed ibn Hamed, but who was familiarly known as Tipo Tipo, came into Nyangwé, and told Cameron if he would go down with him to his own camp, eight days' march towards the south, he would be able to get thence to the Sankorra. They accordingly crossed the river to its west bank, and went southwards in company. After sundry ineffectual efforts to make his way to the Sankorra, Cameron at last determined to proceed on southwards to Kasongo, the supreme chief of Urua, and see what help he could get from him. On his way through the jungle he was attacked by the natives in force, and, in self-defence, had to burn down a village, and entrench himself in its ruins. This camp appears in his chart as Fort Dinah, on account of the conflict having arisen, in the first instance, in consequence of his attempt to recover a serviceable goat, called Dinah, which had been stolen from him; but he afterwards had reason to believe that the attack was due to a party of Portuguese slavers having been pursuing their nefarious work within five miles, and of his having been looked upon by the natives as an associate of the slavers. However this might have been, after a siege of five days, Cameron succeeded by good management in arranging a truce with his besiegers, and he then continued his progress to Kilemba, the head-quarters of Kasongo. At this place, he found an Arab trader of great wealth and intelligence, and of high character, named Jumah Merikani, who was of great service to him. Kasongo was absent at the time, and when he returned, proved to be a cruel, besotted, capricious savage, of the most impracticable stamp. Whilst, however, Cameron was waiting for the chief's return at this place, he made a trip a short distance northwards to a small lake, called Lake Mohrya, which he found studded with native villages, built upon piles six feet above the water. He also attempted a second excursion towards the south, hoping to see another and a larger lake connected with the Lualaba, and called Lake Kassali. He was, however, stopped at Kowedi, within six hours of the lake, because some fetish men had declared that if the white man looked upon its waters, the lake would dry up, and its fishes would all die. Some of his native followers, however, were allowed to go to the lake, and they brought word back that its surface was encumbered with vegetation, and that there were people there living in huts, which were built upon tangled masses of vegetation, and floating about upon them from place to place. It appears that this district of Urua is the central spot where the Portuguese traders and their dark-skinned *employés* from the Atlantic, and the Arab traders from Zanzibar, meet.

After four months' detention at Kilemba, during which time Cameron was virtually a prisoner, and compelled to witness the most horrible cruelties, hut-burning and mutilation and murder being apparently the favourite amusements of this savage chief and his slave-making friends, the traveller was at length enabled to effect an arrangement with a scarcely less brutal black Portuguese slaver, named Kendelé, to be allowed to accompany his caravan to Bihe, to which he was himself bound; this being the general caravan route past Lake Dodolo, and along the main watershed, to the Atlantic coast. Cameron was, however, at this time so exhausted of all means of barter or payment that he had to contract a debt to this slaver before the arrangement could be carried out.

Still delay after delay occurred. First the start could not be made until a house had been built for Kasongo. That difficulty was got over by Cameron himself undertaking the work of construction with his own men. The caravan then got as far as the territory of Ussambi, and there came to a halt again. The real cause of this procrastination was then too manifestly revealed by a string of fifty female slaves, tied together by their waists, and laden with the plunder of their own households, coming in. In this choice companionship Cameron had now reluctantly to travel as his only alternative. Having passed the sources of the Lomami, the caravan ascended gradually out of the great valley of the Lualaba watershed, leaving at this spot the region of the oil-palm, which had been for some time present in the greatest abundance. It next traversed the kingdom of Ulunda, which was one vast stretch of jungle, broken by small patches of clearance, in which the villages were placed. From Ulunda it entered the territory of Lovale, crossed the track which Livingstone had used in his early expedition from Linyanti to Loando, and then made its way over an elevated plain, having the waters of the Lulua and the Congo on one side, and of the Zambesi on the other, but with the several streams so interlocked with each other that it was absolutely impossible to decide to which particular system each individual river belonged. This high plain is often flooded by the rise of the rivers, and at such times is covered with fish, which are collected by the natives for purposes of trade. Soon after passing the sources of these great river systems, the hilly region of Kebokwê was entered, and found to be a more frequently visited land, and soon afterwards the regular caravans from the Portuguese trading port of Bihé were encountered. The Coanza river was next crossed. This is a stream with an independent watershed running down to the Atlantic near to Loanda. Beyond the Coanza, a village belonging to Senor Gonzalves, a wealthy Portuguese merchant, was reached, and soon afterwards the wearied traveller enjoyed his first civilised entertainment in the luxurious residence of this hospitable trader, having first, however, to pay his respects to the Chief Kagnombe, or King Antonio, at the capital of Bihé. This town proved to be a large place, five miles round, with a dense population of pigs and cattle, as well as of men, and with abundant plantations of tobacco. The potentate himself was dressed in black clothes, with a wide-a-wake hat, and a Scotch plaid artistically arranged across his shoulders. But he was destitute of boots or shoes, and had to be held up by a small boy at the time of the interview, because he could not quite manage to perform that important operation for himself. Cameron was now within 300 miles of his goal on the Atlantic Coast, and in a comparatively civilised land. From Bihê he passed through a beautiful and fertile country, continually stumbling upon the settlements of Portuguese traders. At last, with half a dozen picked men, he broke away from his more cumbrous following, and made a forced march over the mountainous ridge which here forms the barrier fringe of the great central table land, crossed it by a pass 5,800 feet high, and then descended through gorges of granite, until at length the Atlantic burst upon his sight forty-five miles away. He next passed down the valley of the Katombela, and at length emerged upon the coast at the mouth of the river of the same name, a short march to the north of the Portuguese trading settlement at Benguela. He was now hospitably entertained by M. Cauchoix, a French merchant, but was for some time seriously ill from scurvy, induced by his lengthened exertions and privations. Commander Cameron's recent appearance at the African Section of the Society will, however, have satisfied us all that he is, happily, not much the worse for his two years and three quarters' adventurous sojourn in the not always hospitable land, and for his marvellous walk across the vast African continent; for it must be understood that his twenty-two donkeys lasted him for a very brief interval indeed, when he was once fairly on his way towards the interior. The long route between Nyangwé, at the head of the Lualaba, and Bihé, on the confines of the Atlantic trade, amounting to some 1,200 miles, was almost entirely unexplored territory, and all the interesting details of the incidents of the entire march are now, fortunately, before the world in the traveller's own admirable account of them, which has just issued from the press under the terse and expressive title, "Across Africa," concerning which excellent and well-illustrated volume it may emphatically be said, that it has very rarely indeed happened to a man who has done so much, to be apparently so little conscious of his own personal share in the success of the arduous performance.

It will have been gleaned from this somewhat detailed narrative, which has been ventured upon on account of the great public interest that attaches to this so recent memorable expedition just at this time, that the marvellous scattering of lakes which thus appear to have been sown almost broadcast over these central regions of the great tropical continent, were believed by Commander Cameron to belong almost certainly to the system of the Congo, with their waters running through its capacious channel to the Atlantic. Certainly none of them have anything to do with the watershed of the Nile, although there are still maps in existence under the earlier suggestion of Livingstone's first hope and faith, which show a broad sea between the Tanganyika and the Victoria Nyanza, serving as a connecting link between the former of those lakes and the Nile watershed. The chief fact upon which the Atlantic destination of this fraternity of lakes rests is the all-important one, that the vast river which certainly receives the waters of the greater number of these broad basins at Nyangwe was found by Commander Cameron's very careful and exact observations to have a height of 1,400 feet above the sea, whilst the height of the Nile, even at Gondokoro, below the Albert Nyanza, is 1,800 feet. If, therefore, the Lualaba and its tributaries run into the Nile anywhere above Gondokoro, it would have to accomplish the hitherto unmanageable feat for rivers of running 400 feet uphill! If it entered the Victoria Nyanza it would have to manage the still further climb of another 2,000 feet to get into that yet more elevated basin. There is also the not unimportant evidence in the same direction that Commander Cameron found the flow of the Lualaba at Nyangwé in even the dry season to amount to as much as 126,000 cubic feet per second, which is more than half as much again as the volume of the Ganges in flood, whilst the flow of the Nile at Gondokoro is only estimated at between 40,000 and 50,000 feet per second. If, therefore, the Lualaba emptied itself into any of the head channels of the Nile, it would have to lose two-thirds of its water before it arrived at Gondokoro. When these awkward conditions began to dawn upon Livingstone, which they did during his sojourn in Manyuema, he seems to have still clung to his idea of the Nile outlet, under the notion that the Luabala entered the Nile lower down through the Bahr-el-Ghazal, but he was not aware of the insurmountable difficulty, that the great river at Nyangwé contains nineteen times more water than that of the Bahr-el-Ghazal, which this hypothesis assumes that it feeds.

Commander Cameron, therefore, believes that all these great central lakes are the tributaries of the Congo, and contribute to the distinction which that river has for some time possessed, of being next to the Amazon in the might and volume of its stream. The Lakes Bangweolo and Moero feed the Luvwa. (Webb's Lualaba of Livingstone). Lohemba, Kassali, and the chain of five smaller Kamorondo lakes (Kowamba, Kahando, Ahimbe, Bembê, and Ziwambo), which Cameron heard about, but failed to see, belong to the channel of the true Lualaba, and join the Luvwa just above Lake Lanji. The Luvwa and the Lualaba then unite in the Lake Lanji (or Kamolondo). The Luwembi River supplies Lake Lincoln, and then joining the Lomami, which is the Young's Lualaba of Livingstone, mingles with the main stream of the Lualaba (there called the Ugarowwa, a name which appears to be simply an Arab corruption of Lualaba). The augmented flood after this enters the great Lake Sankorra, and from it moves onwards through another twelve degrees of longitude, receiving no one yet knows what other mighty tribute of waters, and finally reaches the Atlantic somewhere between the equator and the 6th parallel of south latitude. The connection of the Lukugu, with the Luvwa and the Lualaba, it will be remembered, is the only link in the chain which is required to attach the Tanganyika to this great lake system, and this connection is held by Commander Cameron to have a very high degree of probability. The Lufira, which is the central or Mere's Lualaba of Livingstone, runs into Lake Kussali, and contributes to swell the Kamorondo, or *tane* Lualaba system of Cameron. The Luvwa is, however, no doubt, the main channel of these Lualaba rivers. In completing the survey of this large lacustrine family, it is not possible to do otherwise than to sympathise with this gallant and adventurous explorer, and to wish that he had succeeded in getting his boats at Nyangwé, and in being floated triumphantly through the Sankorra down to the Western Ocean on this mighty flood, even at the grievous cost of having his pleasant little stroll across the vast continent spoiled.

Almost simultaneously with the return of Commander Cameron at the end of 1875, a series of expeditions were organised to endeavour to complete the missing links of this exploration of the central African systems of watershed, by ascending some large river from the Atlantic Coast. The Ogowé, or Ogovai, a river but recently opened out, and which enters the Atlantic in Lopez Bay, just to the north of Cape Lopez, and from 80 to 100 miles south of the estuary of the Gaboon, was chosen for this purpose. Last year there were three several expeditions endeavouring to make their way into the interior regions of the great continent along this new route; namely, a German party under Dr. Linz, Mr. Mohr, and Dr. Poggé; a French party under the Count de Brazza; and an American party under Dr. Nassau, which had also established a mission station upon the banks of the Ogowé, among the Bakele tribes, and some 20 miles above the confluence of the River Ngunié, with the main stream. In the beginning of last year Monsieur de Brazza left the village of Lembarenli, some 300 miles up on the left bank of the Ogowé, in the expectation that he should be able to ascend the stream, and that in three years he should emerge by it into the Tanganyika. He overtook Dr. Linz, but it was afterwards understood that both had failed to make any material progress on account of the exhaustion of their resources. Whilst, however, this paper is in the printers' hands, a report appears of a communication just made by Dr. Poggé to the Geographical Society of Berlin, in which he states that, from information he has collected whilst residing at the capital of Muata Yanvo, he has no doubt the Kassabé, the rivers crossed in that neighbourhood by Dr. Livingstone in 1853, and the Luwati and Lulua of Cameron, are tributaries of the main branch of the Congo, but that he believes the Lualaba and its lakes and affluents all find their way to the Ogowé, which is the largest stream impinging upon the Atlantic between the Congo and the Niger, and which opens into the ocean about two-thirds of a degree to the south of the equator. It will be remembered that in his interesting paper on the Gaboon, communicated to the Society of Arts in May last, Mr. R. B. N. Walker very strongly inclined to the same view, and that he gave as one chief reason for having this notion that the Mpongwé tribes which inhabit the Ogowé district, are familiar with the word Nyangwé, whilst it is quite unknown upon the lower stretches of the Congo; and he also urged that Nyangwé is at a comparatively low elevation above the sea, and that the Ogowé runs through a low flat country. Other well informed geographers, however, seem to doubt whether the Ogowé can be of sufficient size to receive such a volume of water as that which flows past Nyangwé, and conceive that if the Congo is not the receptacle of that great stream there must be some vast inland sea, like the Caspian, for the reception of the Lualaba system of water. These, therefore, with the Congo hypothesis, it will be understood are the three alternatives which have now to be tried by the test of further exploration, and pending the prosecution of that test, the diagramatic sketch of the lake and river systems of Central Africa, which is given in connection with this memoir, is only to be looked upon as a contribution to the current history of this interesting geographical investigation, and as representing the view regarding the outlet of the Lualaba lakes, which has been in the ascendant amongst geographers since Commander Cameron's expedition, and until any more certain evidence from the Ogowé, or elsewhere, comes to hand. It is a somewhat curious fact that in this investigation the problem which has to be solved is exactly the opposite of that which had to be dealt with in the instance of the Nile. In the case of the Luabala lakes, the search is, not for the sources of a great river, but for the outlet of a great river system, which has been encountered in the middle of the continent, and of the destination of which nothing is yet certainly known.

The great Lake Nyassa, which lies some 200 miles away from Tanganyika further to the south, and which now only remains to be mentioned in this lacustrine family, was discovered by Dr. Livingstone when he ascended the River Shire, in 1859, and was visited almost immediately afterwards by Dr. Boscher. It was next explored by Dr. Livingstone nearly as far as the eleventh parallel of south latitude, upon a subsequent opportunity, in 1861; but the entire survey of the lake was only completed last year by Mr. E. D. Young, of the United Scotch Missions, who succeeded, by the aid of 800 natives, in carrying a steel steam-boat, in separate pieces, beyond the cataracts which obstruct the upper channel of the Shire, and then put them together, and launched the little vessel on the waters of the lake. He surveyed the shores of the lake to its northern extremity, which he found one hundred miles beyond the furthest point seen by Dr. Livingstone, and in 9 deg. 20 min. south latitude. This lake is 300 miles long, and sinuous and deep. A settlement, called Livingstonia, has been formed at its southern extremity, by the United Scotch Missions Committee, under the charge of Mr. Young. This large inland sea, which belongs properly to the water system of the Zambesi, is, as has been already incidentally mentioned, also somewhat nearly approached by the River Rovuma, a large stream which empties itself by an independent mouth into the Indian Ocean, near Cape Delgado. But its proper approach is the Shire River, which falls into the Zambesi within 100 miles of the sea, and which is navigable for vessels of light burden nearly up to the lake. It is anticipated that this may ultimately prove one of the most practicable routes of entrance into the interior of Africa.

It will be remembered that in an able and very interesting contribution to the Section last year, Mr. Edward Hutchinson gave an account of the proceedings of five missionary societies which are engaged in establishing settlements on one or other of the great lakes that have been here again brought under notice, and that he advocated the route by Unyanyembé and Ujiji as the one which is most likely to prove favourable to the establishment of trade communications with the interior of Africa. The very comprehensive memoir by Mr. Hutchinson is printed in No. 1,228 of the *Journal* of the Society, and will be found well worthy of careful perusal by any one to whom it is not already familiar. The present sketch has unavoidably travelled once again over some part of the ground which was then occupied. But a glance at the excellent little map which is contained in that paper, at page 695, will at once show the reason for this. It will appear, in that map, that the Albert Nyanza is simply dotted round as a *mare incognitum*, under the name of the Little Luta Nziga Lake, the Victoria Nyanza, or Ukerewe, is in the same shadowy state, excepting on one small spot on the coast of Uganda, and at Mutanza at the opposite extremity, the two points visited by Speke and Grant. The Victoria Nile, through the middle of its course, and between the Karuma Falls and the Albert Nyanza, is unknown. The Victoria Nyanza is connected with the Asuan branch of the Nile by a long and broad *cul de sac*, which runs far away, as the Bahara 'Ngo, towards Mount Kœnia, and which has, nevertheless, changed under the recent survey of Stanley into the solid ground of the Unyara and Ugana districts. The northern end of Tanganyika is connected with an imagined Rusizi lake by the Rusizi River, which have both under subsequent exploration disappeared, and the Tanganyika is spoken of as belonging, with the Victoria and Albert, Nyanza to the Nile basin (see page 690.) The Lukuga River, which Cameron believes to establish the connection of the Tanganyika with the Congo system of watershed is not seen at all. The north-west shore which is still unexplored, and which is keenly suspected of harbouring some more practical channel of communication with the lower reaches of the Lualaba is sketched in as an unbroken line. The southern half of the basin of the Tanganyika is dotted in as a probable, and as yet barely imagined coast, and the northern end of the Nyassa disappears north-westwards into unknown space. That map was, nevertheless, compiled, and very admirably and excellently compiled, from the best material at command, when it was sketched. A short nine months have since elapsed, and we now think of the unexplored little "Luta Nziga," and lake Nyassa as vast, practicable, and known inland seas, with steamers plying upon them, the Victoria Nyanza and the central sketch of the Victoria Nile between the Karuma and Ripon Falls as having been already traversed from end to end, and as being marked for the next stages of the central steam-boat route of communication, and even Tanganyika itself is threatened with an early launch. It will be scarcely necessary to say more than this of the marvellous promise that happily now shines upon this important field of exploration and enterprise, when nine short months have sufficed to produce such substantial results, and such startling changes.

It will amply repay any one interested in the rapid march of this branch of exploration, which it has been the object of this paper to describe, to look attentively at five small charts which appear in illustration of one of Dr. Livingstone's expeditions, at page 193 of the 37th volume of the *Journal of the Royal Geographical Society*.* In the first of those charts the Ujiji Sea (Tanganyika) is seen opening out into a long narrow valley in the north, within easy reach of the Kitangura River, which runs into the Ukereway Sea (Victoria Nyanza). In the second chart the Mountains of the Moon are shown gripping tight the north end of Tanganyika, and extending from it to the Equator. In chart 3, the very heart of the Mountains of the Moon has become the Rusizi Lake, and the Akenyara Lake of the Victoria Nyanza system comes very near to the northern end of Tanganyika. In No. 4, which belongs to the period of 1864, the Rusizi Lake lies within the shores of the Albert Nyanza, and the Albert Nyanza and the Tanganyika are connected together by the channel of the Rusizi River. In No. 5, Lake Chama appears connected with the south end of Tanganyika, and with the Chambese River, which rises in the Highlands very near to Lake Nyassa, and the Rovuma River appears running down from very near to the east coast of Nyassa to the neighbourhood of Cape Delgado. To this chart is appended the explanatory note, "The Rusizi River was heard of by Burton and Speke in 1858, the Rusizi Lake by Speke and Grant in 1862. The Albert Nyanza is made to extend south beyond the Rusigi Lake by Sir Samuel Baker. If this be so, Lake Tanganyika and its affluents must be the head waters of the Nile." The Rusizi lake, which was heard of by Speke and Grant, no doubt was identical with the Albert Nyanza. But the Rusizi outlet of Lake Tanganyika very inconsiderately and unhandsomely, but also very summarily and finally, disappeared in the conjoined trip of exploration by Livingstone and Stanley, from Ujiji in 1872.

It will be gathered from the general thread of this narrative, that the great trust of the best friends of African progress is now in the establishment of civilised trading stations, and lines of steam navigation, upon these splendid inland seas, and upon all practical lines of water communication connected with them, such as is offered by the Zambesi and Shire, by the Victoria branch of the Nile, and, it is to be hoped, as will be offered, before long, by the great trunk of the Congo, or the Ogovai, flowing down from the Nyangwe termination of the Lualaba rivers and lakes to the Atlantic Ocean. It will be understood that unbroken water transport throughout this long stretch of inland territory is by no means looked for. There are numerous spots at which invincible obstructions, in the form of rapids and cataracts, are already known. But these obstructions are all of comparatively limited extent, and will each have to be met and circumvented by its own particular expedient of portage. The broken links which will have to be in that way covered by land carriage are, however, as nothing when compared with the difficulties of the long caravan routes that have hitherto had to be faced. It is well-known that the greatest of all the inducements to the nefarious slave traffic pursued by the Arabs, and Portuguese, and brutal half-castes, is the necessity to provide transport for the ivory that is procured by barter from the native chiefs. The trader first buys his ivory, and next makes a raid upon some of the native villages within his reach to get porters for the conveyance of his merchandise to the sea, and he then sells the carriers, as well as the burthen, as the easiest way of getting rid of all further concern in the transaction.

Mr. E. D. Young states that the Nyassa Lake is a great stronghold of the slavers, and that the chiefs on the south and the west are actually subsidised by the Arabs to make war upon the tribes further inland, in order that the captives may be furnished to them as slaves. He found five large dhows upon the lake which were employed for transporting the slaves from one side of the lake to the other; and he estimated the slave traffic of the Nyassa at not less than 20,000 souls every year. He himself says, in his interesting report of his successful survey of the lake, which reached England in June last year:—"The Arabs were so much astonished and frightened when they heard that the English had come with a steamer, that no slaves were conveyed across for a whole month—a clear proof that they are aware we can command the lake. The common people are rejoiced at our presence, and for many miles around us slavery has ceased, as there are no Arabs brave enough to come near us." Happily, however, more will soon be heard of Mr. Young's views, as the gallant traveller has just reached England, and is to give an account of himself at the meeting of the Royal Geographical Society, on the evening of the 22nd instant.

Commander Cameron, again, states that Nyangwe is a great centre of the ivory traffic. A large tusk can be there purchased for an old knife, and the market price of 35 lbs. of ivory is 7½ lbs. of glass beads. The old despot Kasongo accordingly issues licenses for the destruction of entire villages, and for the capture of unlimited slaves, for from two to three muskets.

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* Dr. Livingstone's last journey (1867), and the probable ultimate sources of the Nile, by A. G. Findlay, F.R.G.S.

The idea in establishing the steam-boat traffic of the interior of Africa is to put together and launch each steamer on its own section of navigable water, as has been so successfully done with the Albert Nyanza, and the Nyassa Lake, by Signor Gessi and by Mr. Young, and then to connect the extremities of each limited navigable route by such intermediate expedients as can be contrived. In a communication made to the Royal Geographical Society, on behalf of Colonel Gordon, by the Rev. E. J. Davis in the middle of the last year, the statement was furnished that at that time the only part of the Nile between the Mediterranean and the Albert Nyanza, which was not practicable to a vessel of from 60 to 80 tons, was about ten miles of the river just above the confluence with the Asua, and that steamers would soon be placed on the Victoria Nile, to ply between Foweira and Urondogani, and also on tho Victoria Nyanza itself. The distance of the broken link between Nyangwe and the Tanganyika is about 200 miles; and the similar gaps between the northern end of Tanganyika and Victoria Nyanza, and between its southern end and Lake Nyassa, in each instance about 200 miles. There, therefore, comes out from this survey the surprising fact that the great inland routes between the mouths of our three great river systems, namely, the Nile, the Zambesi, and the Congo, or Ogovai, connecting the Atlantic, the Mediterranean, and the Indian Ocean, and involving a track of something more than 6,000 miles in continuous length, have probably not more than a tenth part of the whole, or 600 miles, which is not in some form navigable by water, and that those 600 miles are conveniently broken up into three two-hundred-mile segments.

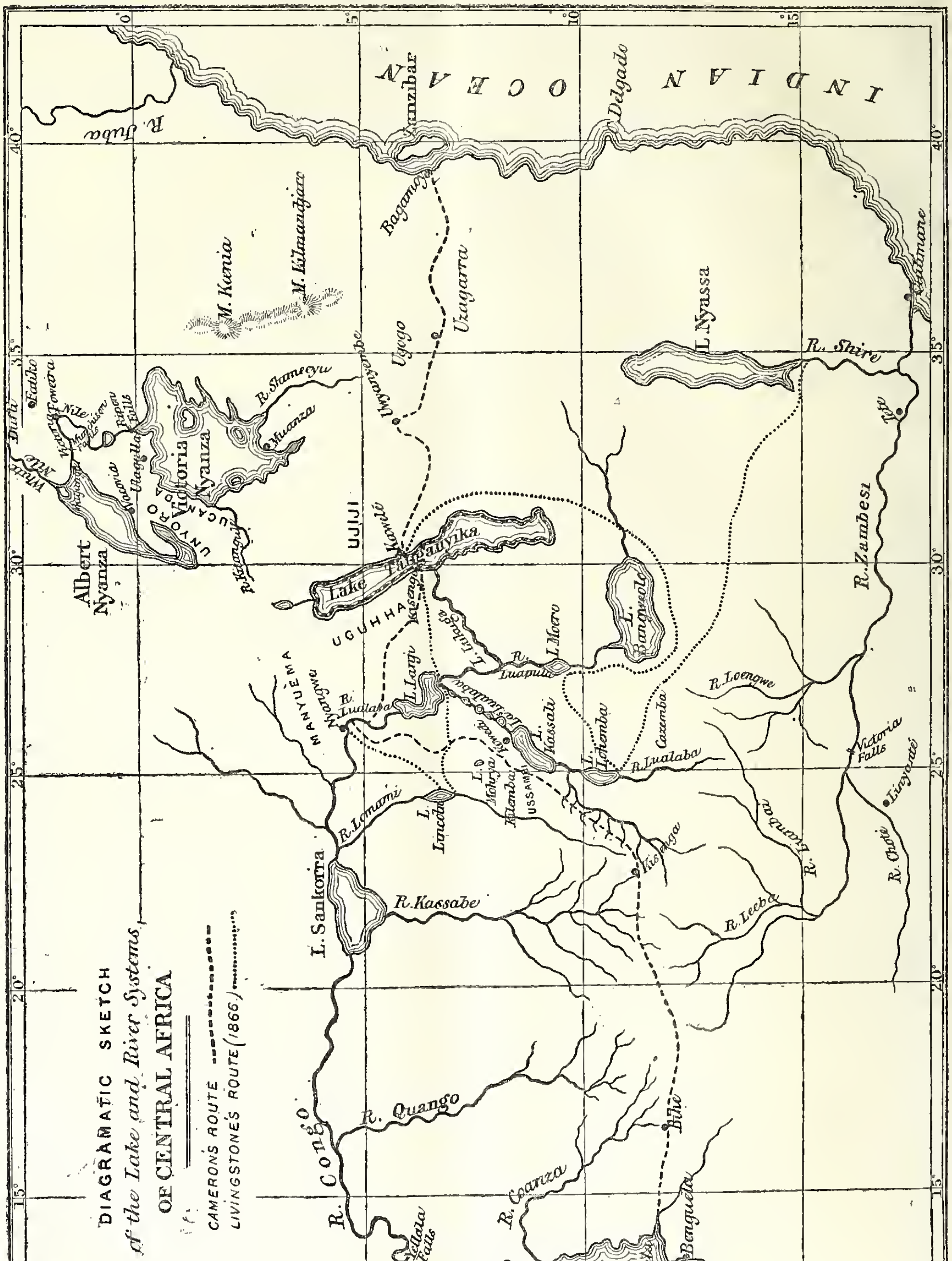
It only remains, in concluding this paper, to draw attention to the further hope that is involved in the proceedings so recently inaugurated by the enlightened benevolence of the King of the Belgians, in which one of the fundamental features is that these vast inland paths laid down by Nature for the service of civilisation and trade, are now to be occupied and utilised by a large co-operative organisation of nations, working together upon a carefully-matured and well-thought-out plan. The account which it has been possible here to give of the advance that has been actually made since the last Session of the African Section of the Society, in the "Explorations of the Lake Systems of Central Africa," certainly goes far to warrant the most sanguine expectation that can be formed of the beneficient results that will follow from the enlarged opportunities and the quickening influences of this scheme, which must be admitted to be as regal in its dimensions and in its spirit as it is in its inspiration and origin.

The African Exploration Fund, which has been started in England under the immediate patronage of the Prince of Wales, and under the superintendence of the President of the Royal Geographical Society, is to be one practical answer to the appeal of the King of the Belgians.

The readers of this paper are requested to add to the map which accompanies it, and which is intended to illustrate Commander Cameron's views of the relations of the great central lakes and rivers, the mouth of the Ogovai, or Ogowé, immediately to the north of Cape Lopez, in latitude 0° 40' S. (eighty miles south of the estuary of the Gaboon), and Mueta Gauvo's capital, three degrees north of Kisenge (and in lat. 9° S., long. 22° 30' E.). The river-course between Lake Tanganyika and the Luvwa, and between Nyangwe and the Congo, should also be a dotted line to indicate the need of a personal examination of the connection there somewhat conjecturally laid down.

DISCUSSION.

Mr. Edward Hutchinson (Secretary to the Church Missionary Society) had listened with great pleasure to the *resumé* Dr. Mann had given of all that had been done in geographical discovery during the last 25 years in Africa. He should like to mention, also, that the researches of Burton and Speke were initiated by the information furnished by the missionaries of the Church Missionary Society to the Royal Geographical Society. On looking at the map before the meeting, it was evident that the only portion of Africa which remained unknown was the great circle which lay to the left of the centre of Africa. The Sahara and the northern districts were tolerably well known, and so were those parts below the equator, and the Somali land to a certain extent, but the great circle enclosed by the Niger and Mohammedan states, and on the two Nyanzas and Janganyika, the lands explored by Cameron and Livingstone, and the sea, was still unknown. Dr. Mann had thrown the Niger out of consideration, as not being one of the rivers which had a watershed connected with the subject in hand, but he was not sure whether he had given sufficient consideration to the Quarra branch, which he thought would some day play an important part. Dr. Barth had traced it right up to tho Ichad, and he was not sure that another great river flowing away to the west of the mountains, which Stanley had described, and to which Dr. Nachtigal and Schweinfurth had directed attention, might not in some way be connected with tho Niger. Again, the River Luelle had never had its exit discovered. He hoped that some day the Niger would form the highway to these unexplored portions of Africa. With regard to the watersheds, it was not at all improbable that further discoveries would show that the right-hand system of rivers, or Lualaba, found its exit farther north than the left-hand, or Kassabe, system, and that the river at Nyangwé might find its way into the sea in the direction indicated by the discoveries of Dr. Poggé. In regard to the statements by the natives, that these rivers found their way into a great lake on which were ships manned by men dressed in civilised clothing, he thought it probable, from similar reports which used to be received on the East coast, that they might really refer to the sea. To return to the Nyanza, and the system of lakes supposed to be the inland sea, of which the missionaries had spoken, he said, last June, that he did not attach much importance to the idea of a through communication, and he still adhered to the same view; in the first place because of the immense distance from Nyassa Tanganyika, by the Nyanza and the Nile, 3,400 miles, with which there would be serious competition should the other route, only 400 miles to the coast, be fairly developed. In the second place, the question arose in whose hands was the traffic to be? Supposing it went northwards by the Nile and Egypt, what arrangement had England with that country to participate in the benefits of that important system of water-carriage? As to the southern half, it was utterly hopeless to utilise the southern route to Lake Nyassa unless the Portuguese were prepared to give up their heavy protective duties on traffic coming down the Zambesi. He was glad to hear that our Government had addressed a remonstrance to the



DIAGRAMATIC SKETCH
of the Lake and River Systems
OF CENTRAL AFRICA

CAMERON'S ROUTE
LIVINGSTONE'S ROUTE (1866)

Portuguese Government on this subject, but unless something more followed, he feared they would have to fall back on the expedient of making a road. The friends of the Scotch Mission were endeavouring to make a road along the route which Dr. Mann pointed out to the north end of Lake Nyassa, and hoped that would solve the problem. Dr. Mann had said that, in the course of a short time, a steamer would be placed on the Victoria Nyanza, but he was glad, as that probably involved the annexation of the lake, to know that there were serious obstacles in the way. They knew pretty well that the intention of the Khedive was simply to annex the whole of the Nile basin, and he thought Englishmen might well be thankful that that prince's finances were limited, and his power not quite equal to his desires. Personally, they might have the greatest possible respect for him; and his motives might be purely philanthropical, but he had a shrewd suspicion that ivory had a great deal to do with it; and he feared that Sir Samuel Baker and Colonel Gordon, with whom he had talked the matter over within the last few days, though they had acted with the best possible motives, had not foreseen what lay in the future. If they succeeded in increasing the Khedive's territories, who was to carry on the work afterwards? He feared that Egyptian influence would not be for the best, and that Englishmen would have to regret the establishment of that power in this region. King Mtesa, though he was not so powerful as Mr. Stanley represented, was still a powerful chief, and could place a goodly number of braves on the war-path if necessary, and they were rapidly becoming furnished with firearms. He did not intend the Khedive to annex the whole of the Victoria Nyanza, and friends in England were anxious that the independence of King Mtesa should not be interfered with; but if the Khedive did get to the Nyanza it was to be feared he would appropriate what was really the inheritance of England. He hoped, therefore, that the annexation of the lake and the placing a steamboat upon it would not be very soon accomplished. One thing was certain, that it would not be attended with any great success unless Egypt had a port on the East coast; and there was no doubt that was the real object of McKillop Pasha's expedition, though it was ostensibly for the purpose of exploration. He trusted before long England would awaken to the importance of having in her own hands, or in those of a ruler in whom she could trust, like the Sultan of Zanzibar, the access to Lake Nyanza. Englishmen ought to realise the importance of having free access to the interior of Africa, and with that view he begged again to call attention to the importance of making a road from the sea coast. In some small measure the Church Missionary Society were trying to contribute to this result, and they hoped to be able to reach their station at Mpwapwa in bullock waggons, and from thence they could easily communicate by the high plateaus of Central Africa with the Tanganyika on the one hand and the Nyanza on the other. He might add that Mtesa was not a Mohammedan, for when Col. Gordon sent up to him a German doctor, who, for his own purposes, had embraced that religion, he was stopped at some distance, and asked if he were a Christian, because King Mtesa did not wish to receive any one who was not; and when, after some difficulty, he approached him, he found him in possession of a Bible, which was read to him by a negro boy who had been in Bishop Tozer's School at Zanzibar. The first question he put to the Doctor was, whether the Bible was true, and when he confessed that it was true, Mtesa said he was a Christian, and wanted to have explained to him one of the most difficult portions of the Book of Revelation.

Mr. Trelawny Saunders said the work in this room was to discuss not questions of geography but of commerce, and he thought it was somewhat to be regretted that commercial men did not come more freely forward to discuss the fortunes of Africa from a commercial point of view. For 100 years and more geographers had been working at the interior of Africa, and as a geographer, he thought they had done enough to open the languid eyes of commercial men to see that their interests lay in the development of the commerce of that vast continent. But if self-interest was asleep, sentiment was not, for the missionaries were by no means backward in this matter. Probably commercial men were too much engaged in other pursuits, and brought up their sons in too much hurry for them to do what their forefathers had done towards the creation of the commerce of the world. It was for the Society of Arts to arouse public attention to the importance of this subject. The representative of one of the great missionary societies had shown the great political importance of the interests which were being developed there, and they must remember that when the ground was already occupied by others it would be too late to say that we ought to have a share in it. We were already shut out from some of the principal doors to the interior by people who would neither use them themselves nor allow others to do so, namely, the Portuguese. But it was almost impossible to effect a trade with the interior of Africa by private means, because as soon as it became of any importance there would be constant conflicts with the petty chiefs, who endeavoured to interpose obstructions, such as could only be put down by force. It was impossible for a civilised Government to entrust the exercise of force to private individuals, and hence the importance of great commercial companies, like the old East India Company, taking the matter up. It was the ventilation of such practical questions as this that he wanted to see taken up. These regions were not barren, but teeming with riches, agricultural and pastoral. Mr. Hamilton, the successor of McGregor Layard, in establishing a permanent port at the confluence of the Niger with the Tchadda, had been able to export manufactured cotton cloth to the coast, and find a market for it even in competition with Manchester; and that great curve to the north-east of the Nyanza was one of the richest pastoral regions in the world. Captain Burton had attempted to get in there, but had only penetrated as far as Harrah. In conclusion he repeated that the points to be discussed were not so much geographical or philanthropical as commercial.

The Chairman, in proposing a vote of thanks to Dr. Mann, said he had read all the papers which had been brought before the Royal Geographical Society on the subject, but Dr. Mann's interesting narrative had made it much clearer to his own mind than it was before. With respect to the question whether the Congo or the Ogowé drained the lake system, they must, for the present, be content to say they did not know; but, looking at the Lake Nyanza, which was only 500 miles from the sea, no one supposed it would send its merchandise through 3,000 miles of river transport to the Mediterranean, and therefore they could not be surprised that a different route should be contemplated.

The vote of thanks having been unanimously passed,

Dr. Mann, in replying, said he cordially agreed with all the remarks which had fallen from Mr. Hutchinson, and, to a large extent, with those of Mr. Saunders, although he was not, perhaps, quite so indifferent to the presence of geography in this room as that gentleman was inclined to be. He entirely, however, assented to what had been said by Mr. Hutchinson with regard to land transport. The present route from Nyangwé to the west coast was a good practical road travelled by waggons and caravans along the top of the watersheds, the same method of travel that had been so largely and so well used in the district of South Africa. The main point he wished to draw attention to, however, was that these large watershed systems gave a series of points to be occupied. He hoped that Nyanza would be occupied by those who would know how to take charge of its resources, and that whether the communication was made by land or water, civilisation would be brought to bear upon this hitherto unknown continent. He had simply omitted the Niger watershed in order not to make his paper too long. He recognised its importance, and had no doubt it would be brought forward on some other occasion.

ELEVENTH ORDINARY MEETING.

Wednesday, February 14th, 1877; GEORGE GODWIN, F.R.S., in the chair.

The following candidates were proposed for election as members of the Society:—

Bower, John A., 1, St. Paul's-terrace, Brockley-road, S.E.
Brown, Henry William, 124, Lower Thames-street, and 102, Grove-lane, Camberwell, S.E.
Blyth, Alexander Wynter, Barnstaple, North Devon.
Cheshire, Frank R., Avenue-house, Acton, and 168, Camden-street, N.W.
Chevassus, Henry, 106-8, Old-street, E.C., and 20, Montem-road, Forest-hill.
Forster, Anthony, Finlay-house, St. Leonards-on-Sea.
Graham, Harry Robert, 15, Warrior-square, St. Leonards-on-Sea.
Hughes, Henry, Tintern-house, Leicester.
Josolyne, John Augustus, Belmore-lodge, Herne-hill.
Manser, Alfred, Lampits, Woddesdon, Hertford.
Owen, R. Brisco, M.D., F.L.S., Mayor of Beaumaris.
Preston, John, J.P., Mayor of Belfast.
Salter, Frank, B.Sc. (Lond.), A.I.C.E., 4, Glengall-terrace, Old Kent-road, S.E.
Samayoa, Señor Don José Maria, Hotel de Bade, Paris.

The following candidates were balloted for, and duly elected members of the Society:—

Bisiker, William, 2, York-villas, Stroud-green-road, Finsbury-park, N.
Brittle, John Richard, A.I.C.E., 12, Queen Anne's-gate. Westminster, S.W.
Giles, Thomas, West Cowes, Isle of Wight.
Harrison, Robert William, 2, Grittleton-road, St. Peter's-park, W.
Hart, Ernest, 59, Queen Anne-street, W.
Kensington, Edward Thomas, Weston-super-Mare.
Livesey, James, 9, Victoria-chambers, Westminster, S.W.
Royle, Thomas, F.C.S., Greenford-green, Harrow, N.W.
Rylands, Thomas Glazebrook, Highfields, Thelwall, near Warrington.
Samson, Louis, 48, Sussex-gardens, Hyde-park, W.

AND AS HONORARY CORRESPONDING MEMBER:—

Morel, Dr. Jules, Ghent, Belgium.

The paper read was—

ZINC WHITE AS PAINT, AND THE TREATMENT OF IRON FOR THE PREVENTION OF CORROSION.

By Professor Barff, M.A.

WHITE LEAD.

Some years ago, when I first had the honour of delivering a course of lectures before this Society, my subject was artists' colours and pigments. In these lectures I pointed out very earnestly the great objection I had to white lead as a pigment for artists. The following reasons which I then assigned for its disuse I have still further confirmed by long experience. First, white lead is discoloured by sulphuretted hydrogen, which is known as foul air. In small quantities sulphuretted hydrogen changes the tint of white lead to that of a dirty brown colour, and in larger quantities it blackens it completely. It is manifest that such a pigment ought never to be employed, where the permanency of a delicate tint is desired, and where foul air can have access to the painting in which it is employed. Another reason I then explained was, that oil with which lead is ground up is decomposed, first, by the action of the oxide of lead in the white lead, forming a lead soap known as lead plaster; and further, after the lapse of a long time, an interchange takes places between the acids of the oil and the acid of the carbonated lead; take for example the oleic acid and the carbonate of lead forming oleate of lead, which is, in fact, lead soap. I shall presently show you a specimen of lead soap, and you will be able to distinguish the difference of opacity between it and lead paint; therefore, if lead paint, that is, carbonate of lead, loses its opacity, it loses that quality for which it is so much valued. It is true that a saponification of the oil by the oxide of lead and the carbonate of lead gives to the paint at first a quality for which it is much valued; and this quality consists in the facility with which the workman can lay it on, and make it cover the ground which it is intended to conceal. But this very change, which in the first instance is an advantage, brings about future calamity, for the saponification increasing, the transparency of the pigment also increases, and so at last that which it was intended to conceal, again reveals its existence through it. I do not intend this evening to enter upon the subject of white lead manufacture. I have, on one or two occasions, very fully explained it in this room, and other gentlemen in treating on subjects in which it occurs have also treated its manufacture in an exhaustive manner. It is enough for me to remark that wherever white lead comes in contact with the digestive organs of a human being, whether it be by passing in a state of fine division into the mouth, and thence out, as it must do, without excessive precautions, into the system—in places where white lead is manufactured and ground—or through the carelessness and want of cleanliness of painters, who eat their meals with hands sullied by noxious materials, so that it passes into their system, it produces the same disease, which is known by the name of "lead-poisoning." Experience tells us that many, even most men, will for temporary ease run the risk of future pain and calamity. It is all very well to say that precautions are taken to save men from the consequence of their carelessness and indulgence. Similar precautions are taken in coal-mines, which if attended to would prevent the awful calamities which so frequently result from their neglect. We must not content ourselves with these precautions when we can, if we chose, do away with the danger altogether. It is clear we cannot give up the use of coal, but now we can give up the use of white lead in those employments where it is injurious to the health of the employed; and nothing but a miserable prejudice, and what is worse, a miserable clinging to commercial interests, can stand in the way of this reform, which, I believe I can show you to night, will not require any sacrifice on the part of those who use this material for the decoration, cleaning, and beautifying of the houses in which they dwell. I have to introduce to your notice a zinc pigment, which possesses nearly, if not quite, as good a body as the best white lead, and which will neither turn brown nor blacken by the action of foul air, nor will it become semi-transparent, as I have already shown you white lead does.

The processes of its manufacture have been patented, and it is now being made on a large scale for the inventor, Mr. T. Griffiths, of the Silicate Paint Company, Liverpool. It has for its basis the white sulphide of zinc, a precipitate well known to chemists in their analysis, but one which usually presents a most dingy and uninviting appearance in the test-tube. It was found, however, that this precipitate, properly treated, possessed what painters term "body," and the problem to be solved was, how to prepare it pure in tint. Like most important inventions, the first laboratory experiments were disappointing and unsatisfactory. It was attempted to precipitate pure sulphate of zinc by pure sulphide of sodium. But it was found that, even after several crystallizations, the zinc sulphate still retained sufficient impurities to injure the brilliancy of the white, and the sulphide of sodium was liable to the same objections. For a time this was abandoned. Sulphuretted hydrogen was tried, the zinc solution being made alkaline as it became acid. It is well known to chemists that zinc frequently contains traces of cadmium, which it is very difficult to remove. The cadmium at once showed itself in this method, being precipitated as a yellow sulphide. Of course, the cadmium might have been easily removed, by saturating the acid zinc solution with the gas, and filtering from the precipitate thus formed; but the process had the great objection of being too expensive for large manufacture. Sulphide of calcium was found to answer well as a precipitant; but, for some unexplained cause, the product lacked "body." It was determined to try sulphide of sodium on a large scale, no attempt being made to purify the zinc solution, and the sulphide of sodium only being allowed to deposit such solid matters as did not remain in solution. Strange to say, the zinc sulphide precipitated was perfectly white, and the original impurities remained in solution. The washed and dried precipitate, although having better body than ordinary zinc white, still fell far short of white lead in this quality, and calcination was resorted to remedy this. The result was satisfactory as regarded body, but the pigment acquired a yellow tint, which could not be removed; besides this, it acquired a degree of hardness which necessitated much grinding to make it fit for use as paint. If the particles of zinc sulphide could be kept asunder in the process of calcination, this might be remedied. Sulphate of barium promised well for this purpose, and it was accordingly tried. Zinc sulphate was first precipitated by sulphide of sodium, and to the mixture was added a certain proportion of chloride of barium. The resulting precipitate of sulphate of barium was intimately mixed with the first precipitate of sulphide of zinc, and the washed precipitates were subjected to a red heat for several hours in a reverberatory furnace. On examining the product it was found to be excellent as regards body, far better than the sulphide of zinc alone, in fact quite equal to white lead, and the tint was pure. These results were most satisfactory, and it was clearly shown that sulphate of barium was far from being detrimental, and therefore could not be looked upon as an adulterant. One quality was still wanting, "softness." The product, when ground with oil, did not work kindly under the brush, but had a tendency to drag and become streaky. Many remedies were suggested to obviate this, but for various reasons had to be rejected. It was found, however, after much experimentation and research, that magnesia in small quantity imparted this quality of softness to the pigment and caused it to unite kindly with oil. This admixture was effected in the precipitating vats along with the sulphide of zinc, and no doubt saponification is brought about between the magnesia and the oil similar to that produced by white lead and oil, but not to the same extent, and thus ease in working is imparted to the paint. This pigment is now being manufactured on the principles I have described, such small modifications only being introduced as the growing knowledge of the peculiarities of the process suggest.

IRON.

While experimenting, two or three years ago, with my friend, Mr. Hugh Smith, on different methods for preventing incrustation and corroding of steam-boilers, I was led, through the failure of all the processes employed, to believe that, if it were possible to convert the surfaces of iron plates into the magnetic, or black oxide of iron, in such a manner that the particles of black oxide formed in the position of the original particles of iron could be rendered perfectly adherent to the iron surface, which does not become per-oxidised, and perfectly coherent with one another, the object would be effected. I do not intend to enter into the chemistry of the oxidation of iron to its full extent; it would take too much time, and it would rather tend to confuse than to enlighten those who are not well up in their chemistry, and would raise questions which would bring on prematurely a collision with the views of some of my brother chemists, which collision, under suitable circumstances, at some future time, not very remote, I look forward to with considerable satisfaction, as it will be the means of solving many phenomena which have never yet been explained. A piece of dry iron, its surface being polished, may be exposed for any length of time to dry air without rusting, but it begins to rust at once as soon as the slightest moisture comes in contact with it. We have to consider only two oxides of iron: one containing 56 parts by weight of the metal to 16 parts of oxygen, and the other containing twice 56 parts of iron and three times 16 parts by weight of oxygen. We speak of these oxides as the protoxide and sesquioxide, or as ferrous and ferric oxide.

Immediately the protoxide is formed, it being more moist, it unites with oxygen and becomes gradually converted into the ferric oxide. Now, let us suppose a moist iron plate to come into contact with oxygen. It is clear that the protoxide will be first formed, and this rapidly becomes converted into the higher oxide. Now, suppose you take a solution of the salt of the higher oxide and put into it metallic iron, in time, the air being excluded, this higher salt will become converted into a salt of the lower oxide. Let us now see how this bears upon the rapid oxidation of iron in the presence of moisture. We have seen that when oxygen comes in contact with moisture the first oxide is formed and becomes rapidly oxidised into the higher one. But this higher oxide is in contact with metallic iron, which will reduce it to the lower oxide, thus becoming oxidised by the oxygen which it has taken up from the higher oxide. You will now see clearly how it is that iron rusts throughout its whole substance with such rapidity, for the oxide of iron serves as a carrier for atmospheric oxygen to the iron to almost any depth. There is another oxide of iron, called the black or magnetic oxide, containing 3 times 56 parts by weight of iron, and 4 times 16 parts by weight of oxygen. Some chemists consider this oxide to be a sort of mixture of the two others, and they call it ferroso-ferric oxide; whether this be the case or not does not matter to us this evening. But it is a most important point for our consideration, that this oxide undergoes no change whatever in the presence of moisture and atmospheric oxygen. Nor does any temperature to which it can be exposed, in any of the ordinary uses to which iron is applied in the presence of moisture, either decompose it or produce its further oxidation. In every school where chemistry is taught, in the most elementary lecture on hydrogen, the pupils are told that if they pass steam over red-hot iron filings contained in an iron tube, they will be able to collect and burn hydrogen gas at the opposite end of the tube to where the steam enters. For a long time it was thought that the particles of black oxide formed by this decomposition of the steam were pulverulent, and could not be made to cohere into a solid mass. The result of a considerable number of experiments has been to prove that they can be made not only coherent amongst themselves but adherent to the body, and that both these produce a proper formation of this black oxide on the surface of iron plates; for, as I will show you later on, the oxidised surface of the iron resists for a long time, and more effectually, the rubbing with emery paper, than does the simple metallic iron itself, and that there is a very manifest difference between the ease with which a sharp rasp is able to cut away the surface of the iron, and the difficulty with which this black oxide is removed from the surface by that same instrument. The method which long experience has taught us is the best for carrying out this process for the protection of iron articles in common use, is to raise the temperature of those articles, in a suitable chamber, say to 500° F., and then pass the steam from a suitable generator into this chamber, keeping these articles for five, six, or seven hours, as the case may be, at that temperature in an atmosphere of superheated steam. I will presently call your attention to the diagram of the furnace and muffle which I have employed in all our later experiments, and in which all the specimens before you, which will be alluded to in this paper, were prepared. Differences of temperature are employed where different objects are to be obtained. If it be wished to act upon surfaces of polished iron or steel, it is desirable to let the temperature remain at 500° F., until the operation is completed Articles coated in this way will not resist the action of continued moisture such as has prevailed for the last two months, when exposed out of doors; but they will resist the action of any amount of moisture with which they may come in contact in a house or building; and the reason of this will be very obvious, because only a thin film of the iron, on its surface is transformed into the black oxide. This I will explain more fully to you, when I call your attention to individual specimens. At a temperature of 1,200° F., and under an exposure to superheated steam for six or seven hours, the iron surface becomes so changed that it will stand the action of water for any length of time, even if that water be impregnated with the acid fumes of the laboratory. Before calling your attention to our failures and successes as they lie before you on the table, I will just allude to a few of the uses to which this process may be, as I consider, successfully applied—to water-mains, also to water-connecting pipes, as well as to the water-pipes used inside the house, which, in this case, would supplant their leaden predecessors. In this hall of hygiene, these words will, doubtless, sound as sweet music to the ears of many of those who have honoured me with their attendance this evening. The greatest objection to the use of iron pipes for the supply of water in houses hitherto has been this, that by rusting they caused the first quantities of water drawn off in the morning to be dirty and turbid; now this will be entirely prevented, if the pipes be first exposed to the treatment which I have just explained to you—of course gas-pipes could with advantage be similarly acted upon—and as the surface, when oxidised, is harder than the natural surface of the iron, the friction of large bodies of water through the pipes, and the friction necessarily employed in fixing them in their places, would be much better resisted than by the untreated iron itself. I cannot over-estimate the advantages which the employment of this process must confer on architects, who will be by it enabled to employ iron, whether wrought, or cast, much more largely, not only in the decoration, but in the construction of their buildings. Last summer, I was at a very large house in the country, where the entrance portico, some 20 feet high, was being painted and decorated, when one of the large plaster ornaments of the ceiling broke away from its holdings, and would have fallen to the ground except that it was caught by a workman. This ornament weighed not less than 25 lb., and if it had fallen from this height upon the workmen below, it must have killed them. The ornament had been there many years, and was fixed up in the best method possible, it being supported and secured by iron rods. On examination I found that these rods were rusted through completely to the very centre. I need not make any comment upon this, since I have been able to introduce you to iron treated in such a way that it will never rust. Of course if the process will answer for architectural ornaments, it will answer for statues, so that iron may be used instead of bronze, which will materially lessen the cost of casting statues, both in the material and in the expense of making the moulds. You well know that when a tinned saucepan is allowed to get dry on the fire and burns, as the servant calls it, that it is rendered useless until it is tinned again. Now, if such a saucepan be treated by the method I recommend it may be allowed to get red-hot without suffering injury, for the protection on its surface is produced at a red heat. We have experimented on some screws, hinges, locks, keys, bolts, with complete success. It has been suggested to me that the iron nipples used in gas-lights would not corrode, and would, therefore, be more useful, if submitted to this action of super-heated steam. Wherever iron is used, railings, street gas-posts, iron safes for keeping documents fire-proof and thief-proof, the framework of filters, tanks, cisterns for domestic and other uses, iron employed in the erection of temporary buildings —which, I flatter myself, if treated by this process, would become permanent buildings—all these, and many other applications of iron to the arts, would immensely gain by being submitted to this oxidising action. I think I need hardly take up your time by enumerating other applications for the preservation of iron, for it appears to me that they would be commensurate with most of the uses to which iron is applied, save and except those where friction—such as that to which rails and iron wheels are exposed—would necessarily wear away the coating, as they wear away the material itself. I am happy to see a namesake of mine here present this evening, who will tell you that he is carrying out a process for the manufacture of peat into charcoal by the action of super-heated steam, and that he is enabled, by super-heated steam alone, to raise the temperature of his chambers to a red heat, quite sufficient to effect his carbonising process. I will now call your attention to the specimens here before you, and to a description of the furnace which we employ, and I shall be most happy to explain, on being questioned, any parts of my process which may appear to be obscure, and to answer, if I can, any objections which you, gentlemen, in the interests of science, will feel it your duty to bring against it.

At the conclusion of the paper, Prof. Barff exhibited various specimens of white lead and zinc white, showing how one was discoloured, and the other not, and also the zinc pigment in the various processes of manufacture. He also exhibited a number of specimens of iron objects which had been oxidised in the two methods described, some at the lower, and some at the higher temperature, the latter not being so black in appearance.

Mr. Ward, who had been working with Prof. Barff in these experiments, stated that iron so treated was very much harder than before, and resisted emery cloth and steel wire cloth, which common iron would not do.

In answer to a question,

Prof. Barff said he would not say anything as to the cost of zinc paint, as he had only taken up the question from a scientific point of view, and from a desire to see white lead, which was so pernicious in every respect, superseded. He went on to describe the apparatus used for coating the iron articles, and said the cost would be very trifling.

DISCUSSION.

The Chairman said that two such important matters had seldom been brought forward at the same time; and he would invite gentlemen to treat them separately. They all knew the evils resulting from lead paints, but they did not all know the difficulties which attended the use of zinc. Twenty years ago, a house was painted with zinc white under his direction, which did not succeed, but he hoped the present efforts would be more successful. With regard to the oxidisation of iron, it was too grand a thing to be achieved without many difficulties, and they must not suppose that the question could be solved by three or six months' experience. Iron buildings were always getting weaker and going to decay, and any invention which would prevent that, and render iron available for construction in the way they hope to see it, would be of such immense importance, that it might well become the subject of a long series of careful experiments. They must ask what would be the effect in 100 or 200 years by this process before they were satisfied they had achieved all that was required; but even if it preserved iron for a much shorter period it would be a very great advantage.

Mr. George Howe said he had used this pigment as a decorator very successfully, and if others would only take it up they would find its covering properties were quite equal, if not superior, to most white leads. It was well known in the trade that a painted ceiling done with white lead would very soon come to grief, and a few months ago he had painted a ceiling with that material a delicate grey, but it was now of a light brown colour. Six or eight months ago, however, he had painted a ceiling with this new pigment, and, although it had several Argand burners under it, it was still as white as when first done. He had a relative who was now suffering from the evil effects of lead poisoning, and therefore hoped that this new paint would generally supersede it. If anything, it was cheaper than white lead.

Mr. Laing said he should be very much rejoiced to see something which would replace white lead. He had tried years ago to introduce oxide of zinc, but it would not do, because the oil would not mix with it, and when it was cleaned the zinc washed off by pailfuls. The oil and lead mingled, and if the lead was varnished it would last for many years; but it was very pernicious, both in the manufacture and use. At the present moment an effort was being made by some of the manufacturers to do away with the noxious effects in the manufacture, and he was experimenting on some which had been produced by the new process. He only feared that this new pigment might have the same properties as the older zinc whites, which were not stable; for, if the pictures round the walls had been painted with that material, when they received such a scrubbing as they had many years ago, there would not be much left of them. He should be very glad, however, to have some of this new pigment to experiment with.

Mr. Williams said one of the greatest difficulties met with at first was that the sulphide of zinc would not commingle with the oil, and worked badly under the brush, and that led to the introduction of magnesia. This united with the oil and formed a kind of soap, just in the same way as the lead did, but it did not produce semi-transparency, as was the case with lead soap. This magnesian soap gave the peculiar property of softness to the pigment. It occupied about twice the volume, and had the same covering power as lead, so that it might be reckoned at about half the price. One point of great importance was its good drying qualities. He at first took it for granted that it would not dry well, but when it was well washed—and this was an important point in the manufacture—so as to remove all the chloride of sodium and other impurities, it was by no means a bad dryer. He had proof of that a few days ago, in preparing the specimens for the lecture, for when he suggested to the workman the use of sulphate of zinc or borate of zinc as a dryer, he said it was not necessary, as it would dry quicker than the lead, which proved to be the case. Another point was that, as far as he had yet experimented, it had no effect on other colours; it might be that it would not work with arsenical greens, but he thought they might well do without them both for decorative and artistic work. Prof. Barff had suggested that it might not stand with Prussian blue, but he had a specimen with him which had been painted some time and had not changed colour, so far as his eye could tell.

Mr. Laing asked if it would not be necessary to add any driers?

Mr. Williams said decidedly driers should be added. At the present time they were experimenting to find a drier which would not injure either the body or the colour of the pigment, and would make it dry quickly. They had met with some little success, but he was not at liberty just at present to point out what the result was.

Mr. Tozer said he had been out of the decorative trade for some years, and now represented a large house in the colour trade; and if any new white were brought out it was pretty sure to be brought to them. Having been apprentice, journeyman, and master, he took a great interest in all these matters, and his idea of a good white was one which would cover black best. He had always attributed the great blistering of paint work to the use of white lead, and he had found that a front door grained in the ordinary way would not blister on the zinc paint, though it would on white lead. It would be always found that the blister brought you down to the priming, or second coat, and whatever was the outer it was generally primed with white lead. He had tried this new white, and found it did not blister. He also found that it "bore out" as well as covered; no man could grain until the work bore out, and you got a solid surface. Now this zinc paint bore out well, and you could grain as well on three coats as on four coats of white lead. He mentioned several instances in which it had been found to answer admirably for church decorative work.

Mr. Wills remarked that there were two aspects in which this pigment might be regarded; one as useful for domestic purposes, and the other for artistic use. The latter, he thought, was much the more important of the two, as they would only have, in that case, to take care that the paints should not be acted upon by any normal condition of the atmosphere. If this zinc paint was to be used in ordinary work, it must not be used over lead, as had been done at the laboratory at the Royal Naval College at Greenwich, the result being that after a few months the sulphuretted hydrogen, which was always present in such a place, got behind it, and the upper part of the room was now almost black. This was a zinc sulphide, and he should fancy that on exposure to the air for some time it would become oxidised, which might be accompanied by a separation of free sulphur, and this would, no doubt, give a slightly yellow tint to the paint, such as was found when some of the zinc white was calcined. The sulphide of zinc would finally be converted into a carbonate or sulphate, and then, if any free sulphur were present, it would give rise to a yellowish tint. He should like to know if this had been tried for a sufficiently long time to show that decomposition did not take place. White lead was a carbonate, and, under normal conditions, was unalterable, because you could not consider the presence of sulphuretted hydrogen in the air as a natural phenomenon, and it could be prevented. A painting could be glazed, or could be placed in such a position that sulphuretted hydrogen could not have access to it, and under these circumstances the great objection to white lead would be removed.

Mr. Glasse said sulphide of zinc oxidised very readily, and was converted into sulphate, leading to the separation of sulphate, which was soluble, and thus he feared this pigment would not be permanent, especially for outside work. This was the explanation of the oxide of zinc paint—which underwent a similar change—washing off so readily.

Mr. Harland asked how much magnesia was required in the preparation of the paint. It appeared to him that the magnesia had been taken as a base, combined with the fatty acids of the linseed oil, and the sulphide of zinc used as a kind of varnish, so as to be covered up by this soap. The same action took place with white lead. There was a chemical combination with the oil, and you covered up the carbonate of lead. Some chemists believed that there was also an affinity between carbonate of lead and the combination produced by the oxide or some salt of lead. It appeared to him that sulphide of baryta, or some other insoluble compound, which was not acted upon by sulphuretted hydrogen, would answer every purpose as well as sulphide of zinc, because there could be no chemical combination between this body and the oil.

Mr. Pearsall inquired if this new pigment had been tried in the simplest form, namely with water; either with or without the magnesia. He should be very sorry to throw any doubt on an excellent experiment, but he would remark that they did not know the history or composition of the oils which were used with it, and probably impurities in them might affect the result.

Dr. Le Neve Foster asked if the proportion of barytes used in connection with this new pigment was considerable, because if so, it would affect the mines producing that substance if it were introduced commercially.

Mr. Stinson spoke at some length on the impurities commonly present in boiled oils, and suggested that if a pure oil were used it might do away with the necessity for using magnesia.

The Chairman having intimated that it was now time to discuss the second branch of the paper,

Mr. Cobb asked whether this new process of oxidation would be applicable to plates for iron shipbuilding? At present the oxidation of these plates was prevented, as far as possible, by the use of cement, but this was liable to danger, as was proved some time ago in one of the ships in the navy, which would have been lost in the Indian Ocean but for the discipline and bravery of the crew. In the merchant service, ships were continually taking in cargoes which affected their plates, and these sometimes became very much like strong brown paper. If, therefore, this process was applicable to such a purpose, Professor Barff had a magnificent future before him.

Admiral Selwyn said that, in considering this magnetic oxide, they could not do better than look to what nature taught them of its properties. In New Zealand you could find any quantity of this substance, which had remained totally unchanged even by the action of salt water during all the centuries which had elapsed since the creation of the world. Man generally put together substances with which nature did not furnish him, but in so doing he put them into a state of unstable equilibrium, and the air then set to work to undo and disintegrate what he had put together. If you looked at the old pictures in the great galleries of the world, which were mostly painted with earths and ochres, you found no change in the colours, and in the Florentine galleries you would always find that those who were engaged in copying the works of the old masters refused all chemical ingredients, and relied on ochres and earths, and their colours remained, whilst those of many modern masters did not. There was already some experience of the lower form of this process, for Mr. Perkins, in his steam-boilers, pressed the steam up to about 450 lbs. on the square inch, and his tubes had been found after thirteen years use not to have undergone any change of the slightest description. They had an imperfect coating of magnetic oxide upon them, but Mr. Perkins, while he knew that they had not decayed, was not aware of the reason, which Professor Barff had so ably brought before them. Professor Tyndall also, in his "Heat a Mode of Motion," stated that by the use of a powerful gas metals might be varnished.

Now, this was a very powerful gas, and although he had told Prof. Barff that he did not see his way to subjecting rivetted structures, which had to stand a heavy tensile strain, to a great heat, which might alter their tensile strength, he had no doubt that in the future this invention would be largely used for such articles, and he would thus be able to introduce it into structures which now became quite unsafe in the course of a few years from the tendency to rust, which had never yet been overcome. The girders along the Metropolitan Railway were becoming rotten much more quickly than the proprietors could wish, and many iron railway bridges were rapidly failing from the same cause, because it was impossible to properly protect them. He thought, therefore, the Society should hail with satisfaction even the beginnings of such an invention, and he should deprecate the notion of saying you must try a great deal more before we could accept what has been already accomplished. He feared that a great many good inventions had perished for want of a little encouragement, which might have brought them to success.

Mr. A. Barff said that when charring peat some three years ago on the Duke of Sutherland's estate, they used superheated steam, and he had brought with him two pipes through which the steam was conveyed into the hot chamber, the inside of which was covered with just the product of which Professor Barff had spoken. The pipe had been broken in consequence of a stoppage, and had been knocking about ever since, but it showed no sign of change. The chambers used were about 32 feet by 6 feet, and the superheated steam was conducted into them along with the products of combustion, which probably would interfere with this process.

Dr. Le Neve Foster said it occurred to him that this process might be very usefully applied to mining pumps. Those who had anything to do with copper mines, and mines containing iron pyrites, were aware how quickly the water acted on these pipes and destroyed them, and sometimes various expedients had to be resorted to in order to protect the iron.

Mr. Penrose asked if this process would in any way impair the elasticity of the iron?

Mr. Pearsall said the invention would be of immense importance if it could be applied to steam-boilers to prevent corrosion; and asked if any experiments had been made to ascertain whether the magnetic oxide would withstand the action of hot water and steam, or acids.

Dr. Graham remarked that those who were not acquainted with chemistry might suppose that this magnetic oxide would take up more oxygen and so undergo decay; but of all the oxides of iron there was none so stable as this, and it was capable of doing that which the sesquioxide would not, remaining in the position in which it was formed without disturbing the molecular arrangement of the surface. This was the great invention of Professor Barff, that he had been able to form this black oxide *in situ* without disturbance of the molecular arrangement. It could be applied not only to utensils and other small articles, but to many other purposes, such as iron railings, which were usually let into stone with lead for the express purpose of wearing away by oxidation. He believed the invention had a grand future before it.

Prof. Barff, in replying to the various observations, said that sulphide of zinc was not oxidised in the presence of atmospheric oxygen, and, if it were, it would not set free sulphur. Sulphide of zinc was represented by ZnS, whilst sulphate of zinc was replaced by $ZnSO_4$, so that the sulphide could only become sulphate by taking up oxygen, not by setting free sulphur. Why sulphur was set free in the experiment which had been mentioned, he believed to be because the precipitates were not properly washed from the alkaline sulphides. He could not say the exact proportions in which the materials were used, not having the laboratory books with him. He could only say that the amount of sulphate of baryta was extremely small, the object of using it being simply to keep the particles of the sulphide of zinc separate from one another in the heating process so as to render the mass more pulverulent when ground. The magnesia sulphate was mixed with the zinc sulphate and both were precipitated with an alkaline solution of sulphide of sodium, the consequence being that the magnesia was precipitated as an oxide, and was intimately mixed mechanically with the sulphide of zinc. The magnesia itself had little or no body, it did not take up much space in the bulk, and therefore would not interfere with the opacity which was found to exist in the fine sulphide after it had been calcined. If the sulphide were simply precipitated from an aqueous solution, it went down in a sort of gelatinous state in order to bring the particles together, and alter their molecular arrangement, which it was well known had an important effect both on the colour and transparency of bodies. Mr. Griffiths told him that for a year he had used this sulphide of zinc with water, and therefore he did not anticipate that there would be any change if it were exposed to the action of water, but the experiment could be easily tried. With regard to the iron process, of course three or six months was no trial, if it were classed with other processes which had been used for coating iron, because a coat of paint would last for twelve months; but if that were scraped off anywhere, and oxidation took place, it would rapidly spread underneath, and throw off the paint This was not the case with this process, however, as would be seen by examining some of the specimens where the oxidation would be found to be localised, and not to have spread in any direction. The only point to be considered in reference to its durability was whether the oxide adhered perfectly to the iron, and that had been vouched for by Mr. Ward, because emery cloth would not touch it. Admiral Selwyn had called attention to the fact of the sea-shore being covered with magnetic oxide, which did not rust; and some of the articles on the table had been exposed to the action of salt water, and others to water charged with the acid vapours of the laboratory. No doubt pure hydrochloric acid would affect it, but mixed with nitric acid it would not. Common iron would withstand strong sulphuric acid, but if diluted it would act upon it. In answer to Mr. Penrose, he could not see how the strength of the iron could be affected, as it was never raised to a white heat, and only a film of the surface was affected; but it would be easy, if necessary, to add so much to the thickness of the iron, which had to bear a strain. The temperature could not affect it, because the metal had previously been welded or worked at a much higher temperature, and there was no contact with the steam lower than the oxidised surface. The superheated steam would no doubt penetrate in the course of time, because the pieces of pipe produced by Mr. A. Barff showed that half the thickness had been converted into oxide. A gentleman at Mr. Penn's had promised to get some iron bars tested, but he had not been able to come and make known the results. Water did not affect the iron where the oxidised surface was perfect, but where it was knocked off it did. There was a difficulty about the application of it to ship-plates, because they must be raised to a red heat, or a little above, and it was a question for a practical boilermaker whether that would cause the rivets to start. He had asked one or two, who said they did not think it; but perhaps Mr. Bolling could answer that question.

Mr. Bolling feared the heat would destroy the caulking of the rivets.

Prof. Barff said he was afraid they must, for the present, leave the question of coating iron for ships, but he hoped the difficulty would ultimately be overcome. When they commenced, the number of failures were most disappointing, but his friends, who were assisting him, had stood by him manfully, and he hoped in time, by a continuance of the same pluck and perseverance, they would be able to solve the difficulty, even in the case of boilers and iron ships.

The Chairman then proposed a vote of thanks to Prof. Barff, which was carried unanimously, and the proceedings terminated.

MISCELLANEOUS.

MODES OF TREATING TOWN SEWAGE.*

It will be rembered that, in June, 1875, Mr. Sclater-Booth, as President of the Local Government Board, appointed Mr. R. Rawlinson, Mr. C. S. Read, M.P., and Mr. Smith (Secretary to the late Rivers Pollution Committee) to be a committee to inspect and report on the different systems of sewage disposal now actually in operation. The committee were desired to proceed to the various localities where the systems were being carried out, and to examine the schemes for disposing of sewage, (1) by sewage farms, (2) by land filtration, and (3) by precipitation and by chemical process. The points to which special attention was to be directed were, (1) the character and cost of the works, the rateable value of the district, and the population; (2) the length of time during which they had been in operation; (3) their general effect on the sanitary condition of the district; (4) the efficiency of the works and the quality of the effluent water; (5) the question of nuisance; (6) annual outlay, and capital charges; (7) special details of sewage farms; (8) in other cases the amount realised by the sale of the sewage.

It will be seen that these objects are closely allied to the objects of the Society's Conference on the Health and Sewage of Towns, and this consideration appears to make it desirable to give, in the *Journal* of the Society, some notice of the lately issued report of the commission. It may be noted, in passing, that the Local Government Board have paid a high compliment to the Society's Health Committee, by including, as an appendix to the report, the "Report on the Results of the Society of Arts' Conference on Health and Sewage of Towns, June, 1876."

The length of time which elapsed between the appointment of the committee and its final report may readily be accounted for, by the extent of ground which their investigations covered. Not only did they visit the different English towns which have adopted any of the more recent systems of sewage treatment, but they went on the Continent, to Leyden and Amsterdam, to see the pneumatic system at work; to Paris, where a portion of the sewage is utilised in irrigation; and to Brussels and Berlin, where the sewage is about to be thus disposed of.

The opinions arrived at by the committee, as the result of their observations, are summed up in a page and a half of "conclusions." Then follows the "report" proper, dealing in detail with the subject, under a number of separate heads, and this is followed by a number of special reports on the localities visited. Besides this, there are some miscellaneous appendices, such as a list of patents connected with sewage and manures, from 1856 to 1875; extracts from the Reports of the Royal Commission on Town Sewage, 1858-1865, and from that of the Select Committee on the same subject, 1862; the Society of Arts' Report above referred to; and other matter bearing on the subject.

The conclusions may be summarised as follows:—(1.) The scavenging, sewering, and cleansing of towns are necessary to health, and "these operations involve questions of how to remove the refuse of towns in the safest manner and at the least expense." (2.) The retention of refuse and excreta, in cesspools or elsewhere, is to be condemned, and therefore none of the dry earth or pail systems can be approved. Such systems, however, are permissible for detached houses, country villages, &c., under favourable conditions. (3.) The sewering of towns and the drainage of houses are necessary for the lowering of the subsoil water, the removal of waste water, and the preservation in a clean state of streets, yards, &c. (4.) "Most rivers and streams are polluted by a discharge into them of crude sewage, which practice is highly objectionable." (5.) No system of chemical treatment or subsidence in tanks appears "to effect much change beyond the separation of the solids and the clarification of the liquid." This, however, produces great improvement, and may sometimes be considered sufficient. (6.) No manures manufactured from sewage pay the cost of manufacture, nor has any successful mode of dealing with excreta, so as to pay expenses by the sale of the manure, been observed. (7.) Town sewage can be most readily disposed of by irrigation where local conditions are favourable, but the value of the manure is reduced to the farmer by its being constantly supplied throughout the year, often in greatest quantity when least required. (8.) Land irrigation is not always possible, and therefore other systems must be allowed. (9.) Towns on the sea-coast or on tidal estuaries may, with due precautions, be allowed to drain into the sea or estuary below low water mark.

The report itself begins by discussing the volume, constitutents, and value of sewage. These naturally vary for different localities. The amount of water sent into the sewers forms the chief element of volume. The construction of the drains and sewers has a great effect on the rapidity with which the sewage is delivered, and consequently on its value. Where the pail system is in use, the length of the intervals at which collection is made has a similar effect on the value of the sewage, as also on the wholesomeness of the system. The laboratory value of sewage cannot be realised, on account of the vast quantities of water to be treated, or because the bulk of the solid manure, and its continual production, reduce its market value below the cost of production. The Royal Commission, adopting the estimate of the value of sewage as 2d. per ton, came to the conclusion that a farmer, having to dispose of sewage day-by-day all the year round, could not afford to pay more than a halfpenny per ton, and even this the present committee appear to consider too high a value. Experience shows that there is little practical gain from the separation of the solid matter from the sewage. The excreta does not seem to be rendered more valuable, and the system leaves much liquid matter, which must be treated in the same manner as sewage. Towns also and houses must of necessity be drained to remove surface water, &c.

It is insisted on that the cost of the processes employed ought to be quite a secondary question, the completeness and rapidity of the process being far more important. As to town refuse, it is most valuable when dry.

There are many special difficulties in treating sewage. In Birmingham, 109,500 tons per annum of solid and flocculent matter is separated in tanks, and this sludge is "difficult to manipulate, hard to dry, and unsaleable."

Sewage should never be stored, either in cesspools or in badly-constructed sewers. It should pass away as quickly as possible, if it can be managed, direct on to the land. This is effected by having sewers of proper incline, and by flushing. An average velocity of 2 ft. 6 in. per second will carry away any solids likely to be passed into a sewer.

The report next proceeds to some remarks on the well-known Craigentinny meadows, near Edinburgh, the oldest and certainly not the least successful instance of sewage irrigation. They are referred to as showing that the most rough and ready method of sewage farming need not necessarily create a nuisance or breed any sickness, the neighbouring residents and the work-people on the farm being alike free from any illness which could be traced to the effects of the sewage.

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* Report of a Committee appointed by the President of the Local Government Board to inquire into the several modes of treating town sewage. Presented to Parliament.

As to the money returns from sewage, it appears that these depend entirely on local conditions. In no cases brought under the notice of the Commission has it appeared that the purification of sewage has been effected by chemical treatment, clarification being the only result. Seven-eighths of the sewage salts remain in the effluent, which is, therefore, unfit to be turned into any small watercourse, and the Commission had "no reliable evidence that the solids extracted and made into a portable manure have any paying commercial value." At Birmingham it costs £750 per annum to get rid of the sludge. At Leeds, Coventry, &c., it is still cumbering the works to the extent of thousands of tons. At Halifax and Rochdale the collected excreta mixed with ashes can hardly be disposed of. In London about 600,000 tons daily of sewage are sent into the Thames.

The next topic treated is the pneumatic system of Captain Liernur, and of this the report has little good to say. The towns where it has been tried, Amsterdam, Leyden, and Dordrecht, are not sewered on the English plan, but have surface gutters leading inte the nearest canal or watercourse. The description given of the Liernur system need not be repeated here, as the whole arrangement has been more than once described in the *Journal.* The objections urged are, that the user of the closet has practically no control over it, and cannot empty the pan, the effect being that where a closet is frequently used it is liable to become choked, so that the air-suction will not empty it; the same effect may be produced by pouring slops into the closet. The self-acting apparatus proposed for opening and closing the pan is apt to get out of order and not to act; the manure is in a liquid state, inconvenient, bulky, too rich for distribution over grass lands, and it could hardly pay to dry it as proposed. The price paid by farmers for the manure fell from 6s. 8d. per ton to 1s. 8d. per ton, and even his could not after a time be obtained, If the system could succeed anywhere, it would be in Holland, for various reasons. In conclusion, the report says:—"The pneumatic system is ingenious, but it is complicated in its construction and working arrangements, and consequently it is liable to derangements which are sometimes difficult to mend. We do not know one English town in which the apparatus, if adopted, would be other than a costly toy." The pneumatic apparatus gets out of order, the slightest crack in any pipe or pipe-joint will reduce the force of the partial vacuum, and even when all the apparatus remains sound the closet-pans may not be emptied, and in fact neither the pipes nor the pans even are entirely emptied, the power of air and water to remove solids through pipes being as their relative weights and velocity, and air is to water by weight about as 800 to 1."

Turning again to the general consideration of town sewage, the report proceeds to consider the constituents other than human excreta generally found in it, and its treatment. Sewage confined in sewers or covered tanks ferments, and becomes offensive and dangerous to health, though not so dangerous as might be supposed from its offensiveness. It ought to be applied fresh to land; if stored, the tanks should be of smooth material and not covered. The sludge does not dry readily, but a skin forms on the top, under which the rest remains wet. Artificial drying is too costly; mixing with street-sweepings and ashes is the most successful method of dealing with sludge.

Disinfection of sewage is impracticable, costing about 1s. per cubic foot, or 27s. per ton of sewage treated.

Cleaning out foul and unventilated sewers or tanks is always dangerous, but specially so in times of disease.

The application of town sewage to land is the cheapest way of dealing with it. At first a rate in aid may be required for purchasing land and constructing works, but in most cases the farm will, after the first, produce an income. The sewage grass is wholesome. The application of the sewage should not produce malaria. The rent of land used for sewage farms is in some cases excessive. At Croydon the rent paid is £10 per acre for land formerly rented at 25s. to 30s.

Some details as to the proper arrangement of a sewage farm are then given, followed by some remarks on the area of the land required. It appears that—with suitable conditions—each day's sewage throughout the year can be disposed of.

The next part of the report deals with drains and water-closets. It begins with some observations as to the proper construction of these, and then gives some statistics as to the comparative numbers of closets in different towns.

Recurring to the question of sewage clarification, the report refers to cases when this, even without purification, is useful, as in manufacturing districts where water, clean or foul, must be had for the steam boilers. The average cost of the chemical treatment of sewage is £150 for each 100,000 gallons, or $\frac{3}{4}$ths of a farthing per ton.

The concluding portion of the report is headed "Details as to Irrigation by Town Sewage," and gives some further instructions as to the proper arrangements and the most suitable crops for sewage farms. As the Commissioners have throughout advocated the application of sewage to land, they think it right to point out some of the drawbacks to this method of its application. Only certain soils are available for it; there are many practical hindrances, and but little experience has yet been obtained in the management of sewage farms.

CORRESPONDENCE.

STREET TRAMWAYS.

Having been engaged for four years in designing and manufacturing locomotive engines for tramways, I regret not being present at the last meeting of your Society, when a paper was read upon the subject by Capt. Galton.

It must have been well known to some of the gentlemen present, that mine was the only successful steam-engine worked on the Vale of Clyde Tramway, and also that I have just completed an engine for the Wantage Company, which only awaits the official inspection of the Board of Trade before it is forwarded to Wantage.

I shall be obliged if you will insert this letter in your next issue, feeling sure that your Society wishes to encourage manufactures in general, and not manufacturers in particular.

Henry Hughes.

NOTICES.

PROCEEDINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday evenings, at 8 o'clock. The following arrangements have been made:—

February 21.—Lecture, by Sir John Lubbock, Bart., M.P., F.R.S., on "Certain Relations of Plants and Insects."

February 28.—"Middle Class Education in Holland," by John Yeats, Esq., LL.D., F.R.G.S.

March 7.—Lecture on "The Growth and Present Position of the Science of Mechanics," by Professor A. B. W. Kennedy, C.E.

March 14.—"The Treatment of Town Refuse and Sewage," by Prof. Ansted, F.R.S.

March 21.—Lecture on "Vital Air," by Dr. W. B. Richardson, F.R.S.

African Section.

Tuesday evenings, at 8 o'clock. The following arrangements have been made:—

March 13.——"Our Commercial Relations with West Africa, and their Effects upon Civilisation," by James Irvine, Esq., of Liverpool.

April 10.—"The Social State and Prospects of the South African Communities," by Robert Richards, Esq., of Grahamstown.

April 24.—"The Trade and Resources of Morocco," by Dr. Arthur Leared.

Indian Section.

Friday evenings, at 8 o'clock. The following arrangements have been made:—

February 16.—"Indian Railways," by Juland Danvers, Esq. The Right Hon. the Earl of Northbrook, G.C.S.I., will preside.

March 2.—"The Progress of Trade in Central Asia," by Sir T. Douglas Forsyth, C.B., K.C.S.I. Sir Rutherford Alcock, K.C.B., will preside.

March 16.—"The Native Indian Press," by Dr. George Birdwood, C.S.I. Andrew Cassels, Esq., will preside.

April 20.—"The Existing and Possible Commercial Communications between Persia and India," by Major-General Sir Frederick John Goldsmid, C.B., K.C.S.I.

Chemical Section.

Thursday evenings, at 8 o'clock. The following arrangements have been made:—

March 8.—"The Sizing of Cotton Goods," by W. Thompson, Esq., F.C.S., of Manchester.

April 12.—"The Cinchona Alkaloids; their Sources, Production, and Use," by Dr. B. H. Paul.

Owing to an unfortunate accident, Mr. Vincent is too unwell to read his promised paper on "Spontaneous Combustion," on the 22nd inst. The meeting announced for that date will in consequence be postponed.

Science Lectures.

These will be given on the following Wednesday evenings, in place of the usual paper and discussion. The rules for admission will be the same as for the Cantor Lectures. Each member can admit ONE friend by giving the usual order from the book supplied at the commencement of the Session:—

February 21.—Sir John Lubbock, Bart., M.P., F.R.S., "Certain Relations of Plants and Insects."

March 7.—Professor A. B. W. Kennedy, C.E., "The Growth and Present Position of the Science of Mechanics."

March 21.—Dr. B. W. Richardson, F.R.S., "Vital Air."

April 18.—E. J. Reed, C.B., M.P., F.R.S., "The Modifications which Ships of War have Undergone during the last 20 Years."

May 2.—J. Baillie Hamilton, "New Musical Instruments."

May 16.—Professor W. K. Clifford, F.R.S.

MEETINGS FOR THE ENSUING WEEK.

Mon. ...British Architects, 9, Conduit-street, W., 8 p.m. Mr. A. Waterhouse, "Description of the Manchester Town Hall."

Medical, 11, Chandos-street, W., 8.30 p.m.

Asiatic, 22, Albemarle-street, W., 3 p.m.

Victoria Institute, 10, Adelphi-terrace, W.C., 8 p.m. Mr. E. J. Morshead, "Comparative Philology."

London Institution, Finsbury-circus, E.C., 5 p.m. Prof. Armstrong, "Modern Agriculture." (Lecture II.)

Social Science Association, 1, Adam-street, Adelphi, W.C., 8 p.m. "Report of the Municipal Law Committee on the Evidence of Prisoners and Defendants, and Wives and Husbands in Criminal Proceedings."

Tues....Royal Institution, Albemarle-street, W., 3 p.m. Prof. Garrod, "The Human Form; its Structure in Relation to its Contour." (Lecture VI.)

Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Renewed Discussion on "The Sewage Question."

Statistical, Somerset House-terrace, Strand, W.C., 7¾ p.m. Mr Conelius Walford, "Fires and Fire Insurance, Considered under their Historical, Financial, Statistical, and National Aspects."

Pathological, 53, Berners-street, Oxford-street, W., 8½ p.m.

Zoological, 11, Hanover-square, W., 8½ p.m. 1. Prof. Owen, "Additional Evidence of the Genus *Dromornis* in Australia." 2. Dr. G. E. Dobson, "A Collection of Chiroptera Made by Mr. G. Brown on Duke of York Island, and on the Adjacent Parts of New Ireland and New Britain." 3. Mr. Osbert Salvin and Mr. F. Du Cane Godman, "A Collection of Lepidoptera, made by Mr. George Brown, on Duke of York Island and its neighbourhood." 4. Mr. Sclater, "A Collection of Birds Made by Mr. George Brown, on Duke of York Island and the Adjoining Coasts of New Britain and New Ireland."

Wed....**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Science Lectures.) Sir John Lubbock, Bart., "Certain Relations of Plants and Insects."

Meteorological, 25, Great George-street, S.W., 7 p.m, "Opening Address," by the President, Mr. H. S. Eaton. 1. Mr. William F. Stanley, "Barometrical and Thermometrical Clocks for Registering Mean Atmospheric Pressure and Temperature." 2. Mr. James J. Hicks, "Solar Thermo-Radiometer." 3. Mr. James J. Hicks, "An Improvement in Minimum Thermometers for Terrestrial Radiation."

Geological, Burlington House, W., 8 p.m.

Royal Society of Literature, 4, St. Martin's-place, W.C., 8 p.m. Prof. Zerffi, "Slavonic Literature."

Archæological Association, 32, Sackville-street, W., 8 p.m.

Thur....Royal, Burlington House, W., 8½ p.m.

Antiquaries, Burlington House, W., 8½ p.m.

London Institution, Finsbury-circus, E.C., 7 p.m. Mr. W. R. S. Ralston, "English Nursery Tales." (Lecture I.)

Society for the Encouragement of the Fine Arts, 9, Conduit-street, W., 8 p.m. Mr. G. F. Teniswood, "English Landscape Art in the Past and Present Century."

Royal Institution, Albemarle-street, W., 3 p.m. Mr. William Pole, "Theory of Music." (Lecture II.)

Inventors' Institute, 4, St. Martin's-place, W.C., 8 p.m.

Zoological, 11, Hanover-square, W., 4 p.m.

Philosophical Club, Willis's-rooms, St. James's, S.W., 6½ p.m.

Fri.......Royal United Service Institution, Whitehall-yard, 3 p.m. Lieut.-Colonel C. B. Brackenbury, "The Value of Systematic Instruction in Tactics for all Ranks of the Army."

Royal Institution, Albemarle-street, W., 8 p.m., Weekly Meeting; 9 p.m.

Royal College of Physicians, Pall-mall, E., 5 p.m. (Gulstonian Lectures.) Dr. Lander Brunton, "Pharmacology and its Relations to Therapeutics." (Lecture I.)

Quekett Microscopical Club, University Coll., W.C., 8 p.m.

Clinical, 53, Berners-street, W., 8½ p.m.

Sat.......Trades' Guild of Learning and National Health Society (at the House of the Society of Arts), 8.30 p.m. Prof. W. H. Corfield, "The Laws of Health." Part II. (Lecture V.)

Royal Botanic, Inner Circle, Regent's-park, N.W., 3¾ p.m.

Royal Institution, Albemarle-street, W., 3 p.m. Prof. Henry Morley, "Effects of the French Revolution upon English Literature."

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JOURNAL OF THE SOCIETY OF ARTS.

No. 1,266. Vol. XXV.

FRIDAY, FEBRUARY 23, 1877.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

PATENT LAW REFORM.

A Conference will be held on Monday, the 6th March, by the Society of Arts, for the purpose of discussing the provisions of the Patent Law Amendment Bill, now before the House of Commons. The subject will be introduced in a short paper by Mr. H. Trueman Wood, the Assistant-Secretary of the Society, and Resolutions will be proposed to the meeting for adoption.

INDIAN SECTION.

Friday, February 16th, 1877; the Right Hon. the Earl of Northbrook, G.C.S.I., in the chair.

The Chairman said—The subject of Indian railways is not only one of great consequence to the administration of India, alike in its commercial, political, and military aspects, but it is also one of great interest to the people of this country, because 90 millions of English money have been invested in these railways. Mr. Juland Danvers, twenty years ago, succeeded a man of great ability, Sir James Cosmo Melvill, as the Government Director of Indian Railways. That office is one which requires considerable knowledge of business and great tact, and I can say, from what I know and what I have heard, that Mr. Danvers has performed his duties to the entire satisfaction both of the Government and of the companies. Some eighteen months ago he most properly thought it would add to his usefulness if he made a personal inspection of the railways. He, therefore, went out to India, and traversed and examined, in conjunction with Mr. Rendel, all or nearly all the railways which were either constructed or under construction. Therefore I think there is no man who, from his acquaintance with the subject, and from his personal knowledge, is more capable of giving information upon the subject of Indian railways than Mr. Danvers.

The paper read was :—

INDIAN RAILWAYS.

By Juland Danvers, India Office.

In addressing the members of the Society of Arts, it is needless to dwell upon the importance of applying to every country that most necessary of all practical arts, the formation of communications. It may be laid down as an axiom that the nation which has been best provided with the most suitable means of conveyance, within and without its territory, has made the greatest advance in civilisation and prosperity. There are two ways by which communications may be carried on, viz., by land and by water. In many places, and for many purposes, rivers and canals afford the readiest and cheapest mode of internal transit; but the former are only available, and then only when navigable, for places situated on or near their banks; the latter can only be constructed when the water is at hand to fill them, and where the gradients of the country favour its flow. The great advantage of land communication is that it can be formed wherever it is wanted; that it can unite towns and military posts by the shortest routes; that it ensures speed and punctuality, and that it is more free from interruptions.

There should, however, be no rivalry between land and water, between canals and railways, in India. On the contrary, there should be close alliance and well-arranged co-operation. The one will fertilise the land, the other will convey the produce where the river or canal cannot take it. Many important towns and many districts, rich in mineral and agricultural produce, would be cut off from each other, and from their nearest port, if they depended upon water. Even where rivers exist it has been found necessary to construct railways. In England no new canals have been cut since railways were introduced, and some canals have been converted into railways. The establishment of flotillas of steamers on the navigable parts of the Thames, Rhine, Seine, and other rivers, did not prevent the necessity for constructing railways along their banks. In India we have the example of the Indus. For some time it was attempted to carry on the traffic between the port of Kurrachee in Scinde, and Lahore in the Punjab, by the joint instrumentality of the two railways in those provinces, and the flotilla on the river between Kotree and Moultan, but the navigation was difficult, slow, and perilous, and the service was inadequately performed. It has, therefore, been superseded by a railway.

The object of these prefatory remarks is simply to point out that India would have been deprived of an important and necessary aid to advancement if she had not been supplied with railways. I do not for a moment wish to imply that canals are not equally important and necessary in their proper place. I would only say that by the judicious combination of the two the future resources of the country would be found incalculable. An enormous amount of virgin soil might be brought into cultivation; the failures of crops would not be of such common occurrence as they are now, and, if scarcity were to prevail in any districts, the products of more favoured parts of the country could be conveyed to them. Famines, in fact, would not be known, and the general wealth, prosperity, and comfort of the people would be promoted. We have already had instances where canals and railways have gone hand in hand to avert suffering and famine. The scarcity which followed the drought in the North-West Provinces, in 1860, and in Bengal in 1874, would certainly have been accompanied by famine if it had not been for the joint action of canals and railways.

Before describing the railways of India and their effects, it may be useful to take a glance at the country anterior to their establishment. Any history of the material progress of India may well be divided into a pre-railway and a post-railway period. Since their introduction India has made great strides, partly through their instrumentality and partly through contemporaneous causes. For some time after British supremacy had been acknowledged, little was done in the shape of forming good and reliable communications. Fifty years ago the highway from Calcutta to the North-West Provinces was the river. The interesting journals of Bishop Heber and other travellers of those days describe the time occupied and the dangers and difficulties encountered on the journey. Any attempt to go from Southern India to Delhi or Lahore by land was not thought of. It would have occupied an ordinary traveller months, nay more than a year, for he could only move with comfort and safety to health in the cool season. Now it could be accomplished with ease in a week. The physical features of the country offered difficulties which were insurmountable by the ordinary traveller. Within the period I have mentioned—viz., in 1830—Sir John Malcolm, then Governor of Bombay, was opening for the first time a cart road which had been made up the Bhore Ghât, and spoke of it as a work which was "to break down the wall between the Concan and the Deccan." It was regarded as a magnificent engineering feat. What would have been thought by those who rejoiced on this occasion of the railway which, within the period of a generation after, was taken over the same barrier and opened by Malcolm's worthy successor, Sir Bartle Frere, amidst a similar flourish of trumpets? There were obvious reasons why we were backward in prosecuting public works in India. Wars, internal commotions, our political relations with native states, the settlement of newly-acquired territory, occupied and engrossed the attention of the Government and its officers. The want of money also, and the absence of suitable materials for road making, especially in the Bengal Presidency, were serious impediments. It must, moreover, be admitted that there was wanting that recognition and due appreciation of the importance and value of well-chosen public works which characterises our administrators of the present day. It was not unnatural, therefore, nor without some cause, that, in answer to observations which were made on the scarcity of communications, the authorities dwelt upon the fact that, for a third of the year, the whole country might be regarded as a road, that they made the most of the few hundred miles of pucka road which existed, and argued that for the general use of the country fair weather tracks only were required.

As the political atmosphere became clearer and quieter, a stronger sense of the necessity for extended communication was entertained, and a systematic commencement was made with roads and with works of irrigation. Just as railways were on the eve of being introduced, several well-constructed highways had been established, and canals had been cut. In 1850 about 3,200 miles of metalled trunk roads, and 1,800 miles of canal, were in existence. This, of course, was a mere scintilla of what was required, and was by no means commensurate with the social and commercial wants of the community.

Up to this time the question of introducing railways into India had only formed the subject of discussion and controversy. Railways, after all, are nothing more than the best known means of carrying on communication by land. But what with prejudice, timidity, and a dread of spending money beyond the usual limits of military and naval establishments, civil administration and jails, there was considerable difficulty in persuading some even to believe that railways were good for India. The first serious proposal to introduce them was, curiously enough, treated almost with derision by some of those who were, or who were thought to be, the best judges of the country and people. "The railways," said they, "might possibly be made; but the natives will not use them." Then came the bugbear of physical obstructions, and after that the money difficulty. All this may appear to us frivolous and weak, but the irresistable force of facts and examples, used by men of energy and perseverance like Macdonald Stephenson, John Chapman, W. P. Andrew, and others, as well as by some in the service of Government who were fully alive to the importance of the work, were required to bring the matter to a point.

When at last it was decided that railways should be made in India, it is not to be wondered, after all that had occurred, that the first step was a cautious and tentative one. It was a question whether the lines decided upon should be taken in hand by the State itself or by joint-stock comcompanies. The latter agency involved the necessity for State assistance and control, and all the inconveniences and complications of a double system. It, nevertheless, had its advantages. The chief reasons for preferring it were that Government was doubtful of its own power to undertake works of this character; that objections were entertained in those days to the raising by the East India Company of money for such purposes in England; that it was desirable to introduce into India private enterprise in some shape, even although its spirit might be damped by the guarantee of a certain return on the capital embarked; and that a permanent body like a London company could be better depended on for the appropriation of funds specially raised for a railway than the Government itself. The Board of Control were very strongly in favour of employing companies; the Court of Directors were not so. But it was plain that more delay would occur if some agreement was not come to, and all were now anxious to see a commencement made. It was accordingly settled, after a prolonged negociation with the East Indian Railway Company and the Great Indian Peninsula Railway Company, that an experimental line of about 100 miles in Bengal should be committed to the former, and of 50 miles in Bombay to the latter. Interest at the rate of 5 per cent. per annum was guaranteed on £1,000,000 for the line from Calcutta, and on £500,000 for that starting from Bombay. A complete Government control over the proceedings of the companies was provided, and such provisions made for giving a share of profits to the shareholders in the event of successful management, as, it was hoped, would counteract the enervating effects of an assured minimum rate of interest. I do not propose to discuss at any length the merits or demerits of this arrangement. I know that the policy which dictated it has been objected to; that the guarantee system is regarded by some with aversion, and that it has been condemned. I rejoice that the necessity no longer exists for resorting to it, but, with all its objections, it was on the whole the most practicable one at the time. The delays and failures which had occurred in operations undertaken by the Public Works Department, the habits which had been acquired of commencing works and making no provision for completing them, the reversal by one superintendent or commissioner of a district of the policy of his predecessor, all concurred to show that the organisation of the department was not such as qualified it to take in hand the railways of the country. The financial difficulty was greater still. The only sure way of raising money as it was wanted, and of securing its application to the object in view, was through the instrumentality of companies. This alone was an immeasurable advantage, and has been acknowledged as such by many who are most opposed to the system. I have only further to say that Lord Dalhousie, who, besides his powers of administration, was not a man to do anything without good reasons and without much reflection and deliberation, recommended the employment of guaranteed companies for carrying out the scheme of main lines over the country which he submitted, and which I believe would not have been brought to its present state of completion under any other plan. After Lord Dalhousie's recommendations arrived in Leadenhall-street, much remained to be done. I happened to be behind the scenes, and witnessed the difficulties as they cropped up one after another, and it was fortunate for India that there were men at hand like Lord Broughton and Sir Charles Wood,* Sir James Melvill, Sir James Hogg, and Mr. James Wilson, who, with willingness to drop minor points of difference, had the practical sagacity to arrive at conclusions by which the object they all had at heart should be accomplished.

The trunk railways proposed by Lord Dalhousie were selected with the view of securing the greatest political and commercial advantages. Commencing in the south at the port of Beypoor, on the western coast, a line stretches across to Madras, with branches to the foot of the Neilgherries and to Bangalore. A line proceeds thence in a north-westerly direction to Bombay, and from that city crosses the central provinces of India viâ Jabbalpur to Allahabad, throwing out a branch to Nagpur. At Allahabad it meets the great line which extends from Calcutta to the north-west frontier, *viâ* Agra, Delhi, and Lahore. A line was also laid out commencing from Bombay and going north, its ultimate terminus being Delhi. This latter line has only proceeded at present so far as Ahmedabad in a northerly direction, but a metre gauge State line has been brought down to Ajmere from Agra and Delhi, the important gap between Ajmere and Ahmedabad being in the category of those which have been sanctioned, and will be commenced when money is forthcoming. Lord Dalhousie described this line as of the "greatest political and commercial value" more than twenty years ago. It certainly has not diminished in value since that time, and in addition to the objects just mentioned, the prevention of a repetition of famine in the districts through which it will pass may well be borne in mind. Famines have cost, and one at this moment is unhappily costing, the country millions. Money disbursed on these occasions is necessarily spent hurriedly, lavishly, and perhaps wastefully, whereas, if applied to canals, irrigation works, and railways, well chosen and economically constructed, it would afford better means of relief when scarcity occurred, and would produce revenue to the State out of the increased traffic receipts. As an illustration of this, I have only to refer to the traffic on the East Indian Railway for the years preceding and following the scarcity of 1874. The total amount received in 1873 and 1875 together, from the class embracing grain, was £1,331,400. In 1874 it was £1,385,000, or more than double the average of the other two years. The amount of grain moved to the famine-stricken districts, was 800,000 tons.

The gauge fixed upon for the original trunk lines was five feet six inches. It is easy to be wise after the event and to be critical when experience has been gained. It does not, therefore, show any particular sagacity to say of Lord Dalhousie's grand scheme that, in some cases, the alignment might have been more suitable, and that it would have been better if the gauge of English lines, as was proposed by the Court of Directors, had been adopted. Lord Dalhousie himself would probably have said the same if he were now alive. At that time the Court of Directors were thought to be rather behind the age in proposing so old fashioned a gauge as the four feet eight inch; and in India the question was, not whether five feet six inches was wide enough, but whether six feet would not be better. The five feet six inches was, in fact, a compromise.

A decided and determined commencement was thus made in the work of constructing a comprehensive scheme of railways, which should provide India with main lines of communication, and form a basis for future ramifications. With the exception of the larger rivers and the Western Ghâts, the natural features of the country did not present very serious difficulties. The course of the lines was chiefly across extensive plains and through valleys. The obstacles just referred to were, however, of no ordinary character. I have already alluded to the lines which were taken over the mountain barrier separating Bombay from the Deccan, the first running parallel with, although at an average of some fifty miles from, the coast for many miles. The works on these ascents are magnificent monuments of engineering skill and perseverance. The crossing by the Thull Ghât on the North-Eastern line of the Great Indian Peninsula Railway is 1,912 ft. above the level of the sea; that by the Bhore Ghât, on the South-Eastern line, is at an elevation of 2,037 ft. The Thull Ghât incline is nine miles in length; the steepest gradient is 1 in 37, for upwards of four miles; the sharpest curve is 15 chains radius, for 20 chains 50 links; the length of tunnelling is 1,962 yards. The Bhore Ghât incline is fourteen miles in length; its average gradient, 1 in 48; its steepest gradient is 1 in 37 for 1 mile 38 chains, and 1 in 40 for 8 miles 6 chains; its sharpest curves, one of 15 and two of 20 chains radius; its length of tunnelling, 1 mile 44 chains. The cost has been at the rate of from £50,000 to £60,000 a mile. These were formidable and expensive works; but the rivers of India are what have puzzled and thwarted the engineer, and upset his calculations, more than anything else. Bridges have been broken down and swept away by the floods, and their foundations, even when laid sixty feet below the bed of the river, have been undermined by the water. We have very little idea, in this country, of such tremendous forces, and they were scarcely expected in India; at any rate, they were not understood. The shifting character of these streams has also been a source of expense and trouble. While the bridge over the Sutlej was being constructed, the river, which had been flowing for eighty years along the north side of the valley, changed its course to the south, and the length of the bridge had to be increased in consequence from 4,000 ft. to 6,200 ft. At Goalundo, also, the terminus of the Eastern Bengal Railway, notwithstanding that £100,000 had been expended on protective works, the ground on which the station buildings stood disappeared in the course of a week, and was carried down by the two great rivers which here meet, to be added to the deposits at their delta. The bridges which carry the East Indian Railway over the Jumna, at Allahabad and Delhi, and over the Soane, are magnificent structures, and have remained firm and safe since they were put up. A list of the principal bridges and their dimensions is given in a table appended to this paper. They are constructed generally of iron girders placed on well foundations made of stone, brick, or iron cylinders. The railroads are constructed generally with a single line only. Out of a length of 6,760 miles now open, about 800 miles only are double. The original gauge was, as I have already stated, five feet six inches. A narrower gauge of the width of a metre has since been introduced, and many of the State lines, as well as the South Indian Railway Company's system, are made on the smaller scale. I will only venture to say one word on this very controversial point. The object of adopting the narrower gauge was to ensure economy, and to enable India to be supplied with an extended system of railways at the cheapest possible rate, it being a question in some cases whether there should be light narrower gauge lines or none at all. I may be allowed to add in passing, that the narrow gauge lines over which I travelled in India, were as steady and smooth as the others, and there need be no apprehension as to their not being easy and comfortable if properly worked. The rails vary in weight from 84 lbs. to 40 lbs. to the yard. Latterly, in consequence of the cheapness of steel, many rails have been sent out of that material. Iron is used for sleepers where the soil is suitable for packing. Incredible as it may seem, India failed to supply wood for its own sleepers, and it has been found necessary and more economical to send out Baltic wood creosoted than to use that grown in the country. The materials sent from this country to India for the railways include all the iron and machinery, as well as stores of every description. Even grease for lubricating purposes has been sent out; but country oil is now universally used. The weight of these materials had reached to about 5,250,000 tons, and their value amounted to £35,000,000, up to the end of last year. All this had been sent out since 1850. In the early stage of operations, one great difficulty was the inland transport of this mass of dead weight, and a large outlay was incurred in the process. The ease with which this is now performed is an enormous aid to the progress of future lines.

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* Now Lord Halifax.

The first railway in India was opened in April, 1853, the last by H.R.H. the Prince of Wales, the President of this Society, in December, 1875, when at Madura, in Southern India. The line first opened started from Bombay, and went to Tannah, a distance of 22 miles. The next year it was extended a length of 13 miles to Callian, near which place the line bifurcates, and proceeds over the two ghâts in south-east and north-east directions. In the same year, the first thirty-seven miles of the East Indian Railway, extending from Calcutta to Raneegunj, were opened. In 1855, a length of 171 miles had been completed, 120½ in Bengal, and 50½ in Bombay. The next year Madras contributed 65 miles. Five years afterwards (in 1860) 836 were open, including 368 of the East Indian, 297 of the Great Indian Peninsula, 35 of the Bombay and Baroda, and 136 of the Madras. In 1861, the Scinde line from Kurrachee to Kotree (105 miles) was opened, as well as 49 miles of the South Indian, and in the following year 110 miles of the Eastern Bengal, and 15 of the line from Calcutta towards the Mutlah were finished. In 1862, the first narrow gauge and lightly constructed line was opened, joining Moorshedabad with the East Indian Railway at Nalhati. By this time, the East Indian Railway Company had completed upwards of 830 miles, the Great Indian Peninsula 495, the Madras 447, and the Bombay and Baroda 185, making altogether 2,352 miles. Progress for the next five years proceeded at the rate of about 200 miles a year, and, in 1865, 3,368 miles were open for traffic. Many of the lines were still disjointed, and through communication between the principal cities and the seats of the various Governments had yet to be completed. The year just mentioned was, however, memorable for the completion of the splendid bridge over the Jumna, at Allahabad, and through it of a continuous line of 1,020 miles from Calcutta to the left bank of the Jumna at Delhi. In the following year that city was connected with the railway by the bridge across the river. In the year 1870, the completion of the last section of the North-Eastern line of the Great Indian Railway enabled the whole line between Bombay and Calcutta to be opened for traffic. The distance by the route then established was 1,470 miles. This was reduced to 1,400 in the following year, when the Chord line of the East Indian Railway was finished. In 1871, the line across the southern part of the peninsula joining Bombay with Madras was completed. The opening of the last section on the Punjab and Delhi line also established uninterrupted railway communication between Calcutta and Lahore and Moultan, and thus was the system of trunk lines laid down by Lord Dalhousie carried to completion. Upwards of 5,000 miles of railway were at this time open in

India. In the five years which have followed, that length has been increased to 6,760, principally by the system of lines in the provinces of Oude and Rohilkund, 542 miles, on the standard gauge; the lines from Delhi and Agra going south through Rajpootana by Ajmere, which have been constructed on the metre gauge, and are worked by the State; and by 520 miles belonging to the South Indian Railway Company, whose system, also constructed on the metre gauge, will extend from Madras to Tuticorin, and include the line formerly called the Great Southern of India Railway, going from Errode, on the Madras Railway, *viâ* Trichinopoly, to Negapatam.

Subjoined is a list of all the railways, small and great. [A sketch map on the wall exhibited their course.]

	Gauge.	Length of Line sanctioned.	Total length opened.	Portion laid with Double Line.	Length remaining to be finished.	Capital Cost.
GUARANTEED.	ft. in					£.
East India:—						
Main line	5 6	1,280	1,280	414¾	...	27,200,000
Jabbalpur line		223¾	223¾	...	...	3,300,000
Great Indian Peninsula......	5 6	1,278¾	1,278¾	327	...	23,500,000
Madras	5 6	856¾	856¾	...	...	10,250,000
Bombay, Baroda, and Central India	5 6	408	408	21⅔	...	7,750,000
Scinde, Punjab, and Delhi ...	5 6	663¾	663¾	4½	...	11,000,000
South Indian	3 3⅜	617¾	527¼	...	90	3,700,000
Eastern Bengal ...	5 6	159¾	157½	...	...	3,000,000
Oudh and Rohilkund	5 6	711	542¾	...	168¼	5,500,000
STATE.						
Nalhati	4 0	27½	27½	...	...	30,000
Calcutta and South-Eastern	5 6	28	28	...	...	690,000
Northern Bengal.	3 3⅜	358½	...	...	358½	Unfinished
Punjab Northern.	5 6	267½	62	...	267½	
Indus Valley	5 6	508	..	...	508	
Rajputana (Agra and Delhi to Nasirabad)	3 3⅜	402	402	...	...	2,500,000
Neemuch (Indore to Neemuch)	3 3⅜	302½	...	...	302½	Unfinished
Indore to Khandwa (Holkar's)	3 3⅜	85½	57	...	28½	
Patri branch of Bombay, Baroda, and Central India Railway ...	5 6	22½	22½	...	...	Unfinished
Wurdha Valley	5 6	76	18	...	58	
Tirhut	3 3⅜	93	44	...	49	
Rangoon and Irrawaddy Valley	3 3⅜	371	...	...	371	
Sindia (Agra to Gwalior) ...	5 6	72	...	...	72	
West Rajputana	3 3⅜	314¾	...	...	314¾	
Magpur and Chattisgarh...	3 3⅜	123½	...	...	123½	
BERAR.						
Khamgaon	5 6	7½	7½	...	...	48,600
Amraoti	5 6	5½	7½	...	...	30,600
NIZAM'S GOVERNMENT.						
Wadi to Hyderabad and Secunderabad	5 6	121	121	...	...	1,150,000
PROVINCIAL.						
Muttra and Hathras	3 3⅜	30	30	...	...	93,000
Total	...	9,415¾	6,764	768	2,651	

It is well known that, under the contracts with the companies, the Government have the power to purchase the undertakings on certain specified terms, the amount to be paid being regulated by the average price of the stock during three preceding years, and the sum so arrived at being payable at the option of the Government in a lump sum or in the shape of an annuity. The following are the dates at which the different railways come under the operation of this provision:—

The East Indian main line......	15th February,	1879.
" " Jabbalpur line	21st April,	1883.
Great Indian Peninsula	17th August,	1899.
Madras	1st April,	1907.
Bombay, Baroda, and Central India	1st May,	1905.
Scinde, Punjab, and Delhi	1st January,	1885.
Eastern Bengal................	30th July,	1883.
South Indian..................	1st March,	1890.
Oudh and Rohilkund	2nd August,	1887

It will be easily understood that all the great undertakings have not been carried out without much human exertion, both of mind and body, and without a large expenditure of money. The professional work done by the engineer, both civil and military, has not been light. He not only had to overcome the natural physical difficulties of the country, to which allusion has already been made, but he had to submit to a hostile climate and to the pestiferous vapours of the jungle. The labour at his command was inferior to what he had been accustomed, and at first difficult to manage. Separated sometimes hundreds of miles from head-quarters, and frequently 30 or 40 miles from the nearest European habitation, he had to depend on his own resources in a great measure and to make the best of poor materials. The wayside graves bear evidence to the loss of many a valuable life. The Mutiny overtook many more while helplessly engaged in the execution of their work, and on a single tablet in the Memorial Church at Cawnpore I counted the names of 19 engineers who had fallen by the hands of the mutineers. I could not help thinking that these men died as nobly as if they had fallen in the field of battle. Some indeed did good service. It will not soon be forgotten how, at the famous defence of Arrah, Boyle and others connected with the staff of the East Indian Railway, in company with Wake and his companions, succeeded in keeping the enemy at bay until relieved by Sir Vincent Eyre.

Besides the well-known names of Berkly, Bruce, Brereton, Brunton, Campbell, Graham, Harrison, LeMessurier, Bradford-Leslie, Logan, Manning, Mathew, Prestage, Purdon, Purcell, Rendel, Sibley, Turnbull, Hardy Wells, and Barton-Wright, who were in the service of the companies, the distinguished corps of Royal Indian Engineers contributed some of its most able men to the work. There were Baker, Beadle, Chesney, Crawford, De Bourbel, Dickens, Drummond, Greathead, Hancock, Johnson, Luard, Kennedy, Pears, Peile, Pollard, Killow-Pye, Rivers, Stanton, Shaw-Stewart, Strachey, Taylor, Trevor, Yule, and White, all of whom have been some time or other engaged in railway work or administration. It may be safely said that India will never cease to feel the effects of their labours.

We now come to the cost, the capital cost of these 6,760 miles of railway, with their 700 stations, 1,400 locomotives, and 30,000 vehicles of all kinds. It will be convenient, first of all, to define what the capital is which I propose to take as representing expenditure on this head. I do not include in it the guaranteed interest which has yet been unpaid by the companies; nor the loss incurred by Government by the fixed rate of exchange; nor the price of the land; although I must admit that the two latter have formed a real part of the cost borne by the State. The loss by exchange has been a contribution by the Government, and has amounted altogether, after making deductions for gains, to something like £2,000,000. It came to pass in this way. When the contracts were entered into, the rate of exchange for the rupee was 1s. 10d., and it was stipulated that for every 1s. 10d. received by the Government in England they should advance to the companies a rupee in India. The value of the rupee gradually rose, however, as the railways advanced, and at length the Government found themselves giving a rupee, which was equal to 2s., for the 1s. 10d. they received. Some consolation for this sacrifice was then felt in the expectation that the turn of the Government would come when the railway receipts were paid into their treasuries, for then would the Government, in the same way, receive rupees worth 2s. in India and credit the companies with 1s. 10d. in England; but the Government were doomed to be unfortunate. No sooner did the railways begin to earn respectable revenues than the exchange again fell, not only to 1s. 10d., but far below that rate, incurring further loss by the very operation through which the Government expected gain. The Government have, however, gained to the extent of about £500,000, through the higher rates of 1s. 11d. and 2s. having been fixed upon with some companies. Whether their losses in the end will be wholly recovered it is impossible to say, and it would certainly be unsafe to predict.

The value of the land is, of course, an essential part of the first cost of the railway, and ordinarily would be a capital charge. It is not, however, included in the capital accounts of the companies, as one of the conditions of the contracts is that the land is granted free. The exclusion of the sums representing these items will not, perhaps, be considered as giving so very unfair an advantage to the railways as would appear to be the case, if it is borne in mind, when making up the accounts, that the companies are not credited with what might have been earned from mails and troops, had not the former been carried free, and the latter at reduced charges, for the Government.

The unrepaid guaranteed interest should not, I think, be regarded as capital. True, it is not interest earned, and it is a gift, *pro re ratâ*, to the shareholder; but the capital of a railway, or any work, is, I take it, the actual amount which, on its completion, has been expended on it. If railways had been made by Government with borrowed money, their capital accounts would not have been charged with the interest accruing on the loans which fell short of the receipts. And if a man builds a house, and finds that the rent gives him two instead of five per cent., he does not year by year look upon his house as having cost the amount of the difference in addition to the original outlay. I propose, therefore, to take as the capital cost of the railways only what I find entered as such in the accounts.

These show that the guaranteed lines now open have cost in round numbers £94,000,000, and the State lines about £12,000,000. This gives an average of about £15,600 a mile. But some have cost much less than others. The cheapest line hitherto has been the Rajpootana, a metre gauge line, which has cost so far about £6,000 a mile; the most expensive, the Bombay and Baroda, which will be upwards of £20,000, although portions of this line have recently been constructed at the lowest figure yet reached, viz., £1,000. The outlay on the East Indian has been about £20,000; on the Great Indian Peninsula, £17,800; and on the Madras, £12,000 per mile. The Oude and Rohilkund will have cost about £11,000 per mile, and the Sinde, Punjab, and Delhi, £16,000. The South Indian, also a metre gauge line, when finished, will probably have cost about £6,500. The expenditure on the trunk lines has been much larger than was expected. Some of it could not have been foreseen; some could not have been prevented by any skill or forethought; some may be ascribed to imperfect calculations; and some to mistakes and mismanagement. A general spirit of recklessness and extravagance has been laid at the door of the guarantee system, because a certain dividend was assured to the companies; but opinions differ on this point. A more efficient system of co-operation and control might, I think, have been established by the Government and the companies from the first, whereby costly mistakes might have been avoided and delay prevented; but they were not errors consequent on the payments of interest to shareholders, and it is only necessary to point to the experience of railways in the rest of the world, whether England, the Continent, or America (with the cost of which those of India will not compare unfavourably) to show that the absence of the guarantee did not encourage or enable shareholders to prevent waste, extravagance, and even ruin.

Amongst the sources of expense not foreseen may be included the Sonthal rebellion in 1855, and the Mutiny in 1858, both of which events produced destructive effects upon the works of the East Indian Railway, besides costly delays and alterations. The actual amount of loss incurred by these calamities has not been positively ascertained, but it has been estimated at between three and four millions sterling.

Then the difficulty of transporting materials from the ports to the interior was much greater than was expected. So great was the necessity felt for pushing on the works, that the lines were not constructed "telescopically" (by which means the rails themselves as laid down become available for the conveyance of materials), but were commenced at various places at the same time. The ordinary carrying service of the country, both by road and river, broke down, and it was thought worth while for the East Indian Railway Company alone to provide steamers, at a cost of half a million, for taking their stores up country on their arrival at Calcutta. The river crossings were also a source of unexpected expense. They were, as I have before observed, sometimes beyond the grasp of the engineer, who had miscalculated or been misinformed on the volume and force of the floods in the monsoon, and the repairs and additional works which became necessary greatly added to their original cost. Mistakes, and worse than mistakes, have also been made in the mode of executing portions of the lines, which have failed from sheer mis-construction.

It would, of course, have been much more satisfactory if railways had cost less. We can only now make the most of the experience which we have gained, and take care that in future past errors will be avoided, and suitable lines constructed at a much smaller outlay.

Before leaving the subject of capital, I should mention that the whole of the guaranteed stock has practically been raised in England. Scarcely 1 per cent. is held in India, and not half that by natives. It consists of £85,000,000 share capital, of which £82,225,000 receive 5 per cent.; £1,275,000, 4¾ per cent.; £500,000, 4½ per cent. This is held by 56,400 shareholders, of whom 800 are in India, 390 of these being natives. In addition to this, £4,766,300 has been raised by debentures, with rates of interest varying from 4½ to 4 per cent.; £5,786,300 by debenture stock at 4 and 4½ per cent. There is also a sum of £562,000 not bearing interest, consisting of premiums on stock, &c. The capital for the State lines has been raised by Government loans, principally in India, at from 4 to 4½ per cent.

One gratifying feature in the present position of railway finance is that more money is being obtained in India for the purpose of extending railway communication. Some native States have come forward, and undertaken, with the assistance and under the guarantee of the Government, to provide the necessary capital. This has been done by the Nizam, Holkar, Scindia, and the Guicowar. Provincial revenues are being also devoted to meet local wants, and natives interested in the agriculture and commerce of their neighbourhood have come forward with their subscriptions. A line constructed under an arrangement of this kind was laid down between Hathras, a station on the East Indian Railway, and Muttra, on the River Jumna. It is about thirty miles in length, and cost about nine lacs, six of which were provided from provincial funds and three from local subscribers. And another case has just occurred, where the whole of the sum required for a railway, twelve miles in length, between Deldanagur, a station on the East Indian Railway, and Ghazeepore has been subscribed by natives in the neighbourhood.

We have now to consider the various effects which railways have produced upon the country. These may be regarded in their social and political, as well as in their commercial and financial, aspects.

The first effect which railways had upon the lower strata of society in India was to improve the wages of the labourer, and to open his eyes to the fact that he possessed a property, the value of which was regulated by natural laws, and not, as was often the case before, by the will and caprice of his employer. The railways will also improve the condition of the people by enabling them to be supplied with cheaper food and raiment, and by helping to educate them. As they go to and fro, they will see and learn much that they never thought of before. There will also be more intercourse and friction. The power of caste has also been shaken. Rather than pay more for his fare, a high caste Hindoo travels in the same carriage with a fellow creature whose presence in the same room would be considered pollution. At first natives hesitated to travel for fear of the mysterious motive force which he could not understand. His dread has been converted into admiration. The pilgrim was doubtful of the propriety of travelling by railway, but an authoritative opinion being obtained from the great Sanhedrim of Hindoos that railways might be used by devotees without impairing the efficacy of their pilgrimage, hundreds of thousands use them annually. As "trifles make the sum of human things" it may be worth while to mention that, in the early days of railways, the lower classes attempted the game, to which they are very partial, of bargaining, and tried to beat down the prices of their tickets at the booking office; I need not say that they soon learnt to discontinue this practice. The higher classes have also been taught a lesson. A petty rajah, at first, would come up to a station breathing out "threatenings and slaughter" upon the station master for allowing a train to go before his arrival. Now he finds that even a rajah in his own territory must submit to the "imperative call" of the railway bell. Thus in many indirect ways are railways producing a salutary effect upon the social condition and habits of the population at large, and aiding the approach of that social improvement and regeneration which we all hope to see. Direct advantage may be better measured by the numbers who actually use the railway. It is quite clear that the natives are not deficient in that desire to move about which is attributed to the whole human family, and that the number travelling will be in proportion to the facilities given. Fifteen years ago the passengers numbered about 12½ millions; ten years ago they amounted to 18¼ millions, and in 1875 they rose to 26¾ millions in the year. When it is stated that the population of the lower class passengers is generally about 97 per cent., the second class being about 2·25, and the first less than one per cent., it will be seen that it is the mass of the people who travel. The fares must be low to attract them. On some lines the lowest class is about a farthing a mile, so that a passenger may travel nearly 50 miles for a shilling. Nor in enumerating the social effects of railways should the advantages which they bring to Europeans be omitted. They contribute enormously to their health and comfort, and are the means of saving the life of many a sufferer and invalid, who is now conveyed easily and rapidly to a port, over distances which before involved weeks of distressing fatigue and exposure.

Regarded from a political point of view, the value of railways in India can hardly be exaggerated. It is scarcely necessary to point out that whatever, in a country of such extent, unites the various seats of Government; whatever enables the military force to be moved with ease and expedition, must be a source of strength to the Government and a means of preserving peace and security to the country. Railways do this at a large saving of money besides, and bring home, moreover, to the native observer, whether within or without our territory, the wonderful energy, power, and resources of the governing race.

Nothing, perhaps, shows the effect of our rule upon India more than the railways. It is visible, tangible, and felt by all. Liberty, security, justice, irrigation might, in some modified forms or other, have been attained without us, but if the superfluous capital of England had not been available for her railways, India would have been as China is now, with nothing but a toy line.

On their importance as engines of commerce I need not enlarge. They have already become the chief instruments for carrying on internal trade, and have greatly contributed to its development. They have also been the means of increasing external commerce. New markets have been opened to places previously shut out from commercial communication with the rest of the world. Commodities have been supplied from sources before unknown to dealers in them. Energy has been aroused, and the desire to exchange and barter goods has been increased. The native trader is quick and calculating. I was surprised to find, in remote parts of India, how familiar he was with the prices which prevailed in distant markets. He does not fail to take into account every anna which he has to pay for the transport of commodities, but he attaches a value to greater certainty and celerity of despatch than he has been accustomed to, as well as to the absence of waste in transit. We met with an interesting example of the union of ingenuity and submissiveness in the native character, when travelling last year in the Punjab. At a station between Lahore and Moultan, heaps of wool were waiting to be taken on, but were delayed in consequence of the inability of the flotilla to convey them down the river Indus. The poor consignors, who had remained day after day with their merchandise, were in a great state of perplexity and excitement, and were at first ready to demolish the traffic manager. They not only wished to avoid disappointing their correspondents at Kurrachee, but feared lest rain should come and spoil their goods. The traffic manager, unfortunately, could not help them, but promised to do his best, and with considerable tact, checked their complaints, and pacified them by reminding them that it was the will of Providence that the vessels could not convey more goods than they could contain, and that if the rain did come they must remember who sent it.

The amount of goods carried by the railways is in a great measure dependent on trade, and is affected by the same influences, being increased or diminished by good and bad seasons, confidence and distrust, peace and war, high and low prices, and so forth. The following figures show the increase of traffic during the last fifteen years. In 1860, the tonnage was 553,857; in 1865, it was 1,628,970; in 1870, it was 3,435,269; and in 1875, it was 4,388,649. The mileage open in these respective years was, 840, 3,000, 5,000, and 6,500. For last year I am not able to give the sum total, but I know that a great stride was made, especially on those lines where the rates were lowered, and where an enlightened management has been pursued. This was particularly the case on the East Indian Railway, and to the course followed by that company may be attributed the chief part of their prosperity. In consequence of the low rates, combined with other circumstances, viz., the removal of the export duty, the price of silver and the facilities afforded by the Suez Canal, large quantities of grain have found their way to this country at a price which left a good margin for profit. During the eight months between March and December of last year, 3,864,780 cwt. of wheat were exported from India. In the same period of 1875 and 1874 the amounts were 1,835,000 and 835,518 respectively. There has also been a large increase in seeds. In 1874, the quantity of linseed exported in the above-mentioned period was 2,420,973 cwt.; in 1875, it was 3,892,206, and in 1876 it rose to 4,755,741. This is something for railways to have helped to accomplish. Who would have expected, twenty years ago, that a granary for England would be found in the valleys of the Jumna, the Ganges, and the Sutlej? Or that, by the influence of steam, America and Russia would find in the far East a competitor for supplying us with food?

The goods are generally divided into five classes, the rates varying from 4d. a ton per mile for the highest to ½d. a ton for the lowest class, this last being exceptionally low, and only adopted by the East Indian Railway for grain and coal.

The financial results, as a whole, have hitherto disappointed expectations. Many thought, and I include myself amongst the number, that the railways would have paid better before this. Our opinions were, it is true, founded upon estimates of a smaller capital outlay, but our hopes rested upon a larger increase of revenue. Besides the large original cost, the causes of this disappointment may be found principally in the slower development of traffic than was expected, and, to a certain extent, in the high charges for working and maintenance. Let us see what the deficiency is which we lament. Some of us may think that, after all, what India now pays for her railways is not so ruinous, and that she either directly or indirectly receives compensation for the burden imposed upon her. This may be true. But the absence of the burden would nevertheless be a more satisfactory state of things. The deficit falls upon a people who cannot afford to bear it. What is first desired is, that the receipts from the railways should cover the amount of guaranteed interest annually paid on the capital. During the last twenty-six years the State has paid to the companies a sum of about £61,500,000.* Up to the end of last year, about £34,736,000 had been earned by the railways, so that there has been an average annual deficiency of rather more than £1,000,000. In some years it has approached £1,500,000. It must be borne in mind that for a long time a large portion of the capital was unproductive. Extensive works have been going on all over the country, and of course it was only open lines that were able to contribute to the revenue. It was not until 1871 that the system of trunk lines was completed, so that time has hardly yet been given to develop their capabilities. Time, however, is not only required to bring out the actual productiveness of the railways, but the powers and abilities of managers, and the due appreciation by customers of the value of this novel mode of conveyance. The total net revenue earned by the railways in 1875 was £3,647,868. The amount paid for guaranteed interest was

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* See Appended Table.

£4,650,346. The deficiency was thus rather more than one million. Last year's results will I expect be more satisfactory. I am in hopes that it will be found that the deficiency will be reduced to half a million.

Again, taking the results of the same five years which have before been selected for purposes of comparison, we find that in 1860 the net revenue from the railways was £276,800. In 1865 it amounted to £1,434,000; in 1870, £2,805,188; in 1875, £3,576,514. In 1876 I estimate that it will be £4,200,000. The gross receipts from passengers were £1,188,000 in 1865; in 1875 they were £2,341,000. The gross receipts from goods in 1865 were £2,000,000; in 1875 they were £4,773,000.

I have been referring hitherto to the guaranteed railway in the aggregate, but this appearance of average mediocrity conveys anything but a clear or correct notion of some of the undertakings. Although it may not be in railways "to command success" while they may deserve it, results, for our present purpose, must be the test of superiority, all due allowance being made for disadvantages attendant on age and position. The East Indian Railway stands out pre-eminently as a valuable, well conducted, and prosperous line. Its advantages are great, and the company is now making the most of them. The results of last year show that it yielded nearly 7 per cent. on a capital of £30,500,000. The gross receipts were upwards of £3,000,000; the working expenses about a third of that sum. The East Indian Railway has thus beaten all the English lines, some of which, by dint of debentures and debenture stock, guaranteed and preference stock, raised on favourable terms, have been able to squeeze out a dividend at the same rate, or sometimes a higher rate than the above, to the holders of a third of the whole capital expended. If the capital of the East Indian Railway had been divided in the same proportion of ordinary stock, preference stock, and loans, as the average of English lines is, the dividend to the shareholder would probably have been about 11 per cent., and this too, be it remembered, with average charges for conveyance, taking goods and passengers together, one half those in England.

Next comes the Great Indian Peninsular Railway, the expended capital of which is about £23,500,000. The gross earnings last year were £2,230,000, and the expenses will probably amount to £1,050,000. The net receipts will thus produce a dividend of 5 per cent.

The Eastern Bengal Railway, with a capital of £3,000,000 will yield about 4½ per cent.; the Bombay, Baroda, and Central India Railway will produce 3¾ per cent. on a capital of £7,750,000; the Madras 2½ per cent. on a capital of £10,250,000; the Scinde, Punjab, and Delhi 2¼ per cent. on a capital of £11,000,000; and the Oude and Rohilkund 2½ per cent. on £5,500,000; the South Indian yielded 2½ per cent. on the capital of £3,700,000: but nearly 4 per cent. on a capital of £2,560,000, which is the amount expended on the open line.

These figures are approximate, but they are sufficiently accurate to serve our present purpose. It thus appears that out of a capital of £94,200,000, expended on the guaranteed lines, the Government have been exonerated from the payment of any interest on £54,000,000 which earned more than 5 per cent., and that last year's deficiency is derived from certain lines, representing a capital of £4,200,000, of which £3,000,000 yielded 4½ per cent., £7,750,000, 3¾ per cent. and £30,000,000 between 2 and 3 per cent. With regard to these last, it may observed that they are for the most part labouring under disadvantages which, in the case of the Scinde, Punjab, and Delhi, will be removed when the Indus Valley Railway brings the Punjab into connection with its natural port, Kurrachee; and in the case of the South Indian, which already shows strong signs of life and vigour, when the important link connecting Madras with the southern portion of the line is finished. It should be remembered also that the Oude and Rohilkund is still in its infancy, and also disconnected at its extremities with other lines of railway.

The State lines which constitute the rest of the system now open are, with the exception of the Rajputana railways, not favourable specimens; they are either cripples or dwarfs. The line I have just mentioned does, however, furnish a good example of a well constructed and well managed undertaking, and the results are already satisfactory. It starts from Delhi and Agra by two separate lines, which form a junction at Bandikui, whence it proceeds to Ajmere and the cantonment of Nasirabad. From thence it will go south to Indore and join the Great Indian Peninsula Railway at Khandwa, and south-west to Ahmedabad, where it will meet the Bombay and Baroda line. At present it is only open to Nasirabad from Delhi and Agra, with a branch to the Sambhur Salt Lake, and it is this portion with which we have now to do. It is a single line, and has been constructed on the metre gauge. Its length is about 400 miles. It has cost £2,500,000, or about £6,000 a mile; but it is estimated that another £500,000 will be required to complete and equip it properly, bringing its total cost to £3,000,000, or about £7,200 a mile. This includes a bridge over the Jumna at Agra and minor bridges. It was opened for traffic in 1875. The total earnings for the half-year ending 30th June last (the half it must be admitted when most traffic takes place) were Rs. 1,321,535; the expenses Rs. 749,248, leaving Rs. 572,260 as the net receipts, being at the rate of 2·27 per cent. for the half-year, and more than 4½ per cent. for the year. Considering that the result has been attained in a single year, it cannot but be regarded as very satisfactory, and as furnishing good ground for hope in the future.

The revenue of all lines, whatever their cost, must depend not only on the traffic attracted to them, but on the cost of working and maintaining them. Different undertakings vary much in this respect. One from its position may naturally command a large traffic; one may be able to obtain fuel at a cheap rate; another may have easy gradients: another may be a good serviceable length, and have an equal stream of traffic each way; and another may be connected with a port where the freights for goods from England are comparatively low. All these would possess advantages which would promote economical working; but skilful management will overcome, or at any rate diminish, most impediments, and more than counterbalance the favourable circumstances of a neglected undertaking. As with men, the better trained and more cultivated will surpass their more gifted competitors, so with railways economy of working and correct principles of management will ensure success more than natural advantages. I do not mean that natural advantages are to be despised. They should certainly be made the most of, and not made the excuse for folded arms, while adverse circumstances should be regarded as a stimulus to extra care and exertion.

There can hardly be a better specimen of a line which at present combines the twofold advantages of favourable position and good management, than the East Indian Railway, and yet its direct competition with the river was at one time thought to be a serious drawback. It is this very competition which has helped to make it what it is. The proof of the economical arrangements which characterise it may be seen in the working expenses, which, for the half-year ending June last, were only 33 per cent. of the gross receipts. Those of the Great Indian Peninsula for the same period were 46; the Madras, 72·75; the Bombay, Baroda, and Central India Railway, 43·56; the Scinde Punjab, and Delhi, 63·69; the Eastern Bengal, the Rajputana, 56·69; Oude and Rohilkund, 58·28 per cent. The proportion per cent. of expenditure to receipts for the year 1875, on English and Irish lines, was 55, and on Scotch, 52.

The expenses peculiar to Indian Railways are not, as was first expected, so much those which are produced by a tropical climate or by the ravages of insects, but are those which arise from the damage done to bridges and other works in the vicinity of rivers by the force of the floods, and those also which follow the necessary employment of European agency. Both these causes will in time become less. Our engineers will, no doubt, in the end vanquish the rivers, and by degrees natives will take a larger share in the working of the lines. It is at present requisite to send out not only engineers, managers, superintendents, and foremen, but to employ Europeans as accountants and engine-drivers, as well as a certain proportion of inspectors, pointsmen, and guards. Their wages are three or four times what they earn in England, and ten times more than those of natives. The latter, however, are apt learners in mechanical art, and have been trained to very useful work in the locomotive shops. It will take time to qualify them for the more arduous duties of locomotive drivers, which require coolness, courage, and decision, but some have already shown themselves to be equal to such employment, and I have known a case where the European driver was drunk, and the native fireman took charge of the engine as well as of his companion. On the other hand there are examples of the pusillanimity of the native in an emergency. In an accident which occurred from a collision, the native stoker threw himself off the engine and was killed, a fakir jumped from his carriage and met the same fate, and the station-master was never seen again. Educated natives fill the offices of station masters, accountants, assistants to traffic managers, clerks, and guards. But a certain proportion of European officers and servants will always be necessary. At various selected places on the lines, provision is made for the Europeans and their families, and railway towns have sprung up, with their churches, schools, institutes, baths, co-operative stores, and libraries. Cricket, fives, and billiards are played with the same energy as in this country. The children are educated, and the sons are growing up to take part in the work their fathers have been engaged in. It is wise to attend to the health and amusements of these communities, and also to rouse a spirit of interest in the work among all the *employés*, by allowing them to participate in the success of the line they are connected with. This principle is carried out on some of the lines, contributions out of any excess profits over 6 per cent. being made to provident funds, which belong to all who subscribe a regulated proportion of their pay. The amount added by this means to the fund of the East Indian Railway last year was about £20,000. The principle is also applied, in another way, to the working of the Oude and Rohilkund Railway, where, instead of maintaining permanent staffs at the station for the purpose, contracts are made with the station masters to load and unload the goods on terms which give them a small profit, and consequently an interest in the increase of traffic.

The only accidents *peculiar* to Indian railways are those produced by the violence of the elements. I have already mentioned how viaducts have been carried away. It has happened that, no notice having been received of the sudden destruction of a portion of a bridge, a train was plunged into the gap. On one occasion in Scinde, a village on the banks of a nullah was swept away and brought down a railway bridge in its ruin. There has also been an instance of a train being blown over by a hurricane. Wild animals are sometimes the cause of accidents. An elephant has been known to charge a train, and a buffalo has been the means of throwing a train off the line. But these are of rare occurrence, and railway travelling in India is quite as safe as in this country. Poor people sometimes die in the carriages from heat and fatigue, but they are almost always cases of those who should not have attempted a journey, being worn-out creatures, who perhaps are making a last attempt to reach some favourite shrine. The "line-clear" system is applied to the working of the traffic; but as necessity arises the block system is gradually introduced.

It now only remains to consider the policy which should guide the administration of these great undertakings. As political, or strategical, works they should, of course, be made capable of rendering such service as may be required of them whenever the occasion may arise. But it is in their other capacity—as carriers of men and merchandise—that they have to be chiefly regarded when we are concerned with their remunerative powers. It appears to me that, in every sense, their commercial character should be preserved and developed, and that the broadest view should be taken of their aims and capabilities in this respect. I believe that a policy dictated by such a view of their position, would enable the railways to confer the greatest advantages to all concerned. In the first place, whether in the hands of companies or of the Government, they should be allowed to earn the full fruits of a careful and liberal management. I know that some would limit the profits to an amount sufficient only to cover the interest on the capital, and would give the customer the benefit of any excess. The vicissitudes of traffic might interpose a difficulty in the way of this arrangement; but supposing it feasible, would it be fair to the community at large who have furnished the means of obtaining the money to deprive them of a participation in the benefits? The more legitimate mode of dealing with the excess would be to spend it on extending the railway system. I have just advocated a liberal policy as being the most likely to pay. By this I mean one that brings the railways down to the wants and capacities of the people, which considers carefully the peculiar circumstances of the country, encourages the growth of its agricultural produce, and stimulates fresh industries. The policy which would strive for high returns from a contracted traffic is not the policy suited to India; if, indeed, it be suited to any country. As I believe some of the most successful commercial enterprises have been conducted so as to secure a large aggregate profit by numerous small gains, so should railways be managed as to produce large receipts from the small earnings of a multitude of transactions. The people of India are poor, and the distances are great. Fares for the low classes of passengers, and charges for the staple commodities of the country, must be very low in order to secure the traffic which may reasonably be expected. I do not forget that, to enable this to be done, thrift and skilful management is necessary, and we have seen on the East Indian Railway how it is possible for an Indian line, by these means, to carry its freight cheaper than any English railway. Besides the usual obvious measures for attracting traffic by good accommodation, punctuality, and all reasonable conveniences, care in the selection and economy in the use of materials must be exercised, and every effort should be made to reduce the dead weight and unprofitable work, by running as few trains as possible, and filling them up to the brim; in other words, by reducing the train mileage and increasing the train loads. There is nothing so objectionable in railway returns as "a beggarly account of empty boxes." Lessons may be continually learnt by a careful study of statistics. The very word I am afraid brings to some minds the idea of mystifying doubts and suspicions, but however much a mass of ill-arranged figures may confuse and deceive, properly prepared statements furnish the most instructive information for future guidance. Rates and fares, for instance, should be regulated chiefly by the cost of transport, and as such charges are made by the ton, and for the passengers per mile, it is most important that the cost of conveying a passenger and a ton a mile's length should be ascertained. This has been done by Mr. Rendel, who, by an intelligent analysis of the traffic returns, has from time to time prepared tables which show not only the cost but the amount earned from each passenger and each ton of goods carried one mile. The East Indian Railway Board were thus enabled to explain, in their last report, that the average sum received for carrying a passenger one mile was ·38d., the average cost ·14d., and consequently, that the profit on each passenger was ·24d.; that the average sum received for carrying one ton a mile was ·91d., the average cost ·26d. and the profit ·65d. This is turning statistics to good account, for a unit of great value is arrived at, and the secret of success is revealed. I have already given the results of this line. Mr. Crawford, the chairman of the Company, was able to point out to the shareholders that its present prosperous position had been attained by thrift, enterprise, and liberality, and he spoke in a confident tone of the success of the policy which he recommended, and which was explained in the last report of the Board.

After alluding to the economy exercised by the staff in India, the report goes on to say:—"It was this which prompted and justified the policy of the Board in regard to reduction of rates, and it is this reduction of rates which has conduced so much to the late development of traffic. The action and re-action of these three influences—that is to say, economy of cost, low charges, and increase of traffic—upon each other have operated, and are still operating, to produce not only financial prosperity in the line itself, considered as a property, hardly surpassed by any line in England, but, what is of still more importance, a commercial activity in India in some of the most important products of the soil, which will have a marked effect on the welfare of that country at large."

It is gratifying to see so high and at the same time so just a view taken of the duties and obligations of a guaranteed Indian railway company. Satisfactory as this account is, I cannot but think that, if the principles here advocated are formed into a settled policy by the administrators of our railways in India, we shall see yet more favourable results. The prosperity of these great works and the improvements of the country should go hand in hand together. Any system of management which does not promote the due development of the produce of the soil, and stimulate the various rising industries of the country, cannot be a proper one for adoption. We have already seen how, in the case of wheat and seeds last year, the agricultural riches of the country "derived from benignant skies and a prolific soil" received an impulse from low rates. Other products will be acted upon in the same way. The growers of cotton find it difficult to compete with America, but India is now spinning much of her own produce, and will soon go a step further. Along the western coast, at Bombay, Surat, and Broach, large mills are at work. When visiting one of these in company with Mr. Rendel last year, I spoke to the owner on the subject of the import duty on manufactured goods. His remark was, "Whether the duty is kept on or taken off, we intend to beat Manchester." In Calcutta mills for working up jute—which, as an article of commerce, has only been heard of in India within the last twenty years—have been established. There is great activity in the coal producing districts of Bengal and Central India, and supplies of coal are being taken many hundred, and even more than a thousand miles up country for the use of the railways. Tea has already become an important article of commerce, and now rivals that of China in quality, There is no reason why tobacco should not be more extensively cultivated and prepared for European consumption. There are probably other articles which in time, and with proper facilities for reaching a market, will

Railway.	1860.					1865.				
	Receipts.			Working and Maintenance Expenses.	Net Receipts.	Receipts.			Working and Maintenance Expenses.	Net Receipts.
	Passengers.	Goods, &c.	Total.			Passengers.	Goods, &c.	Total.		
	£	£	£	£	£	£	£	£	£	£
East Indian.—Main Line	131,798	202,584	334,382	165,543	168,839	525,669	916,435	1,442,104	670,005	772,099
Do. Jabalpur	..	..	Not	opened.	..	..	..	Not	opened.	..
Great Indian Peninsula	88,343	108,206	196,549	119,795	76,754	241,469	628,827	870,296	555,670	314,626
Madras	39,913	36,487	76,400	46,979	29,421	149,449	200,007	349,456	177,817	171,639
Bombay, Baroda, and Central India (opened on 10th February, 1860)	..	..	6,090	4,268	1,822	154,630	41,805	196,435	123,365	73,070
Scinde, Punjab, and Delhi (including Indus steam flotillas)	..	..	Not	opened.	..	36,330	145,371	181,701	155,636	26,065
South Indian { Amalgamated Gt. Southern of India and Carnatic Railway Companies }	Not	opened. {	Great Sout Carnatic	hern of Ind Railway ..	ia Railway	19,127 ..	16,109 ..	35,236 Not	17,451 opened.	17,785 ..
Eastern Bengal	..	..	Not	opened.	..	62,158	50,682	112,840	54,094	58,746
Oude and Rohilkund	..	..	Not	opened.	..	..	..	Not	opened.	..
Totals	260,054	347,277	613,421	336,585	276,836	1,188,832	1,999,236	3,188,068	1,754,038	1,434,030

Railway.	1870.					1875.				
	Receipts.			Working and Maintenance Expenses.	Net Receipts.	Receipts.			Working and Maintenance Expenses.	Net Receipts.
	Passengers.	Goods, &c.	Total.			Passengers.	Goods, &c.	Total.		
	£	£	£	£	£	£	£	£	£	£
East Indian.—Main Line	722,510	1,908,959	2,631,469	1,099,459	1,532,010	801,311	1,708,352	2,509,663	963,054	1,546,609
Do. Jabalpur	62,846	59,617	122,463	104 846	17,617	77,300	107,748	185,048	107,326	77.722
Great Indian Peninsula	434,276	1,225,671	1,659,947	1,032 630	627,317	478,530	1,494,554	1,973,084	932,786	1,040.298
Madras	187,112	306,101	493,213	259,693	233,520	226,049	363,343	589,392	414,204	175,188
Bombay, Baroda, and Central India (opened on 10th February, 1860)	189,578	303,520	493,098	288,526	194,572	228,348	357,106	585,454	318,543	266,911
Scinde, Punjab, and Delhi (including Indus steam flotillas)	182,589	236,938	419,527	333,125	86,402	227,275	369,619	596,964	397,443	199,621
South Indian { Amalgamated Gt. Southern of India and Carnatic Railway Companies }	39,318 3,054	31,644 464	70,962 3,518	42,646 3,967	28,316 Loss 449	} 54,228	49,125	103,353	49,774	53,579
Eastern Bengal	70,553	107,539	178,092	99,187	78,905	110,298	185,520	295,818	190,081	105,737
Oude and Rohilkund	16,329	8,254	24,583	17,605	6,978	137,585	137,587	275,122	164,273	110,849
Totals	1,908,165	4,188,707	6,096,872	3,291,684	2,805,188	2,340,994	4,772,904	7,113,898	3,537,484	3,576,514

Statement of Cost, and of some of the Dimensions of the largest Bridges on Railways in India.

Railway.	Name of Bridge.	No. of Spans.	Length of Bridge.	Depth of foundation below Low Water.	Height from Low Water Level to under side of Girders.	Total Cost.
			Feet.	Feet.	Feet.	Rs
East Indian	Jumna (Allahabad) ..	14	3,080	40	60	40,75,800
”	Soane	28	4,536	32	37·6	26,10,167
”	Jumna (Delhi) ..	12	2,640	7 to 39	23·5	16,60,354
Scinde, Punjab, and Delhi	Sutlej (Loodianah) ..	59	6,456	40 to 50	17·5	31,06,076
”	Beas	34	8,820	43 to 70	21	22,90,366
Eastern Bengal	Goraie Bridge ..	7	1,295	78 to 98	51	16,95,009
*Oude and Rohilkund..	Ganges (Cawnpore)	25	2,750	50 to 65	31·66	19,40,000
”	Ganges (Rajghât).	33	3,040	55	24·39	9,63,580
Madras	Chittrawutty	40	2,800	12 and 30 ft. deep	20	3,54,705
Great Indian Peninsula.	Kistna..........	36	3,865	Average 15·69	†46·51	12,80,001
”	Taptee (Bhosawul)	33	2,556	” 17·30	†57·88	13,64,900
”	Toongabudra ..	58	4,060	Shallow on rock	37	7,55,756
Bombay, Baroda, and Central India	Taptee (Surat) ..	30	1,875	Average 14	†53	8,95,260
”	Nerbudda (Broach) ..	67	4,187	” 37	†48·5	46,93,490
Rajpootana (State)....	Jumna (Agra) ..	16	2,272	” 70	31·66	16,54,203
Punjab Northern	Chenab	64	9,088	” 75	20	46,78,924
”	Sutlej (Bhauwulpoor) ..	16	4,224	” 100	Minimum of 30	38,85,780

* The figures for the bridges on the Oude and Rohilkund Railway are only approximate, and subject to revision.
† Height of railway above low water.

appear on the list of exports. All these are encouraging features in the material prospects of India, and all are being helped by railways. For these and for other reasons which have appeared in the course of this paper, their judicious extension is, I submit, to be desired.

DISCUSSION.

Mr. Crawford (the Chairman of the East Indian Railway) remarked that people who took any interest in Indian railways were very much indebted to Mr. Danvers for his clear and comprehensive paper. What these railways were capable of doing for the country was only now appearing, and the prosperity on which some of them had embarked only now commencing. A very different state of things existed now from what there had been, and this was mainly owing to the extremely accurate and exhaustive statistics which had been prepared by Mr. Rendel, and the method which the companies now had of ascertaining the exact cost of doing every item of their work. Formerly it had been thought impossible to bring grain from the upper parts of India, where large quantities where known to be stored, to Calcutta, at a profit; but this had been done, and recently grain had been brought from Cawnpore to Calcutta, a distance of 684 miles, at a cost of 6s. 4d. per quarter; and arrangements had recently been made by which a large quantity of wheat, which was raised in more distant parts of Delhi and Lahore, would be brought to Calcutta, for 12s. 6d. per quarter. Was there any railway in England which could afford to carry a commodity like that such a distance, at such a cost, with profit to it? But for Mr. Rendel's method of ascertaining the cost of working, and what they could really afford to carry their goods for, these things could not be carried on successfully. It was this which made the difference between the English and Indian railways. Rates of a halfpenny per mile were unheard of in this country, and there was no limit to the amount of profit which would be opened up in time to come. It would surprise people who knew India in former days, and who were accustomed to the jog-trot way of travelling, when the cost was so enormous, and three months' time was required to bring goods from the interior to the coast, to see the change that had been effected, and that the superabundance of produce which existed in some districts of India was available for our own requirements. It was deeply interesting to the people of this country to know now, that even if the great granary of South Russia might possibly be jeopardised, there existed in India a vast source of supply, which could be brought to this country with profit to all. Upwards of 200,000 tons of wheat were last year exported from India, 170,000 tons of which left the port of Calcutta, and the greater part of which came here. Taking the produce as being four or five quarters to the acre, that quantity would not require more than about 200,000 acres of land to produce it, and the extent of country was enormous where grain could be grown. There was another enormous trade which had recently sprung up in India, for which they were indebted to the railways, and that was the growth of linseed and rapeseed. The quantity of linseed alone exported from India in 1876 represented £4,000,000, though it was not to railways alone that this was owing. One of the principal things which gave an impetus to the trade was the measure, of which Lord Northbrook was the father, for the abolition of the export duties. The amount of the duty in the case of wheat was nearly 1s. per quarter; in the case of linseed it was more. When they remembered that represented about two per cent., and that in these times that was considered a mercantile profit, they could understand the great advantage of the abolition. Then there came the depreciation of silver; and, then, again, the enormous advantage in having commodities which it was possible to export to England, to the extent of some six or seven millions, was at once seen. He seriously hoped Mr. Danvers' paper would not lie buried in some report, but that it might be spread abroad to enlighten the public mind upon the subject of Indian railways. It would show that Indian railways had not been the extravagant and ill-considered enterprises they were thought to be by many people. Only on Tuesday evening, in the House of Commons, they had heard on high authority that it was in consequence of the extravagance connected with Indian railways that the State railways had been introduced. He entirely differed from that statement, and he hoped an opportunity would offer when this view could be tested by those who were interested in the matter, and who could prove that, all things considered, Indian railways had been as economically constructed as any vast series of railways in Europe, or the world. It was all very well for other countries to trade upon the experience gained in England. People said Continental railways had been constructed more cheaply than those in India, but who, he would ask, had bought the experience that enabled them thus to construct them at less cost? Why England had bought the experience and paid dearly for it too, and it was after we had learned in the school of experience how railways were best made, that other countries were able to avoid the errors which had led to the extravagance and enormous cost which marked the construction of the railway lines. The companies had to introduce works of a character hitherto unknown in India, and had to resort to expedients wholly novel to the country. True, some mistakes had occurred, but they were of an unimportant character really, and it was this experience which enabled other people to be so wise after the event, and make such boasts of how much better they could do. The statement of Mr. Danvers was a very proper sequel and a very proper commentary on much which had been said in the House of Commons at the debate on Tuesday, and he (Mr. Crawford) believed if there had been any member of the House present who was thoroughly acquainted with the matter, a vast amount of misapprehension and misunderstanding would have been prevented.

Mr. Scott Russell, F.R.S., said although he had never been in India, he was well acquainted with all that had taken place there in regard to railways, as he had known many engineers and others connected with those undertakings. He had watched their progress with very great interest, and as an engineer he had frequently had occasion to advise other countries upon their public works. And what he had generally recommended was that they should imitate England as little as possible in what had been done in regard to its railways, but should imitate as much as possible what Englishmen had done for railways in India. There was much in the administration and utilisation of railways in India which might be followed with great advantage in England, if in nothing more than in knowing the exact cost of carriage of, and the profit and loss on each item of goods. One thing, however, in connection with Indian railways he deeply regretted, and that was that a uniform gauge had not been adopted. He did not care whether the gauge was wide or narrow, but a difference of gauge was certainly a great evil. In saying this he did not mean to indulge any crotchet, though he had his crochets, but he was merely giving utterance to a view into which he had been disciplined, for one of the earliest duties of his life as an engineer was to do some work in connection with a railway of an exceptional gauge, which after doing much useful work, had to be pulled up and relaid merely because its narrow gauge prevented its getting into the general traffic of the railway system. He strongly regretted that any consideration should have permitted, either the Government or anybody else, to indulge themselves in any other than one uniform gauge for the Indian Empire; and he predicted that if the administrators of India would indulge in exceptional railways, the day would come when in some state of war they would have to regret that the material of their army could not avail itself of the railways because of their exceptional character. In England they had not now any great amount of exceptional railway. At great cost they had got rid of that, and now had an uniform narrow gauge, which not only enabled them to carry everything over the country, but would enable them to assist any of their continental neighbours. It was a mere fallacy to think that the breadth of gauge made a difference in the cost of a railway. He would also urge the importance of uniformity of pattern being adopted in India in respect to locomotives and carriages. If they would organise their railway material, so as to reduce the great variety now existing in engines and carriages, to perfect mathematical uniformity, such as Sir Joseph Whitworth had, and the London and North-Western Company were introducing, that forced uniformity would effect an immense saving in their current expenses. The locomotives so made would only cost two-thirds of their present cost of maintenance, and wear and tear would only be half what it now was.

Mr. J. T. Wood considered that the time had not arrived for making any reduction in the rates charged by the guaranteed railways, but on the contrary, if those railways were to be self-supporting, it would be necessary to increase the rates charged on some of them. He ventured to doubt whether the export of wheat and seeds, consequent on the opening of the Suez Canal, would have been less in the aggregate if the railway charges had even been somewhat higher than those actually in force. He would, as briefly as possible, explain his views on these points, and also offer some observations on the question of surplus profits. He was under the impression that the original guarantees were granted, and the rates fixed, with regard to estimates of traffic actually existing in the districts through which the railways were to pass, and that the idea of development of non-existing traffic by charging low rates was, if entertained at all, considered of very minor importance. As matters now stand, the bill for guaranteed interest must be paid every year. The question was—Whether the practice was to be continued of charging a portion of the bill against the tax-paying community of India, or whether the whole of the bill was in future to be discharged by the persons using the railway? At present the scale of charges on the different railways was not uniform. If the policy be correct and adopted of carrying nothing on the guaranteed railways below cost price, and of so adjusting the rates that each article should bear its full quota, not only of the working expenses, but also of the guaranteed interest, it would be necessary (taking the returns of 1875 as the basis of the calculation) to raise the rates of six of the guaranteed companies to an extent varying from 11 to 55 per cent. The highest rate then chargeable for third-class passengers on any of the guaranteed lines would be ·54 of a penny, and the highest rate charged for the lowest class of merchandise would be 1·8 of a penny, which rates in England would be considered very moderate. It was impossible to tell, except by experiment, extended over a sufficiently long period, whether the increase of rates within moderate limits would have the effect of diminishing the quantity of traffic brought to the railways, or of diminishing the net receipts, but he did not see why the same kind of traffic in different parts of India similarly situated would not bear the same charges of transport. He would give an example. The districts traversed by the Oude and Rohilcund Railway were, for many years, contiguous to the districts traversed by the East Indian Railway. It could be proved, beyond doubt, from the statements given in the report of the former company for the half-year ending June last, that if that company had been allowed by the Government to charge, and been able to obtain the same fares from their passengers as those charged on the East Indian Railway, and been allowed to charge and been able to obtain the same rates for their goods as those charged on other railways, they would have more than covered the guarantee instead of showing a deficit. The imports of wheat into the United Kingdom during the year 1875 from all countries amounted to 2,593,825 tons, of which 27,000 tons came from Bombay and Scinde, and 38,000 tons from Bengal and Burmah. The imports from India during 1876 may be larger. Even assuming that India could undersell the rest of the world and gain the whole of this export trade, the quantity of land required to grow that amount of wheat, in a country where rotation of crops is not necessary, would, at the rate of 30 bushels per acre, be under 6,000 square miles, a tract about the size of Yorkshire; and if the necessary amount of land were available for the cultivation of wheat within a nearer lead by rail or water to Bombay and Kurrachee than to Calcutta, the former ports would be able to beat the latter in tho competition for the traffic. The returns for the year 1875 show that the tonnage of goods, exclusive of minerals, carried on the Great Indian Peninsula and Bombay and Baroda lines, which havo their termini at Bombay, in that year were 110 and 135 per cent. respectively greater than in the year before the Suez Canal was opened; but the tonnage of goods, exclusive of minerals, moved on the East Indian Railway was only 10 per cent. greater than in the year 1869, the money receipts being £185,000 less. This, he thought, was conclusive that the export trade from India created by the opening of the Suez Canal would ultimately take the shortest and most direct route, and that the cultivation of wheat and other produce would be regulated accordingly. Calcutta was at present competing with Bombay and Kurrachee for the export trade in wheat. Wheat was said to have been selling at Cawnpore for £4 per ton, at the time that the price in London was £11, thus leaving a margin of £7 for the purposes of trade. Wheat was being brought to Calcutta by two railway companies at ·654 of a penny per ton per mile. This, according to the tables of the Blue-book of 1875, would give to one of the companies a profit of ·043 of a penny—say, $\frac{1}{25}$ of a penny per ton mile, and to the other company a profit of ·33 of a penny per ton mile. The railway company received 28s. 6d. for freight, the steamers 50s., out of which they had to pay 8s. for the toll of the Suez Canal, and the remaining 61s. 6d., less charges, went to the merchants for profit. Perhaps the railway company did not make the most of the opportunity, and accepted a smaller share of the £7 than they might have obtained. They would, however, according to the tables in the Blue-book, have obtained a profit of $\frac{1}{3}$ of a penny per ton mile on the rate charged. Another company is, however, now bringing wheat from Umritser to the East Indian Railway at the same rato as that charged by the latter company, namely, ·654 of a penny. But, according to the Blue-bock, the Punjab line will only make a profit of $\frac{1}{25}$ of a penny per ton mile on the transaction, and will thus have to carry ten tons of wheat 600 miles to earn a profit of £1 sterling. He was glad to say that there was now a prospect of surplus profits being the rule instead of the exception, at any rate as regards one half of the year. Hitherto the guarantee system had been an excellent school for training shareholders into indifference to the management of their affairs. As long as any guaranteed railway was considered safe to pay its working expenses, the price of its stock on the share-lists would be the same, whether the earnings were £9 per mile per week, or £25 per mile per week, for the shareholders had been so often disappointed in their expectation of surplus profits that they made their investments on the basis of the guarantee only, instead of on the basis of the receipts. But now every florin of surplus profits expected to be permanently paid would raise the value of the stock by 20s. at least. The shareholders had been already recommended by a late member of Council for India to look more closely after their own affairs. It seemed to him that the position of the shareholders of the canal was very analagous to that of the shareholders of the guaranteed railways. It was not necessary for him to discuss whether the two undertakings had or had not materially contributed to the welfare of large communities. The shareholders in both undertakings had vested interests in contracts which were becoming valuable every year. Vested interests were always liable to the attack of classes who would benefit by their demolition. M. de Lesseps had successfully resisted the pressure put upon him to reduce the tolls of the canal by the representatives of steamer property, which had cost more than the canal itself; by the representatives of traders, who every year consigned merchandise through the canal, which aggregated in value more than the canal itself, and by representatives of most powerful political interests; and it was to be hoped that the directors of the guaranteed railways would follow so good an example, and not be persuaded, with or without consulting their shareholders, into consenting to any reduction of rates until the 10 per cent. contemplated by the contracts had been earned, or the lines taken over by the Government in the meanwhile at their full value.

Mr. Conybeare, in a few brief observations, drew attention to the great purity that had been displayed in the management of the Indian railways, in comparison with the way in which railway enterprises had been conducted in other countries. India owed a great deal to the *savoir faire* which had characterised the management of her railways, and, whatever might happen, England would have a noble monument of her rule in India by educating that country, and by giving a good code of laws, and a magnificent system of eternal communication.

Mr. Maitland, speaking as one who had been a merchant in India for some years, bore strong testimony to the immense benefits conferred on the commerce of India by railways, and said there could be but one opinion as to the great value of the principlo laid down by the ruling companies, of reducing the traffic rates for bulky merchandise, so as to increase the volume of the exports of India. He referred specially to the immense increase in the exports of oil seeds, and, to what was practically a new trade, the trade in wheat, which India could supply to any extent, so as to make us independent of both Russia and America. Again, great credit was due, and especially to the East Indian Railway Company, for the reduction made in their expenses, which the last report showed had been brought down from 38 to 33 per cent. on the gross receipts, and this, of course, greatly aided them in carrying cheaply. He alluded, also, to the great importance of feeder-roads in connection with the railways, and said a tribute was due to Lord Dalhousie, to whom India owed her great railway system.

Mr. Crawford, remarking on the price of coal, said that the East Indian Railway Company raised their own coal, at a cost of 4s. 7d. per ton (at the pit's mouth), obtained from deposits discovered by the engineers in the early history of the railway. They were now raising 300,000 tons in the year, but they only had a very small coal bill—unlike many housekeepers in England.

Mr. Ward said he was very much interested in communications with Darjeeling, and asked whether a line to that point existed.

Mr. Danvers replied that the line was being made.

Mr. Ward expressed a fear that the line would stop short at Jullipigoree, and urged that it was very essential to have complete communication between Darjeeling and Calcutta, in order that the district where tea was grown might have the advantage of a railway communication.

Mr. Fleming, C.S.I., observed that under the present system of constructing railways by the direct action of the Government, whenever there was the slightest financial difficulty. the works were stopped, and he mentioned as a conspicuous instance of this, that the Western Rajpootana line had been postponed indefinitely because of the financial difficulty connected with the scarcity in the Deccan and Madras. One of the good results effected for India by the guarantee system was that there was a third party with whom the Government made contracts, and that through good or bad times the work went on. Mr. Fleming also remarked upon the effects of railway communications upon famines in India, and urged that for this reason, and also to give an outlet to the productions of the country, and encourage the people to produce, these communications should be extended as far as possible.

The Chairman, in closing the discussion, touched upon the chief points referred to in the paper. He thought the paper which had been read by Mr. Danvers, and the discussion which had followed, could not but be considered by those who were interested both in the prosperity of India, and the success of the railways there, as highly satisfactory. Looking at the broad results of what had been done, it seemed that they had now in that country a very widely extended system of railroads, which had been completed within the last twenty-five years. While the Government of India had paid year by year out of the revenue the whole of the interest of the money expended in constructing those lines, and, as was the case in other countries, had put the interest to the capital account, at present while there still remained some railways unfinished to be made out of guarantee capital, the charge upon the revenue was in the last financial year only one million. They had heard from the author of the paper that it would be only half a million next year. That was the broad result. Now, he did not think anyone who had any knowledge of India could doubt that that was one of the most profitable investments that ever was made by a great nation. He agreed with one of the speakers that the greatest credit was due to those who encouraged that system, and had carried it through to the present time, and especially to Lord Dalhousie, the eminent Governor-General of India. He had a thorough knowledge of the railroad system in this country, and he applied his great abilities to the subject on his arrival in India with, to his mind, great success. Something had been said upon the question as to whether "guaranteed" railroads or railroads made by the State were the best system. He thought there was no man in England—he was going to say or out of it—who would doubt that the best system for a Government was that the railways should be made by private capital. That undoubtedly agreed with our English ideas, which ideas he himself had not changed by the experience he had gained in India. At the same time every one who knew something of the subject would understand that it would have been quite impossible to raise money in India unless a guarantee had been given. Doubtless, it was obvious that in a system of guarantee one of the greatest inducements for economy in the management, viz., an uncertainty of any return on the part of those who invested their money, was absent. The shareholder knew that he would get his five per cent. whatever might be the way in which the business of the railroad was conducted. No one could deny that; but at the same time those railroads had been conducted by men of honour and ability, and during the time of their construction, although doubtless mistakes had been made—not more, perhaps, than were to be expected under the circumstances—he did not believe that any unnecessary expenditure had been incurred. Referring to the subject of tariffs, as far as he knew, the opinion held by those in India who had gone into the question was that, not only for the development of the resources of the country, but for the profit of the railroads themselves, it was a judicious measure that was taken by the East Indian Railway Company in reducing their rates, and that it might be followed with advantage by other companies. It had been remarked that, in regard to dealing with famine in India, the extension of railways there was the most effective means of guarding against any such calamity. It had also been mentioned by Mr. Danvers that, during the time of the scarcity in Bengal in 1873-4, there were no less than 800,000 tons of food grain brought into the famine districts by means of railroads. That was perfectly accurate, and what he had simply to add was that it was only the existence of railroads in India that had made it possible for any Government, with any exertions and at the expenditure of any sums of money, to meet these calamities. They had heard of famines that had taken place in former times in which there had been great mortality, such as the one in Rajpootana, where the scenes were perfectly heartrending, It was impossible at that time in any manner to have met that calamity. The distance from the parts of India in which there was plenty, and the difficulties of transport, were so great, that he did not believe any foresight would have met that famine in Rajpootana then. On the other hand, at the present time he thoroughly believed, from what he had heard elsewhere, that the measures which the Indian Government and the governments of Madras and Bombay were now adopting, to meet the scarcity in these districts, would be successful. They would be successful mainly, in his opinion, because of the railroads, which now traversed almost the whole area of scarcity, and enabled the enormous quantity of food grain now produced in India to be conveyed to those parts of the country which required it. What he would say was that railways were very good things, and the extension of trade in India very desirable. They were all glad to see those things progress, but there was one matter which signified more than all, viz., the soundness of Indian finance, which the Government of India must have first and foremost in their minds. India was a poor country compared to England, although its exports are so great, and it would not stand any extraordinary taxation. In his opinion the finances of India were in a perfectly sound condition. The finances had been so sound during the past four or five years that, although the cost of the famine in Bengal amounted to some six millions sterling, the surplus of three years was sufficient to produce a sum equal to the whole of that expenditure. In his opinion, so long as the expenditure was properly controlled, and, most important of all, so long as peace was preserved, the natural expansion of the railways of the country would enable the Government not only to meet the expenditure for such calamities, but in the course of years, would be ample to provide for the steady extension of the means of communication there. Moreover, it seemed to him that something like the prospect of a fair profit would be shown in railroad-making in India, and that they would see before very long natives—for he thought the capital was more likely to come from India than from this country—coming forward to make some inexpensive railroads, which would become feeders to the main lines. He thought that was an object very much to be desired, and any encouragement which could be given to the construction of such lines would be well bestowed. In conclusion, he was sure that they would all join with him in offering their most sincere thanks to Mr. Danvers for his paper, and in expressing a hope that the present successful position of some of the principal railway companies in India was only the beginning of a condition of things which would show that those undertakings would not only be useful to the country, but would really show a very large commercial profit.

A vote of thanks to the Chairman concluded the proceedings.

Mr. Hyde Clarke writes:—The protracted discussion did not give me the opportunity of speaking on the paper of Mr. Danvers. It was marked by its liberal tone, but its most important feature—its bearing upon railway extension in India—did not receive due notice. As Lord Northbrook said, "India is a poor country," but assuredly the way to keep it poor is to deprive it of railway extension, the great necessity for its development. This subject requires more consideration than it could receive in one desultory debate. The first thing to which attention should be directed is the existing amount of railway accommodation in India. Taking the figures of Mr. Danvers, 25,000,000 passengers means that one in eight of the population travels once in a year on the railways, and that it would take eight years for each man, woman, and child in India to go once upon a railway. The amount of goods conveyed is possibly a carpet-bagful, or 20 lbs. per head for food, fish, salt, fuel, clothing, implements, seed, manure, building materials, and exchangeable produce, produced and distributed or received. It is absolutely certain that upwards of one hundred millions of people have never been on a railway, nor are likely to do so as matters stand. The provision made by the Government to supply their wants, and to provide each member of the population with an outfit of railways and public works, is 2s. per head. These appalling figures in some degree represent the way in which the development of India, so powerfully portrayed by Mr. Danvers, is to be dealt with. The paltry pittance provided is made dependent on the condition of the finances of India, the maintenance of which in good condition is, as Lord Northbrook says, of great value; but this is not a condition precedent to railway development, but dependent upon it and subsequent to it. Mr. Danvers has given the key to it. One of the first effects of railways felt by the population was, he says, the rise in wages. India is a poor country, but in regard to this question of transport provision it is relatively poorer, because the material has to be found on a European standard of prices, and the return has to be obtained on an Indian standard. As I have more than once pointed out, at the time railways were introduced wages were in many places a rupee a month or a penny a day, and they have since doubled, trebled, and quadrupled. Wheat, as referred to by Mr. Crawford, is 4s. per quarter in the north-west. When the same effect has been produced in India as in Europe, the shores of Western Asia, in Egypt, of raising the price of commodities to the commercial market standard, less the cost of transport, then India will in so far cease to be a poor country, and will be able to pay railway fares and rates and further taxes on a European scale. The effect of the rise of prices of cotton during the cotton famine is an exemplification of the wider and general effects. It is under the influence of this gradual advance that, notwithstanding the land revenue settlement in Bengal, the revenues in India have advanced, notwithstanding the paltry cost of railway guarantees, and it is by such operation that they will advance. Consequently, railway extension has to provide for increased revenues, and to make a provision for famines, as referred to by Mr. Danvers and Lord Northbrook, and not for railways to be dependent on famine deficiencies, and the good or ill administration of the revenue. It could not fail to strike me that no reference was made to railways in America, where population is more sparse than in India, and where grain has to be conveyed by railway enormous distances, and where parallels will be found to those low charges for freight looked upon by Mr. Crawford as exceptional, and which are so necessary for India. It was gratifying to me to find Mr. Danvers enforcing—as I have done so often, and for so many years—the importance of the statistical study of the traffic, which is so well attended to in France, and so ill attended to in this country. It is also acceptable to find the acknowledgment of the confirmation by experience of the influence on the rates for goods of expedition in conveyance, and safety from damage (see my "Practical and Theoretical Considerations on the Management of Railways in India," 1846, pp. 6, 7, 11, &c.). Turning back to those older times, it is useful to say that one reason why Indian railways have been so long in reaching a remunerative return is the neglect of the Government, as in Turkey, in providing the branch communications; and another, the same neglect in delaying the requisite extensions. Another cause is that ingenuously intimated by my friend Mr. Crawford, that it was only four years ago that his administrators or the government found out the right way of determining the rates. This demands none the less notice, because, although the East Indian Railway is now so far in the right way, the principles enunciated in the discussion were calculated to convey erroneous ideas. The principles on which the rates of charge for weight depend do not chiefly rest, as assumed, on Mr. Rendel's calculation of what the goods can be carried for; such an assumption would not be admitted by any French administrator. The first thing is to ascertain what margin there is between the price in the place of production and that at the place of sale or consumption, and the nature and quantity of the goods, and then to determine whether they can be conveyed at a gross profit more or less. It is evident, with regard to a crop of grain, that it can only be moved when the market price will afford the margin for transport, and that unless it be removed at such period it cannot be moved at all. The profit must be on the bulk. It might even, for that matter, be worth while to remove a grain crop at a nominal rate to avoid the risk of its being wasted, and so decrease the price for the district, for the total and continual traffic depends on the greater or less prosperity of the railway district. All these questions can only be decided, as Mr. Danvers has laid down, by statistical investigation, and it is of great importance that establishments for this purpose, which cost little money, should be adequately organised. It is to be trusted that the result of the paper of Mr. Danvers, when it comes to be discussed in England and India, through the wide circulation of the *Journal of the Society of Arts*, will be to place railway extension, and the provisions of irrigation and public works likewise, on a proper basis, by making them independent of the experimental budgets of Indian financial administrators, and of the casual development of a country for which no adequate provision is made.

TWELFTH ORDINARY MEETING.

Wednesday, February 21st, 1877; Lord Alfred S. Churchill, Chairman of Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Cohen, Mrs., 6, Holland-park, Notting-hill, W.
Copland, William Robertson, 83, West Regent-street, Glasgow.
Eve, Henry Weston, 37, Gordon-square, W.C.
Garnett, George, The Friars, Monkton-street, Ryde, Isle of Wight.
Hildebrandt, John Albert Rheinhold, A.I.C.E., M.I.M.E., Bow-chambers, 55, Cross street, Manchester.
Morris, Joseph, Stopford-road, Jersey.
Morton, Robert, 22, The Chase, Clapham-common, S.W.
Nathan, J., 38, Elgin-road, St. Peter's-park, W.
Peto, Henry, 10, Stafford-terrace, Kensington, W.
Steet, G. Carrick, Medical Department, General Post-office, E.C.
Strongitharm, Augustus Horace, Barrow-in-Furness.
Volckman, William, 43, Victoria-road, Kensington, W., and Buckingham Club, Waterloo-place, S.W.
Wigner, George William, F.C.S., 79, Great Tower-street, E.C.

The following candidates were balloted for, and duly elected members of the Society:—

Arnot, William, F.C.S., St. Margaret's, Kirkintilloch.
Baker, Francis Henry, 24, Portsdown-road, Maida-vale, W.
Beresford, Lieut. Claudius, R.E., Learmount-park, Londonderry, Ireland.
Byas, Edward Higley, 25, Belsize-park, Hampstead, N.W.
Chadburn, William, 71, Lord-street, Liverpool.
Dellagana, James, junr., 106 and 107, Shoe-lane, Fleet-street, E.C.
Fuller, Thomas C., 2, St. Mary's-villas, The Elms, Ramsgate.
Haworth, W, 80, Warwick-gardens, Kensington, W.
Keates, Thomas William, The Acacias, East Dulwich, S.E.
Litting, George, M.A., LL.B. (London), Grammar, school, Stevenage.
Lowe, Charles Harlowe, A.I.C.E., Vestry-hall, Hampstead, N.W.
Lundie, George Archibald, Tweed-lodge, Charles-street, Cardiff.
Pope, William, 89, Cold Harbour-lane, Camberwell, S.E.
Rowley, Captain Charles J., R.N., H.M.S. *Iron Duke*, Kingstown, Ireland.
Shepherd, H. H. B., 24, Victoria-road, Kentish Town, N.W.
Tappley, Rev. Frederick, 18, Victoria-grove, Folkestone.

A lecture was delivered on—

CERTAIN RELATIONS BETWEEN PLANTS AND INSECTS.

By Sir John Lubbock.

The Council of our Society have determined this session to have a certain number of evening lectures, and have done me the honour of asking me to deliver the first. Your Secretary has, moreover, suggested that I should take for my subject a continuation of the lecture which I delivered before the British Association at Belfast, and which I have since expanded into a little book, on the "Relations of Flowers and Insects," and especially on the fertilisation of flowers by insects. It would, no doubt, have been easy to occupy not only a single evening, but even the whole time of the course, by descriptions of the various ingenious contrivances through which this is effected. I propose, however, on the present occasion, to ask you to look at the question from a somewhat different point of view, and have taken for my title, "Certain Relations Between Plants and Insects." This will include not only the modes of attraction, but the means of defence, which have been elaborated by plants, and also the influence exercised by plants on insects.

Neither plants nor insects, indeed, would be what they are, but for the influence which each has exercised on the other. We know now, for instance, that certain plants produce no seeds at all unless visited by insects. Thus, in some of our colonies, the common red clover sets no seeds on account of the absence of humble bees; for the proboscis of the hive bee is not long enough to affect the object. According to Mr. Belt, the same is the case for the same reason in Nicaragua with the scarlet-runner.

But even in those cases in which it is not absolutely necessary, it is a great advantage that the flowers should be fertilised by pollen brought from a different plant, and, with this object in view, insects are tempted to visit flowers for the sake of the honey and pollen; while the colours and scents are useful in making the flowers more easy to find.

The real use of honey, indeed, now seems so obvious that it is remarkable to see the various theories which were entertained on the subject. Patrick Blair thought it absorbed the pollen, and then fertilised the ovary. Pontedera thought it kept the ovary in a moist condition. Linnæus confessed his inability to solve the question. Other botanists considered that it was useless material, thrown off in the process of growth. Krünitz even observed that in meadows much visited by bees the plants were more healthy, but the inference he drew was that the honey, unless removed, was very injurious, that the bees were of use in carrying it off. Sprengel was the first to show that the real office of the honey is to attract insects, but his views was far from meeting with general consent, and even so lately as 1833 were altogether rejected by Kurr, who came to the conclusion that the secretion of honey is the result of developmental energy, which afterwards concentrates itself on the ovary.

One reason why the earlier botanists missed the true explanation was, perhaps, that some plants secrete honey on other parts besides the flowers. Belt and Delpino have, I think, suggested the true function of these extra floral nectaries. The former of these excellent observers describes a South American species of acacia, which, if unprotected, is apt to be stripped of the leaves by a leaf-cutting ant, which uses the leaves, not directly for food, but, according to Mr. Belt, to grow mushrooms on. The acacia, however, bears hollow thorns, and each leaflet produces honey in a crate-formed gland at the base, and a small, sweet, pear-shaped body at the tip. In consequence, it is inhabited by myriads of a small ant, *Pseudomyrma bicolor*, which nests in the hollow thorns, and thus finds meat, drink, and lodging all provided for it. These ants are continually roaming over the plant, and constitute a most efficient body guard, not only driving off the leaf-cutting ants, but in Mr. Belt's opinion, rendering the leaves less liable to be eaten by herbivorous mammalia.

Delpino mentions that on one occasion he was gathering a flower of *Clerodendron fragrans*, when he was suddenly attacked by a whole army of small ants.

I am not aware that any of our English plants are protected in this manner from the browsing quadrupeds, but not the less do our ants perform for them a very similar function, by keeping down the number of small insects, which would otherwise rob them of their sap and strip them of their leaves.

Mr. Forel watched, from this point of view, a nest of *Formica pratensis*. He found that the ants brought in dead insects, small caterpillars, grasshoppers, cercopis, &c., at the rate of about 28 a minute, or more than 1,600 in an hour. When it is considered that the ants work not only all day, but in warm weather often all night too, it is easy to see how important a function they fulfil in keeping down the numbers of small insects.

Some of the most mischievous, indeed—certain species, for instance, of aphis and coccus—have turned the tables on the plants, and converted the ants from enemies into friends, by themselves developing nectaries, and secreting honey, which the ants love. We have all seen the little brown garden ant, for instance, assiduously running up the stems of plants, to milk their curious little cattle. By this ingenious idea, not only do the aphides and cocci secure immunity from the attacks of the ants, but even turn them from foes into friends. They are subject to the attacks of a species of ichneumon, which lays its eggs in them, and Delpino has seen the ants watching over them with truly maternal vigilance, and driving off the ichneumons whenever they attempted to approach.

But though ants are in some respects very useful to plants, they are not wanted in the flowers. The great object is to secure cross fertilisation; but for this purpose winged insects are almost necessary, because they fly readily from one plant to another, and generally confine themselves for a certain time to the same species. Creeping insects, on the other hand, naturally would pass from each floret to the next; and, as Mr. Darwin has shown in his last work, it is of little use to bring pollen from a different flower of the same plant; it must be from a different plant altogether. Moreover, when they quitted a plant they would naturally creep up another close by without any regard to species. Hence, even to small flowers (such as many cruciferæ, compositæ, saxifrages, &c.), which, as far as size is concerned might well be fertilised by ants, the visits of flying insects are much more advantageous. Moreover, if larger flowers were visited by ants, not only would they deprive the flowers of their honey without fulfilling any useful function in return, but they would probably prevent the really useful visits of bees. If you touch an ant with a needle or a bristle, she is almost sure to seize it in her jaws, and if bees when visiting any particular plant were liable to have the delicate tip of their proboscis seized on by the horny jaws of an ant, we may be sure that such a species would soon cease to be visited.

On the other hand, we know how fond ants are of honey, and how zealously and unremittingly they search for food. How is it, then, that they do not anticipate the bees and secure the honey for themselves? Kerner has recently published a most interesting memoir on this subject, and pointed out a number of ingenious contrivances by which flowers protect themselves from the unwelcome visits of such intruders.

The most frequent are by the interposition of *chevaux de frise*, which ants cannot penetrate, glutinous parts which they cannot traverse, slippery slopes which they cannot climb, or barriers which close the way.

Firstly, then as regard *chevaux de frise*.

In some respects they are the most effectual protection, since they exclude not only creeping insects, but also other creatures, such as slugs.

With this object it will be observed that the hairs which cover the stalks of so many herbs, usually point downwards. A good example of this is afforded, for instance, by a plant allied to our common blue scabious, *Kuantia dipsacifolia*. The heads of the common carline (*Carlina vulgaris*), again, present a sort of thicket, which must offer an impenetrable barrier to ants. Some species of plants are quite smooth, excepting just below the flowers. The common but beautiful cornflower (*Centauria cyanus*) is quite smooth, but the involucres forming the flower head are bordered with recurved teeth.

In this case neither the stem nor the leaves show a trace of such prickles. In this species the stigma projects about 1-5th inch above the flower, so that if ants could obtain access, they would steal the honey without fertilising the flower; a flying insect, on the contrary, alighting on the flower, could scarcely fail to touch the stigma.

Kerner has called attention to very interesting illustration afforded by the *Polygonum amphibium*. The beautiful rosy flowers of this species are rich in nectar; the stamens are short; the pistil, on the contrary, projects considerably above the corolla. The nectar is not protected by any special arrangement of the flower itself, and is accessible even to very small insects. The stamens ripen before the pistil, and any flying insect, however small, coming from above, would assist in cross-fertilisation. Creeping insects, on the contrary, which in most cases would enter from below, would rob the honey without benefiting the plant. *P. amphibium*, as its name denotes, grows sometimes in water, sometimes on land. So long, of course, however, as it grows in water, it is thoroughly protected, and the stem is smooth, while, on the other hand, those specimens which live on land throw out certain hairs which terminate in sticky glands, and thus prevent small insects from creeping up to the flowers. In this case, therefore, the plant is not sticky, except just when this condition is useful.

All these viscous plants, as far as I know, have upright or horizontal flowers. On the other hand, where the same object is effected by slippery surfaces, the flowers are often pendulous; creeping creatures being thus kept out of them, just as the pendulous nests of the weaver bird are a protection from snakes and other enemies. As instances of this kind, I may mention the common snowdrop, or the Cyclamen.

I have elsewhere ventured to suggest that the so-called "sleep" of flowers had reference to the habits of insects, on the ground that flowers which are fertilised by night-flying insects would derive no advantage by being open in the day; while, on the other hand, those which are fertilised by bees would gain nothing by being open at night. I confess that I suggested this with much diffidence, but it may now, I think, be regarded as well established.

Silene nutans, the Nottingham catchfly, is a very instructive species from this point of view, and indeed illustrates a number of interesting points in the relations between plants and insects. Its life history has recently been well described by Kerner. The upper part of the flowering stem is viscid, from which it has derived its local name, the Nottingham catchfly. This prevents the access of ants and other small creeping insects. Each flower lasts three days, or rather three nights. The stamens are ten in number, arranged in two sets, the one set standing in front of the sepals, the other in front of the petals. Like other night flowers, it is white, and opens towards evening, when it also becomes extremely fragrant. The first evening, towards dusk, the stamens in front of the sepals grow very rapidly for about two hours, so that they emerge from the flower; the pollen ripens, and is exposed by the bursting of the anther. So the flower remains through the night, very attractive to and much visited by moths.

Towards three in the morning the scent ceases, the anthers begin to shrivel up or drop off, the filaments turn themselves outwards, so as to be out of the way, while the petals, on the contrary, begin to roll themselves up, so that by daylight they close the aperture of the flower, and present only their brownish-green undersides to view, which, moreover, are thrown into numerous wrinkles. Thus, by the morning's light, the flower has all the appearance of being faded. It has no smell, and the honey is covered over by the petals. So it remains all day. Towards evening, however, everything is changed. The petals unfold themselves, by eight o'clock the flower is as fragrant as before, the second set of stamens have rapidly grown, their anthers are open, and the pollen again exposed. By morning the plant is again asleep, the anthers are shrivelled, the scent has ceased, and the petals rolled up as before. The third evening again the same process, but this time it is the pistil which grows, and the long spiral stigmas on the third evening take the position which on the previous two had been occupied by the anthers, and can hardly fail to be dusted by the moths with pollen brought from another flower.

An objection to the view that the sleep of flowers is regulated by the visits of insects, might be derived from the cases of those flowers which close early in the day, the well-known *Tragopogon pratense*, or "John Go-to-bed at Noon," for instance; still more, such species as *Lapsana communis*, or *Crepis pulchra*, which open before six and close again before ten in the morning. Bees, however, are very early risers, while ants come out much later, when the dew is off the grass; so that it might well be an advantage to a flower which was quite unprotected to open early for the bees, and close again before the ants were out, thus preserving its honey for another day.

So much for the first part of my subject. I must now pass to the second—the action of plants on insects. It would here, perhaps, be most natural to discuss the modifications which have been produced in insects by the search after honey and pollen, especially the gradual lengthening of the proboscis in butterflies, moths, and bees, to enable them to suck the honey, and the adaptation of the legs of bees to enable them to carry off the more or less dry and dusty pollen. Having, however, already treated of them elsewhere, it will be better for me to take other illustrations, and fortunately there is no lack or difficulty.

Many of the cases in which certain insects escape danger by their similarity to plants are well known; the leaf insect and the walking-stick insect are familiar and most remarkable cases.

The larvæ of insects afford, also, many interesting examples.

I will not, however, refer to isolated cases—however interesting in themselves—on the present occasion, but will take a group and see how far we can explain its various colours and markings, and what are the lessons which they teach us. For this purpose I think I cannot do better than select the larvæ of the *Sphingidæ*, which has just been the subject of a masterly monograph by Dr. Weissmann, the learned professor of Frieburg.

Let me ask you, then, to glance at the diagrams of caterpillars behind me. They are very different in colour—green, white, yellow, brown, sometimes even gaudy, varied with spots, patches, streaks, and lines. Now, are these merely casual and accidental, or have they a meaning and a purpose?

In many, perhaps in most cases, the markings serve for the purpose of concealment. When, indeed, we see caterpillars represented on a white sheet of paper, or if we put them on a plain table, and focus the eye on them, the colours and markings would seem, if possible, to render them even more conspicuous, as, for instance, in this diagram of *D. galii*; but amongst the intricate lines and varied colours of foliage and flowers, and if the insect is a little out of focus, the effect is very different.

Let us begin with the *Chærocampa elpenor*, the elephant hawk moth. The caterpillars, as represented in most entomological works, are of two varieties, most of them brown, but some green, Both have a white line on the three first segments; two remarkable eye-like spots* on the fourth and fifth, a very faint median line, and another more than four inches long. I will direct your attention specially, for the moment, to three points:—What mean the eye-spots and the faint lateral line; and why are some green and some brown, offering thus such a marked contrast to the leaves of the *Epilobium parvum*, on which they feed? Other questions will suggest themselves later, for I must now call your attention to the fact that, when they first quit the egg, and come into the world, they are quite different in appearance, being, like so many other small caterpillars, bright green, and almost exactly the colour of the leaves on which they feed. That this colour is not a necessary or direct consequence of the food, we see from the case of quadrupeds, which, as I need not say, are never green. It is, however, so obviously a protection to them, that the explanation of the green colour of small caterpillars suggests itself to everyone. After five or six days, and when they are about ¼-inch in length, they go through their first moult. In their second stage they have a white subdorsal line stretching along the body, from the horn to the head; and after a few days, but not at first, traces of the eye-spots appear on the fourth and fifth segments. There is also a second pale line running along the side. Please remark these two lines. After another five or six days, and when about ½-inch in length, our caterpillars moult again. In their third stage, the commencement of the eye-spots is more marked, while, on the contrary, the lower longitudinal line has disappeared. After another moult, the eye-spots are still more distinct, the white gradually becomes surrounded by a black line, while the centre becomes somewhat violet. The subdorsal line has almost, or entirely, disappeared, and in some specimens faint diagonal lines make their appearance. Some few assume a brownish tint, but not many. A fourth moult takes place in seven or eight days, and when the caterpillars are about an inch and a half in length. Now, the difference shows itself still more between the two varieties, some remaining green, while the majority become brown. The eye-spots are more marked and the

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* The shaded portions, which replace the eye-spots on the other segments, are an instance of the general rule that a character which appears on every two segments, has a tendency to develop itself on every other segment.

pupil more distinct, the diagonal lines plainer, while the subdorsal line is only indicated on the first three and the eleventh segments. The last stage has been already described.

Now, the principal points to which I desire to draw your attention are (1) the green colour, (2) the longitudinal lines, (3) the diagonal lines, (4), the brown colour, and (5) the eye-spots. There are, however, some other very instructive points to which I should like to draw your attention presently, because they throw much light on this group of insects.

But to return to my five points. As regards the first—the green colour—I think I need say no more. The value to the young insect, the protection it affords, is obvious. We must all have observed how difficult it is to distinguish small green caterpillars from the leaves on which they feed. When, however, they become somewhat larger their form betrays them, and it is important that there should be certain marks to direct the eye from the outlines of the body. This is effected, and much protection given, by longitudinal lines, such as those occurring in the second stage of our larvæ. These lines, both in colour and thickness, much resemble some of the lines on leaves (especially those, for instance, of grasses), and also the streaks of shadow which occur among foliage. If, however, this is the explanation of them, then they ought to be wanting, as a general rule, in very small caterpillars, and to prevail most among those which feed on, or among grasses. Now, similar lines occur on a great number of caterpillars belonging to most different groups of butterflies and moths, as you may see by turning over the illustrations of any monograph of the lepidoptera. We have seen that they exist among the hawk moths, as, for instance, in *Ch. Elpenor;* they occur in many butterflies, as, for instance, in *Arge galathea*, which feeds on the cat's-tail grass; and among moths, as, for instance, in *Pyrophila tragopoginis,* which feeds on the leaves of the "John go-to-bed at Noon" (*Tragopogon*). Now you will find that the smallest caterpillars rarely possess these white streaks. As regards the second point also, the streaks are generally wanting in caterpillars which feed on large-leaved plants. The *Satyridæ*, on the contrary, all possess them, and all live on grass. In fact we may say, as a general rule, that these longitudinal streaks only occur on caterpillars which live on or among narrow-leaved plants. We have seen that in a later stage these lines disappear on certain segments, and are replaced by diagonal lines. In this particular species these diagonal lines are faint, but in a great many other caterpillars belonging to the most distinct families of butterflies and moths, they are conspicuous and no doubt important. Now these diagonal lines come off just at the angle of the ribs of leaves, and resemble them very much in general effect. They occur also especially in species which feed on large-leaved plants, and I believe I may say that though a great many species of caterpillars present these lines, they are rarely if ever present in species which live on grass. In this diagram are represented three of such caterpillars, one belonging to each of the three great divisions of lepidoptera, namely, that of the purple emperor (*Apetura iris*) which feeds on the oak, as representing the butterflies; that of the privet hawk-moth; and lastly, that of a moth, the Kentish glory (*Endromis versicolor*), which feed on larged-leaved plants, and I believe I may say that, though very frequent, they rarely occur in species which live on grass. It might at first be objected to the view that there are many cases, as indeed in our elephant hawk-moth, in which caterpillars have both. A little consideration however will explain this. In small caterpillars these oblique lines would be useless, because they must have some relation, not only in colour, but in their distances apart, to the ribs of the leaves. Hence, while there are a great many species which have longitudinal lines when young, and diagonal ones when they are older and larger, there is not, I believe, a single one which begins with diagonal lines and then replaces them with longitudinal ones. You will also observe that the longitudinal lines still remain in our caterpillar on those segments which have no diagonal ones. This also often occurs, and it is striking where the lines are marked. This is also an advantage, because white lines crossing one another at such an angle have no relation to anything which occurs in plants, and would make the creature more conspicuous. It is an advantage therefore that when the diagonal lines are developed, the longitudinal ones should disappear. There is one other point in connection with these diagonal lines to which I must call your attention. In our species they are white, but in some cases, as for instance in the beautiful green caterpillar of the privet hawk-moth, the white streak is accompanied by a coloured one—in that case lilac. At first we might think that this would be a disadvantage, as tending to make the caterpillar more conspicuous; and in fact if we put one in full view out, for instance, on a table, the coloured lines are very striking. But we must remember that the habit of the insect is to sit on the inside of the leaf, generally near the midrib, and in the subdued light of such a situation the coloured lines beautifully simulate a line of soft shadow, such as must always accompany a strong rib, and I need not tell any artist that the shadows of yellowish green must be purplish. Moreover any one who has ever found one of these large caterpillars, will, I am sure, agree with me that it is surprising, when we consider their size and conspicuous colouring, how difficult they are to see.

The next point is the colour of the mature caterpillars. We have seen that some are green and others brown; and the green ones are obviously merely those which have retained their original colour.

Now for the brown colour. It is evident that this makes the caterpillar even more conspicuous among the green leaves than would otherwise be the case. Let us see then whether the habits of the insects will throw any light upon the riddle. What would you do if you were a big caterpillar? Why, like most other defenceless creatures, you would feed by night and lie concealed by day. So do these caterpillars. When the morning light comes they creep down the stem of the food plant, and lie concealed among the thick herbage and dry sticks and leaves near the ground, and it is obvious that under such circumstances the brown colour really becomes a protection. It might indeed be said that the caterpillars having become brown, concealed themselves on the ground; that in fact we were reversing the state of things. But this is not so, because while we may say, as a general rule, that (with some exceptions due to obvious causes) large caterpillars feed by night and lie concealed by day, it is by no means always the case that they are brown, some of them still retaining the green colour. We may then conclude that the habit of concealing themselves by day came first, and that the brown colour is a later adaptation. It is, moreover, interesting that while the caterpillars which live on plants often go down to the ground and turn brown, those which feed on large trees or plants remain on the underside of the leaves, and retain their green colour.

Thus, in *Smerinthus ocellatus*, which feeds on the willow and sallow; *S. populi*, which feeds on the poplar; and *S. tiliæ*, which frequents the lime, the caterpillars all remain green; while in the convolvulus hawkmoth, which frequents the convolvulus, *Chærocampa nerii*, which feeds in this country on the periwinkle; *Chærocampa celeris*, *Ch. elpenor*, and *Ch. porcellus*, which feed on galium, most of the caterpillars turn brown.

There are, indeed, some caterpillars which are brown, and yet do not go down to the ground, as for instance, those of *Aspilatis aspersaria*, and indeed of the *geometridæ* generally. These caterpillars. however, place themselves in peculiar attitudes, which, combined with their brown colour, make them look almost exactly like bits of stick or dead twigs.

The last of the five points to which I called your attention was the eye-spots. In some cases spots may serve for concealment, by resembling the marks on dead leaves. In *Deilephila hippophae*, which feeds on the hippophae, or sea buckthorn, a very grey-green plant; the caterpillar, also, is a very similar grey-green, and has, when full grown, a single red spot on each side, which, as Weissmann suggests, at first sight much resembles in colour and size one of the berries of hippophae, which, moreover, are present, though not ripe, at the same period of the year. Again, in *Chærocampa tersa*, there is an eye-spot on each segment, which mimics the flower of the plant on which it feeds (*Spermacoce hyssopifolia*). White spots, in some cases, also resemble the spots of light which penetrate foliage. In other cases, however, and at any rate in our elephant hawk-moth, the eye-spots certainly render the insect more conspicuous. Now in some cases, as Wallace has pointed out, this is an advantage rather than a drawback. Suppose that from the nature of its food, or any other cause, as for instance from being covered with hair, a small green caterpillar was very bitter, or in any way disagreeable or dangerous as food, still in the number of small green caterpillars which birds love, it would be continually swallowed by mistake. If on the other hand it had a conspicuous and peculiar colour, its evil taste would serve to protect it, because the birds would soon recognise and avoid it, as Weir and others have proved experimentally. We have a striking case of this among the hawk-moths in *Deilephila euphorbiæ*, which feeding on the Euphorbia with its bitter milky juice, is very distasteful to birds, and is thus actually protected by its bold and striking colours. The spots on our elephant hawkmoth caterpillar do not admit of this explanation, because the insect is quite good to eat, I mean for birds; we must, therefore, if possible, account for them in some other way. There can, however, I think be little doubt that Weissmann is right when he suggests that they actually protect the caterpillar by frightening its foes.

Everyone must have observed that these large caterpillars have a sort of uncanny, poisonous appearance; that they suggest a small thick snake or other evil beast, and the eyes do much to increase the deception. Moreover, the segment on which they are placed is swollen, and the insect when in danger has the habit of retracting its head and front segments, which gives it an additional resemblance to some small reptile. That small birds are, as a matter of fact, afraid of these caterpillars (which, however, I need not say are in reality altogether harmless) Weissmann has proved by actual experiment. He put a caterpillar in a tray in which he was accustomed to place seed for birds. Soon a little flock of sparrows and other small birds assembled to feed as usual. One of them lit on the edge of this tray, and was just going to hop in, when she spied the caterpillar. Immediately, she began bobbing her head up and down, but was afraid to go nearer. Another joined her, and then another, until at last there was a little company of ten or twelve birds, all looking on in astonishment, but not one ventured into the tray, while one which lit in it unsuspectingly, beat a hasty retreat in evident alarm as soon as she perceived the caterpillar. After watching for some time, Weissmann removed the caterpillar, when the birds soon attacked the seeds.

Other caterpillars also probably, of nearly allied species, are protected by their curious resemblance to spotted snakes.

There are many—very many—other points connected with the colouring of sphinx caterpillars, to which I might refer if time permitted. I will only allude to two. The peculiar hues of the death's-head hawk-moth caterpillar, which feeds on the potato, and unites so beautifully the brown of the earth, the yellow and green of the leaves, and the blue of the flowers, that, in spite of its size, it can scarcely be perceived unless the eye be focussed exactly upon it. The other is the anceryx. The caterpillars of this genus differ in style of colouring from all other sphinx larvæ, having longitudinal bands of brown and green. Why is this? Their *habitat* is different. They feed on the leaves of the pinaster, and their peculiar colouring offers a general similarity to the brown twigs and narrow green leaves of a conifer. There are not many species of lepidoptera which feed on the pine, but there are a few, and I have here diagrams of two, *Achatia spreta* and *Dendrobinus pini*, both of which, as you will see, have a very analogous style of colouring, while the latter has also tufts of blueish green hair which singularly mimic the leaves of the pine. I have added also the larvæ of a species of saw-fly (one of the hymenoptera), which also attacks the pine, and you will see that here also the colouring is curiously similar (*Lophyrus socia*).

But, as Wiessmann points out, we may learn another very interesting lesson from these caterpillars. They leave the egg, as we have seen, a plain green, like so many other caterpillars, and gradually acquire a succession of markings, the utility of which I have just attempted to explain. The young larva, in fact, represents an old form, and the species in the lapse of ages has gone through the stage which each individual now passes through in a few weeks. Thus the caterpillar of *Chœrocampa porcellus*, the small elephant hawk-moth, a species very nearly allied to *Ch. elpenor*, passes through almost exactly the same stages as that of *Ch. elpenor*. But it leaves the egg with a subdorsal line. No one can doubt, however, that there was a time when the new-born caterpillars of *Ch. porcellus* were plain green, like those of *Ch. elpenor*. In this respect, then, *Ch. porcellus* is a newer specific form than *Ch. elpenor*. Again, if we compare the mature caterpillars of *Chœrocampa* we shall find that there are some forms, such as *Ch. myron* and *Ch. chœrilus* which never develop eye-spots, but correspond to the second stage of *Ch. elpenor*. Here then we seem to have a species still in the stage which *Ch. elpenor* must have passed through long ago.

The genus Deilephila, of which we have in England three species—the euphorbia hawk-moth, the galium hawk-moth, and the rayed hawk-moth, is also very instructive. The caterpillar of the euphorbia hawk-moth begins life of a clear green colour, without a trace of the subsequent markings. After the first moult, however, it has a number of black patches, a white line, and a series of white dots, and has, therefore, at one bound, acquired characters, which in *Ch. elpenor*, as we have seen, were only very gradually assumed. In the third stage the line has disappeared, leaving the white spots. In the fourth the caterpillars have become very variable, but are generally much darker than before, and have a number of white dots under the spots. In the fifth stage there is a second row of white spots under the first. The caterpillars not being good to eat, there is, as has been already pointed out, no need for, nor attempt at, concealment. Now, if we compare the mature caterpillars of other species of the genus, we shall find that they represent phases in the development of *D. euphorbiæ*. *D. hippophae*, for instance, even when full grown, is a plain green, with only a trace of the line, and corresponds, therefore, with a very early stage of *D. euphorbiæ*; *D. zygophylli*, of South Russia, has the line, and represents the second stage of *D. euphorbiæ*; another Deiliphila has the line and row of spots, and the third stage; lastly, *D. vespertilio* and *D. galii* have progressed further, and lost the longitudinal line, but they never acquire the second row of spots which characterise the last stage of *D. euphorbiæ*.

The larvæ of insects teach us, indeed, many instructive lessons. It would be a great mistake to regard them as merely preparatory stages in the development of the perfect insect. They are much more than this, for the external circumstances act on the larvæ as well as on the perfect insect, and both, therefore, are liable to adaptation. In fact, the modifications which insect larvæ undergo may be divided into two kinds—developmental, or those which tend to approximation to the mature form; and adaptational or adaptive—those which tend to suit it to its own mode of life.

It is a remarkable fact, and except on those principles with which the name of our great countryman, Mr. Darwin, are justly united, I do not see how it can be accounted for, that the forms of larvæ do not depend on that of the mature insect. In these diagrams, for instance, are represented some very similar larvæ, and the very dissimilar perfect forms which they ultimately assume. In other cases similar, or comparatively similar, perfect insects have very dissimilar larvæ. Indeed, a classification of insects founded on larvæ would be quite different from that founded on the perfect insects. The *Hymenoptera*, for instance, which, so far as the perfect insects are concerned, form a very homogeneous group, would be divided into two—or rather one portion of them, namely, the saw-flies, would be united to the butterflies and moths. Now, why do the larvæ of saw-flies differ from those of other *Hymenoptera* and resemble those of butterflies and moths? It is because their habits differ from those of other *Hymenoptera*, and they feed on leaves like ordinary caterpillars.

From this point of view the transformations of the genus Sitaris, which has been very carefully investigated by M. Fabre, are peculiarly interesting.

The genus Sitaris (a small beetle allied to *Cantharis*, the blister-fly, and to the oil-beetle) is parasitic to a kind of bee (*Anthophora*) which excavates subterranean galleries, each leading to a cell. The eggs of the sitaris, which are deposited at the entrance of the galleries, are hatched at the end of September or beginning of October, and M. Fabre not unnaturally expected that the young larvæ, which are active little creatures with six serviceable legs would at once eat their way into the cells of the anthophora. No such thing: till the month of April following they remain without leaving their birthplace, and consequently without food; nor do they in this long time change either in form or size. M. Fabre ascertained this, not only by examining the burrow of the anthophoras, but also by direct observations of some young larvæ kept in captivity. In April, however, his captives at last awoke from their long lethargy, and hurried anxiously about their prisons. Naturally inferring that they were in search of food, M. Fabre supposed that this would consist either of the larvæ or pupæ of the anthophora, or of the honey with which it stores its cell. All three were tried without success. The first two were neglected, and the larvæ, when placed on the latter, either hurried away or perished in the attempt, being evidently unable to deal with the sticky substance. M. Fabre was in despair: "Jamais expérience," he says, "n'a éprouvé pareille déconfiture. Larves, nymphes, cellulles, miel, je vous ai tous offert; que voulez-vous, donc, bestioles maudites?" The first ray of light came to him from our countryman, Newport, who ascertained that a small parasite found by Léon Dufour on one of the wild bees, was, in fact, the larva of the oil beetle. The larvæ of sitaris much resembled Dufour's larvæ; acting on this hint M. Fabre examined many specimens of anthophora, and found on them at last the larvæ of his sitaris. The males of anthophora emerge from the the pupæ sooner than the females, and M. Fabre ascertained that, as they come out of their galleries, the little sitaris larvæ fasten upon them. Not, however, for long: instinct teaches them that they are not yet in the straight paths of development; and, watching their opportunity, they pass from the male to the female bee. Guided by these indications, M. Fabre examined several cells of the anthophora; in some, the egg of the anthophora floated by itself on the surface of the honey, in others, on the egg as on a raft, sat the still more minute larva of the sitaris. The mystery was solved. At the moment when the egg is laid the sitaris larvæ springs upon it. Even while the poor mother is carefully fastening up her cell, her mortal enemy is beginning to devour her offspring; for the egg of the anthophora serves not only as a raft, but as a repast. The honey which is enough for either, would be too little for both; and the sitaris, therefore, at its first meal, relieves itself from its only rival. After eight days the egg is consumed, and on the empty shell the sitaris undergoes its first transformation, and makes its appearance in a very different form.

The honey, which was fatal before, is now necessary, the activity, which before was necessary, is now useless; consequently, with the change of skin, the active, slim larvæ changes into a white, fleshy grub, so organised as to float on the surface of the honey, with the mouth beneath and the spiracles above the surface: "grâce à l'embonpoint du ventre," says M. Fabre, "la larve est à l'abre de l'asphyxie." In this state it remains until the honey is consumed; then the animal contracts, and detaches itself from its skin, within which the further transformations take place. In the next stage, which M. Fabre calls the pseudo-chrysalis, the larva has a solid corneous envelope and an oval shape, and in its colour, consistency, and immobility reminds one of a *Dipterous pupa*. The time passed in this condition varies much. When it has elapsed the animal moulds again, again changes its form; after this it becomes a pupa, without any remarkable peculiarities. Finally, after these wonderful changes and adventures, in the month of August the perfect sitaris makes its appearance.

In fact, whenever in any group we find differences in form, or colour, we shall always find them associated with differences in habit.

To return, however, to my principal subject, the sphinx caterpillars. For such an enquiry as this, the larvæ of Lepidoptera are particularly suitable, because they live an exposed life; the different species even of the same genus often feed on different plants, and are therefore exposed to different conditions, and last, not least, because we know more about the larvæ of the Lepidoptera than of any other insects. The larvæ of ants all live in the wet; they are fed by the perfect ants, and being therefore all subject to very similar conditions are all very much alike. It would puzzle even a good naturalist to determine the species of an ant larva, while, as we all know, the caterpillars of butterflies and moths are as easy to distinguish as the butterflies and moths; they differ from one another as much as, sometimes more than the perfect insect.

There are five principal types of colouring among caterpillars. Those which live inside wood, or leaves, or underground, are generally of a uniform pale line; the small leaf-eating caterpillars are green, like the leaves on which they feed. The other three types may, *si parva licet componere magnis*, be compared with the three types of colouring among cats. There are the ground cats, such as the lion or puma, which are brownish or sand colour, like the open places they frequent. So also caterpillars which conceal themselves by day at the roots of their food-plant tend, as we have seen, even if originally green, to assume the colour of earth. The spotted or eyed cats, such as the leopard, live among trees; and their peculiar colouring renders them less conspicuous by mimicking spots of light which penetrate through foliage. Lastly, there are the jungle cats, of which the tiger is the typical species, and which have stripes, rendering them very difficult to see among the brown grass which they frequent. It may, perhaps, be said that this comparison fails, because the stripes of tigers are perpendicular, while those of caterpillars are either longitudinal or oblique. This, however, so far from constituting a real difference, confirms the explanation, because in each case the direction of the lines follows those of the foliage. The tiger, that walks horizontally on the ground, has transverse bars; the caterpillar, which clings to the grass in a vertical position, has longitudinal lines, while those which live on large veined leaves have oblique lines like the oblique ribs of the leaves.

Thus then, I think, we see reasons for many at any rate of the variations of colour and markings in caterpillars, which at first sight seem so fantastic and inexplicable. I should, however, produce an impression very different from that which I wish to convey, were I to lead you to suppose that all these varieties have been explained or are understood. Far from it, they still offer a large field for study; nevertheless I venture to think the evidence brought before you to-day, however imperfectly, is at least sufficient to justify the conclusion that there is not a hair, or a line, not a spot or a colour, for which there is not a reason, which has not a purpose and a function in the economy of Nature.

MISCELLANEOUS.

WATER SUPPLY OF THE METROPOLIS.

The following letter has been addressed to the Right Hon. Richard A. Cross, Secretary of State for the Home Department:—

Sir,—On behalf of the Executive Committee of the National Health Society, I am to crave your pardon for reminding you at this time of your promise made to a deputation of the society, that you would do your best to prepare a measure for the better supply of water to the metropolis, and to submit to you some suggestions and points of information therein.

Without dwelling on the grievous injuries and losses that have occurred from the delay in the realisation of the promise of the Premier to Colonel Beresford, of support to his excellent Bill, made before the change of government took place, I am to state that the society have derived much encouragement as to your disposition to promote remedial measures for the metropolis, by the fact of your having moved the extension of the inquiries of the grievances of some men of the Fire Brigade, to the grievances of four millions of population in the insecurity of their lives and property from fire arising from the defective conditions of the distribution of water for its prompt extinction. Already has that inquiry elucidated evidence of the most important character. Our committee are further encouraged, by your recent expression, at Birmingham, of your admiration of the local administration of that and other municipal institutions,—because, as the committee are anxious to point out, you will find in the legislation and administration of that municipality, and of Glasgow, Manchester, Liverpool, and other municipalities, most important precedents in principle and working, for the primary measure now prayed for, of placing the entire water supplies of the metropolis under unity of responsible public management. You will find that in those cities, when the water supplies were taken out of the hands of trading companies, the change was effected without difficulty from the intermittent system which occasions the stagnant detention of water in butts and cisterns—which extensively makes good supplies bad and bad supplies worse—to the system of constant and direct delivery of water fresh and well aerated. You will also find from the evidence obtained under the extended inquiry you have initiated, as to the means for better protection of life and property from fire, that in Manchester, Liverpool, and in Glasgow, by the use of hydrants on the constant supply system, and by unity of public management under the police force, the use of horse or steam engines is now only required in some 3 or 4 per cent. of cases, thus diminishing proportionally the need of the brigade force (which here it has been proposed to augment, at a great expense), and occasioning a reduction by two-thirds there of the rates of losses of life and property by fire, and proving that all delay of relief to the metropolis is at the expense of at least two-thirds of the present ordinary losses, as also of proportionate dangers of extraordinary conflagrations. The attainment of a constant supply of water for that one object, is it to be understood, would be the attainment of a constant supply for the sanitary objects so pressingly needed.

For dealing with the sanitary condition of this metropolis by the use of hydrants, also for the improvement of its sanitary condition by surface cleansing, you may be commended to the example of the metropolis of France, where by the adoption of the measures recommended by the first general board of health in England, the distinction has been obtained for that metropolis of "clean-streeted Paris," a distinction in contrast with "filthy-streeted London." The same efficient method of cleaning has been adopted in the metropolis of Austria, and even the metropolis of Spain, and there can be no doubt, from such examples as reported by a special committee of the Society of Arts, "the time and expense of the surface cleaning of the streets may be reduced more than one-half, and injuries to roads and furniture and clothes, as well as excessive dirt on the person, and serious injuries to the health from breathing dust and pulverised dung dust, and its filth on the skin, and injuries to clothes and furniture in dry weather, and from the evaporation of liquefied dung in wet weather may be prevented, and the streets be kept in all weathers in the like states of cleanliness and freshness, to those experienced after the cleansing of heavy thunder-showers."

As to the expenses at which the changes requisite for sanitary purposes as well as for security may be effected, it has been put about by adverse interests, that large sums of money will have to be raised, and great expenses will have to be incurred which must be ultimately borne by the already heavily oppressed ratepayers.

It is on these allegations the committee solicit your especial attention, to the experience of the municipalities of Manchester, Birmingham, and others. And first, as to the expense of the change of system from the intermittent to the constant system of supply; instead of necessitating an entire change of the house fittings, and an expenditure of five or six pounds per house, or of several millions, it is shown in evidence, given before the Fire Brigade Committee, that at Manchester the change was effected at a cost of between ten and eleven shillings per house only, or at an expense, with some attendant economies it would achieve, it were economical to defray from the water-rates. The cost of the hydrants in use in Manchester, and elsewhere, are from a fourth to a third of the expense which has been assumed as an objection to the change.

Your particular attention is solicited to the evidence obtained from competent sources by a committee of the Society of Arts, in which you will see that by a consolidation of the eight separate water companies on a public footing, a saving may be made of upwards of £100,000 per annum, a sum which, if capitalised, will suffice to effect gratis the primary sanitary changes required, after making full compensation on accustomed terms to the directors, officers, and to the shareholders; which, the precedents I am to adduce will show, may be effected mainly by a financial change of securities. For if you will consult the recent experience in this matter of the last municipality you visited and expressed your admiration of what it was doing—Birmingham—you will find that in taking the supply out of the hands of the trading companies and placing it on a public footing, as has recently been done there, not one penny of money need be borrowed, but only the financial change effected, as it was done there, and has been done in many other cities, of giving the shareholders a public security for their dividends, from which they will, without any cost whatever to the ratepayers, obtain a large and important addition to the saleable value of their shares.

It is proper to observe that the chief obstruction to the change of system, recommended by commission after commission, as requisite for the sanitary improvement of the metropolis, has arisen from the office-bearers, directors, and law officers, deriving emoluments from law and parliamentary expenses. Of the foremost in opposition have been those of the New River Company. There have recently been public sales of shares in this company, when the auctioneer dilated on their great value as a permanent investment, especially from the powerful interest there was in Parliament for the support of the property. In June last, on sale, what are called new shares of £100 each, on which £60 had been paid, fetched £285 to £295 each. At another sale, on the 1st ultimo, twenty-nine of the £100 new shares, in what was descanted on as "this most flourishing and successful trading corporation in the world," on which £70 had been paid, and on which the dividend and proportion of rental at Midsummer last was at the rate of £10 3s. 1d. per cent. per annum, were all sold at £310 and £315 per share. It is proper to state that a proportion of these shares is in real property belonging to the company, but it is to be observed that it was not that proportion on which parliamentary influence was, as it were, put up as part of the saleable value. It was stated in the particulars of sale that the income of the company "has never retrograded, and it must continually advance, as the company has the monopoly of the water-supply over a large area, including the City of London and the northern districts of the metropolis, where building speculations are proceeding rapidly."

I am to beg your particular attention to the report of the River Pollution Commissioners, on the quality of the supply of water in which a monopoly is thus claimed. The Commissioners state, in their sixth report, that, "the New River Company supplies 20 to 22 millions of gallons daily to 104,637 houses and about 675,000 people, including in that number 2,000 meter supplies, about 5,000,000 gallons daily, is to trade and manufacturers, the remaining 16,000,000 being for domestic purposes. The whole of this enormous quantity of water is taken from the Lee at Ponder's End." The Commissioners show that the water at the intake at Walthamstow "is charged to a high degree with previous sewage contamination."

The Commissioners further state, "that sewage and other disgusting matters reach the intake of the metropolitan water companies drawing from the River Lee, and that the soluble portions of such matters are not wholly eliminated by the efficient filtration to which the water is subjected before delivery; that the water of the Lee, though less impure than that of the Thames, is slowly though irregularly deteriorating from year to year, and that there is no hope of effectually purifying it to such an extent as to render it at all times safe for domestic use."

After showing the increase of organic impurity from year to year they conclude, "That the Lee should, therefore, be abandoned as a source of potable water; but that this measure is not so urgent as the relinquishment of the Thames water."

If you could yourself see the way in which the water of the quality stated by the Commissioners is delivered and kept stagnant in water-butts for the lower classes, as described in a report by Dr. Sutton, the medical officer of Shoreditch, you would see how the bad supplies are made worse, and why water, as a rule, is not drunk by them, and how drinking habits are induced and confirmed amongst them.

At a recent meeting of the Common Council, the chairman of a committee for examining the condition of the Mansion House, stated that "when the members of his committee and himself were discharging the duty which devolved annually on the committee, they found three-quarters of an inch of fungi-scrub floating on the top of the largest cisterns in the Mansion House, and which supplied all the other cisterns used for domestic purposes in the establishment. Moreover at the bottom of the same cistern there were three-eighths of an inch of mud, and in a bottle of water placed on the Lord Mayor's table could be seen hundreds of nematoid worms." He added "that Dr. Saunders, the medical officer of health, was so struck with the condition of the particular cistern referred to, that he would not allow his inspector to touch or look into it until two other witnesses were brought to look at it." Whether the impurities described were due in any degree to the original impurities of the water at the company's intake, as described by the River Pollution Commissioners, or to the effects of stagnant detention in cisterns, which the constant system would abolish with all care for cisternage, it were unnecessary to ask. The Government have now the supervision, and it is to be hoped will shortly have the direct charge of the county and the borough prisons. The county prisons yield instances of the best known sanitation, by which their criminal populations have an almost entire immunity from the ravages of epidemic and preventable disease; an immunity which, by the exercise of the like care and sympathy, it is hoped may ultimately be obtained for the honest and industrious population of this country. As showing what may be done by the improvement of the water-supplies, particular attention is solicited to the following extract from the last published report of the medical officer of Millbank prison, displaying the improvement made in the health of the prisoners, by such a change of the sewage-tainted river supplies (that have been condemned by the River Pollution Commissioners) to spring sources, as it is hoped by your promised measure may be gained for the general population of the metropolis.

"The prison," he says, "continues to be almost free from diseases of the miasmatic order, and this is equivalent to stating that diarrhœa and dysentery, small-pox and erysipelas, typhus and typhoid fever, are all but extinct as causes of mortality. With regard to the mortality from typhoid or enteric fever, the contrast between the ten years 1845-54 and the four following years, is very remarkable. During the first period there were fifty seven deaths from that disease; during the second only three. The improvement supply, which was effected in August, 1854, explains the great difference, and constitutes the separating line between the two periods. Prior to that date, the prison had been supplied with Thames water, pumped from the river immediately opposite the gates, and afterwards filtered. This supply was cut off, and water from the artesian well in Trafalgar-square took its place, with immediate benefit to the health of the inmates of the prison, and a large reduction in the rate of sickness and mortality. Fifteen years have now elapsed since a case of typhoid fever originated here, and it may therefore be said that in this prison the disease is extinct. Millbank, however, by no means stands alone among the government prisons in this respect. An enviable security is enjoyed, but it is not monopolised. On looking through the annual medical statistics of these prisons for the twenty years 1855-74, I find only eight deaths are ascribed to enteric fever, or 40 per annum in a population, male and female, averaging 7,013. During the five years, 1870-4, only two deaths were caused by the disease in an average population of 9,509. If the sanitary securities enjoyed by the inmates of the convict prisons could be extended to the general population of the country, many thousands of lives would every year be saved."

In all prisons great care is taken of the water-supplies, for it is found that accidental pollutions of them are attended by marked disturbance of the health of the inmates. Subjoined is an account, by a distinguished physician, of the state of the river supply on the south of the Thames.

"1. I pay £10 a-year for water-rate.

"2. I have never had a drop of water for it fit to drink, and as filtration cannot remove the soluble transparent foul matter in it I boil all my drinking water, or else buy it as aerated water.

"3. The foulness shows itself in the following manner:

"(*a*) Unless the house cisterns are frequently cleansed, which of course adds to the water-rate, it would be unsafe to use the water for culinary purposes.

"(*b*) This condition of the water shows itself by distinct putrescence in all the water whether boiled or not, if only it be allowed to stand in a jug or bottle for a certain number of days, and in a moderate house temperature. It is sensible to smell by a strong sewer odour, and to taste as putrid.

"(*c*) The result may be to a certain extent prevented by continued care in scalding and cleansing bottles and jugs, precautions which never should be necessary.

"(*d*) You know all about Dr. Hassel's microscopic investigations, but now-a-days I do not require to use his subsidence vessels.

"After getting your note I had a microscope at hand, and took a drop of water from a water-bottle filled eight hours before, with a clean glass rod, and under the microscope it contained hundreds of paramecia.

"Some time ago I did the same in order to obtain a drop of water for an immersion microscopic lens. But instead of seeing the object under it, I found the water-disk crowded with paramecia, and with numerous specimens of euglenias and bacteroids, the last denoting putridity. I had all the cisterns and water-vessels in the house cleansed in consequence.

"The filtration humbug is played out. The source must be pure and no filtration needed. It does no real good."

It may be proper to call your attention to the manner in which the exceptional functions charged upon the Government as respects the metropolis of the examination of the companies supplies, and of an audit of their expenditure, and of their charges, upon the consumers. It would appear, however, to follow from the enactments for the exercise of those functions, that the position of the companies is that of responsible contractors, as to the qualities and prices of their supplies, instead of their being practically irresponsible monopolists, as the recited unqualified conditions of sale would lead to be supposed.

Your attention is earnestly solicited to our municipal experience, as aiding to an important extent to the solution of the sanitary and economical questions in issue for the improvement of the supplies of water to the metropolis.

The sanitary engineers in the Government service, who are conversant with the subject of the water-supply of the metropolis, will inform you that probably one-half of it is on the intermittent system pumped in to waste. The evil is not alone the waste of money or the mere waste of water, but is in its permeation through bad sewers and permeable drains, foul and tainted water, to the creation of "excrement-sodden," and marshy conditions of the sites of the ill-drained lower districts.

The Manchester municipality on getting possession of the waterworks and changing the system of the supply from the intermittent to the constant system, effected a most important reduction of the like previous waste of water. The rate of supply had been 33 gallons per head of the population, the same as it is now in London, and with such care as a public authority may take it was brought down to 20 gallons per diem. In Liverpool a similar or even a greater reduction has been reported to have been effected on the constant system. In those cities, the proportion of large consumers for manufacturing and other purposes, is reported to be greater than in the metropolis, and here, therefore, the saving may, under competent management, be expected to be greater or to the extent of about one-half; but taking the reduction to be the same as in Manchester, from thirty-three to twenty gallons per head of the population, that on the daily quantity last pumped into the metropolis of upwards of 117 000 000 gallons, would effect a saving of some 40,000,000 per diem of water pumped to pernicious waste, that is to say, a waste of nearly double the quantity supplied by the New River Company, which might all be dispensed with, or the greater proportion of the water derived from the more sewer polluted source of the Thames for pure sources.

Finally, your attention is earnestly besought to the great precedents of what has been achieved in the matter by the several municipal governments for the benefit of their several populations, which may serve for the achievement of the like relief for the population of the metropolis. You have for your aid the counsel of sanitary officers, and for your guidance the results of the careful inquiries in the recommendations of commision after commission of inquiry; and you have, moreover, a measure founded upon them, brought in by Colonel Beresford, and supported by Sir Charles Russell, Captain Ritchie, Mr. Forsyth, and Mr. Gordon, which may probably be improved by your serious practical attention to it. But your beneficient intervention is especially besought with the right hon. and hon. members, the shareholders of the New River Company, and others, to consider fairly the municipal precedents as to compensation, and whether such terms as those which the shareholders of the Birmingham Trading Water Company deemed acceptable for the sale of their property to the municipality, or the terms sanctioned by Parliament in other the like instances, are not such as the shareholders may be fairly invited and called upon to accept as equitable and even liberal—whether the conclusions of expensive inquiries by competent and impartial Commissioners and officers ought to be further set aside, and relief delayed, for the sake of a further increase of the dividends of the trading companies at the expense of the health and the security of life and property of 4,000,000 of the population.

I have the honour to be, Sir,
Your humble servant,
Fay Lankester.
Secretary to the National Health Society.

CORRESPONDENCE.

MR. BARFF'S PAPER.

As some of the remarks I made at the conclusion of my paper on the prevention of corrosion in iron were not fully reported in the *Journal*, I should be glad to be allowed to repeat now what I then said.

Some time ago a notice of my invention appeared in several papers, when it was stated that I was of the London University; in consequence of this several letters were sent to me to that institution, and gave its officers some trouble in forwarding them to me. I do not belong to the London University; I am a member of the University of Cambridge, and all the early experiments which gave rise to this invention were performed in the laboratory of this college. All the specimens exhibited on Wednesday evening were treated at another place, where I had suitable furnaces built by my friend Mr. Hugh Smith, to whose able assistance I am much indebted. I think it right to state that Mr. Stephen Williams, who is now scientific adviser to Mr. Griffiths, worked with me in my investigations into the zinc paint, and also in my experiments on iron.

Frederick Barff.

Catholic University College, Kensington, W.,
February 20th, 1877.

NOTICES.

PROCEEDINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday evenings, at 8 o'clock. The following arrangements have been made:—

February 28.—"Middle Class Education in Holland,' by John Yeats, Esq., LL.D., F.R.G.S. The Rev. Mark Pattison, D.D., Rector of Lincoln College, will preside.

March 7.—Lecture on "The Growth and Present Position of the Science of Mechanics," by Professor A. B. W. Kennedy, C.E.

March 14.—"The Treatment of Town Refuse and Sewage," by Prof. Ansted, F.R.S.

March 21.—Lecture on "Vital Air," by Dr. W. B. Richardson, F.R.S.

African Section.

Tuesday evenings, at 8 o'clock. The following arrangements have been made:—

March 13.—"Our Commercial Relations with West Africa, and their Effects upon Civilisation," by James Irvine, Esq., of Liverpool.

April 10.—"The Social State and Prospects of the South African Communities," by Robert Richards, Esq., of Grahamstown.

April 24.—"The Trade and Resources of Morocco," by Dr. Arthur Leared.

Indian Section.

Friday evenings, at 8 o'clock. The following arrangements have been made:—

March 2.—"The Progress of Trade in Central Asia," by Sir T. Douglas Forsyth, C.B., K.C.S.I. Sir Rutherford Alcock, K.C.B., will preside.

March 16.—"The Native Indian Press," by Dr. George Birdwood, C.S.I. Andrew Cassels, Esq., will preside.

April 20.—"The Existing and Possible Commercial Communications between Persia and India," by Major-General Sir Frederick John Goldsmid, C.B., K.C.S.I.

May 4.—"Thaumato-dendra, or the Wonders of Trees," with illustrations from life, by Wm. Tayler, Esq.

Chemical Section.

Thursday evenings, at 8 o'clock. The following arrangements have been made:—

March 8.—"The Sizing of Cotton Goods," by W. Thompson, Esq., F.C.S., of Manchester.

April 12.—"The Cinchona Alkaloids; their Sources, Production, and Use," by Dr. B. H. Paul.

April 26.—"Phosphor-Bronze and its Applications," by Alexander Dick, Esq.

May 10.—"A New Process for the Production of Carbonate and Caustic Soap, without the Formation of any Noxious Waste and the Recovery of the Sulphur," by George E. Davis, Esq.

Science Lectures.

These will be given on the following Wednesday evenings, in place of the usual paper and discussion. The rules for admission will be the same as for the Cantor Lectures. Each member can admit ONE friend by giving the usual order from the book supplied at the commencement of the Session:—

March 7.—Professor A. B. W. Kennedy, C.E., "The Growth and Present Position of the Science of Mechanics."

March 21.—Dr. B. W. Richardson, F.R.S., "Vital Air."

April 18.—E. J. Reed, C.B., M.P., F.R.S., "The Modifications which Ships of War have Undergone during the last 20 Years."

May 2.—J. Baillie Hamilton, "New Musical Instruments."

May 16.—Professor W. K. Clifford, F.R.S.

Cantor Lectures.

Monday evenings, at eight o'clock. Second Course, "On the Chemistry of the Manufacture of Coal Gas," by A. Vernon Harcourt, Esq., F.R.S.

Lecture I.—March 5.

Formation and chemical nature of coal. Changes produced by the application of heat. Solid, liquid, and gaseous products. Coke—its advantages as a fuel. Separation by condensation of liquids from permanent gas. Composite nature of tar. Process of tar distillation.

Lecture II.—March 12.

Ammoniacal liquor; its composition, treatment, and valuation. Purification of gas from ammonia. Scrubbers and washers. Probable effect upon gas of prolonged contact with tar and ammoniacal liquor. Purification from carbonic acid and sulphuretted hydrogen. Use of lime and of oxide of iron.

Lecture III.—March 19.

Composition of coal gas. Common impurities—carbonic acid, carbon bisulphide. Products of the combustion of gas containing sulphur. Question as to the injurious effect. Modes of purification. Action of calcium sulphide. Effect of contact with heated surfaces. Tests for sulphur.

Lecture IV.—March 26.

Principal constituents. Hydrogen, carbonic oxide, marsh gas, olefiant gas. Value for heating and for illumination. Luminous flames. Development of the illuminating power of coal gas. Burners. Gas compared with other illuminants. Different qualities of gas. Photometry. Standard burner. Unit of light.

Each member can admit one friend to these lectures. No special tickets are now required for the purpose; the tickets issued to members at the commencement of the session are available for the Cantor Lectures, as well as for the Ordinary and Sectional Meetings.

MEETINGS FOR THE ENSUING WEEK.

Mon. ...Royal United Service Institution, Whitehall-yard, 8½ p.m. Mr. R. Griffiths, "The Application of the Ordinary Screw (or Screws), to the Discharge of Water from Leaks, &c.; also a New Form of Vessel for War Purposes."

Institute of Surveyors, 12, Great George-street, S.W., 8 p.m. Mr. J. Lucas, "Hydrogeology; one of the Developments of Modern Practical Geology."

Royal Geographical, University of London, Burlington-gardens, W., 8½ p.m. 1. Mr. E. D. Young, "Recent Journey to Lake Nyassa." 2. Rev. Roger Price, "Examination of a Route for Wheeled Vehicles between the East Coast of Africa and Ugogo."

Institute of Actuaries, The Quadrangle, King's College, W.C., 7 p.m.

Medical, 11, Chandos-street, W., 8 30 p.m.

London Institution, Finsbury-circus, E.C., 5 p.m. Mr. F. W. Brearey, "The Problem of Flight."

Tues....Royal Institution, Albemarle-street, W., 3 p.m. Prof. Garrod, "The Human Form; its Structure in Relation to its Contour." (Lecture VII.)

Medical and Chirurgical, 53, Berners-street, Oxford-street, W., 8½ p.m.

Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Renewed Discussion on "The Sewage Question."

Anthropological Institute, 4, St. Martin's-place, W.C., 8 p.m. 1. Mr. J. Walhouse, "Non-Sepulchral Rude Stone Monuments." 2. Messrs. Wilmot Power and Edward Laws, "A Kitchen Midden Found in a Cave near Tenby, Pembrokeshire." 3. Mr. Hodder M. Westropp, "Some Kitchen Middens near Ventnor, Isle of Wight."

Wed....**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. Dr. John Yeats, "Middle-class Education in Holland."

East India Association, Pall-mall Restaurant, 14, Regent-street, Waterloo-place, 5 p.m. Mr. Robert H. Elliot, "The Indian Problem, and Indian Famines."

Royal College of Physicians, Pall-mall, E., 5 p.m. (Gulstonian Lectures.) Dr. Lander Brunton, "Pharmacology and its Relations to Therapeutics." (Lecture II.)

Thur....Trades' Guild of Learning and National Health Society (at the House of the Society of Arts), 8.30 p.m. Prof. W. H. Corfield, "The Laws of Health." Part II. (Lecture VI.)

Royal, Burlington House, W., 8½ p.m.

Antiquaries, Burlington House, W., 8½ p.m.

Linnean, Burlington House, W., 8 p.m. 1. Mr. J. G. Baker, "Report on the Liliaceæ, Iridaceæ, Hypoxidaceæ, and Hæmodoraceæ of Dr. Welwitsch's Angolan Herbarium." 2. Mr. Edgar A. Smith, "A remarkable form of New Zealand Ophiuridæ."

Chemical, Burlington House, W., 8 p.m. Prof. Thorpe, "The Theory of the Bunsen Flame."

London Institution, Finsbury-circus, E.C., 7 p.m. Mr. W. R. S. Ralston, "English Nursery Tales." (Lecture II.)

Medical and Chirurgical, 53, Berners-street, W., 8 p.m., Annual Meeting.

South London Photographic (at the House of the Society of Arts), 8 p.m.

Royal Institution, Albemarle-street, W., 3 p.m. Mr. William Pole, "Theory of Music." (Lecture III.)

Royal Society Club, Willis's Rooms, St. James's, S.W., 6 p.m.

Psychological, 11, Chandos-street, W., 8½ p.m.

Civil and Mechanical Engineers, 7, Westminster-chambers, S.W., 7 p.m. Mr. W. J. Adams, "Joints in Woodwork."

Fri.......**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Indian Section.) Sir Douglas Forsyth, "The Progress of Trade in Central Asia."

Royal United Service Institution, Whitehall-yard, 3 p.m. Mr. Donald Currie, "Maritime Warfare; the importance to the British Empire of a complete system of Telegraphs, Coaling Stations, and Graving Docks."

Royal Institution, Albemarle-street, W., 8 p.m., Weekly Meeting; 9 p.m. Prof. Huxley, "The History of Birds."

Geologists' Association, University College, W.C., 8 p.m.

Philological, University College, W.C., 8 p.m.

Royal College of Physicians, Pall-mall, E., 5 p.m. (Gulstonian Lectures.) Dr. Landor Brunton, "Pharmacology and its Relations to Theraputics." (Lecture III.)

Sat.......Foremen Engineers (at the House of the Society of Arts), 8 p.m.

Physical Science Schools, South Kensington, S.W., 3 p.m.

Royal Institution, Albemarle-street, W., 3 p.m. Prof. Henry Morley, "Effects of the French Revolution upon English Literature." (Lecture II.)

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JOURNAL OF THE SOCIETY OF ARTS.

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FRIDAY, MARCH 2, 1877.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

PATENT LAW REFORM.

A Conference will be held on Tuesday, the 6th Inst., by the Society of Arts, for the purpose of discussing the provisions of the Patent Law Amendment Bill, now before the House of Commons. The subject will be introduced in a short paper by Mr. H. Trueman Wood, the Assistant-Secretary of the Society, and Resolutions will be proposed to the meeting for adoption.

AFRICAN COMMITTEE.

A meeting of this Committee was held on the 26th February. Present—Vice-Admiral Erasmus Ommanney, C.B., F.R.S. (in the chair), Sir Robert Anstruther, Bart., M.P., Sir Samuel Baker, F.R.S., J. Bergtheil, Lieut-Gen. Bissett, C.B., A. R. Campbell-Johnston, Hon. Francis Drummond, Capt. C. E. Foot, R.N., Lieut.-Col. Grant, C.B., Rear-Admiral Sir Leopold G. Heath, K.C.B., Lieut. R. P. Humpage, R.N., Edward Hutchinson, J. J. Pratt, T. A. Rochussen, E. T. Rogers, P. L. Simmonds, Mark J. Stewart, M.P., and George F. White.

HOUSE DRAINAGE.

On Friday, the 23rd inst., a deputation from the Society of Arts, consisting of Lord Alfred Churchill, Chairman of the Council, Sir Henry Cole, K.C.B., Major-General F. Cotton, C.S.I., with P. Le Neve Foster, Secretary, waited upon Mr. Sclater-Booth, at the office of the Local Government Board, to bring before him the subject of house drainage.

Lord Alfred Churchill, after thanking the President of the Local Government Board for the report issued by that office on the disposal of sewage, and referring to the conference held at the Society's Rooms; the subsequent deputation to the Metropolitan Board of Works on the state of drainage in the metropolis; and the second conference in November last, consisting principally of medical officers, and representatives of the various Boards of Health, said the result was to elicit a large amount of valuable information. Many letters had been addressed to the Society, copies of which he would leave; but he wished particularly to call attention to the statement of Dr. Whitmore, the medical officer of Marylebone, in reference to a remarkable case in Harley-street, as well as to a letter by Mr. Weaver, who had inspected some newly-erected houses in the neighbourhood of Clapham-junction. Dr. Whitmore mentioned the fact that in Harley-street, when a new sewer was being constructed, it appeared from inspection that 28 or 30 houses were entirely without any connection with the main sewer; and consequently the whole of the sewage from those houses, for years and years, must have been choked up, and, but for the accident of the new sewer being constructed, and the active vigilance of an earnest and zealous officer, might have remained in that state down to the present time. Under these circumstances, it was not surprising if typhoid and scarlet fever prevailed. Mr. Weaver drew attention to facts showing the imperfect manner in which the law now existing operated. Another important fact was, that the vestries did not all understand the Act of Parliament in the same sense, some construing it one way and some another, and consequently there was no uniformity of action. Some were disposed to put the Act in force vigorously, whilst others went to sleep over it, and did little or nothing. It appeared to the Society of Arts, therefore, amongst other things, that great good would result if some supervision could be obtained which should ensure a uniformity of action on the part of the vestries or local authorities, and enforce the carrying out of the law in an effective manner throughout the Metropolis.

Sir Henry Cole said the perfection claimed by the Metropolitan Board of Works for the sanitary arrangements of the metropolis was hardly borne out by the testimony of those who had had practical experience of the working of the Public Health Act under the local vestries. If the Society had ventured, which it did not, to make such a statement with regard to Harley-street, where the late Premier was now gone to reside, as had been referred to by the Chairman of the Council, it would have been treated as a poetic statement. The practical point they desired to impress upon the Local Government Board was, that some measures should be taken to relieve London from the absurd position of having spent four millions upon main sewers, and yet that only a small proportion of the houses were known to the local authorities as making use of them. When Parliament sanctioned this expenditure, and the ratepayers found the money, it was no doubt with the intention that the sewers should be used; but, on investigation, he believed it would be found that only a very small proportion of the houses were properly connected with these sewers, even if at all. He might be very unfortunate, but he never heard of anybody taking a house who had not to construct the house drains *de novo*. The subject was not a popular one with architects at all; they had heard of one of the chief architects erecting an enormous public building, he would not say where, but one of great importance, and costing many hundreds of thousands of pounds, where the drains had not been attended to at all in the beginning, but had practically to be constructed after the building was occupied. This showed how little architects looked to this important subject. Lord Alfred Churchill had very recently had to spend a heavy sum of money in putting the drains of his house in order; and he himself had not been three weeks in his house before he found unpleasant stenches, which necessitated the drains being looked to, and he found they had to be entirely reconstructed. The landlord knew nothing about it, and if he had gone to the parish he would only have been laughed at. A neighbour of his was placed in very much the same circumstances. He (Sir H. Cole) had been very much abused for stating that typhoid fever was chronic in South Kensington, but it was quite true, and he had no doubt that on investigation it would be found that three-fourths of the houses did not in reality make use of these sewers which had been constructed at so much cost. What he wished to suggest on the part of the Council of the Society was, that returns should be made to the Local Government Board, showing how many houses in each district of the metropolis were known to the local authorities as using the main sewers, and how many were not, which returns should be laid before Parliament, and published. The Society might go on stirring up the matter, and perhaps after some years they might get the information, but if they went to the Metropolitan Board of Works they would probably be treated as civilly as before; and it seemed to them that the Local Government Board, under whose charge the health of the public was placed by law, might usefully undertake some inquiry as to how far this expenditure of four millions on sewers was, in the interests of public health, being utilised. Another return, which probably might be obtained by the Board, would be copies of any rules of action adopted by the various metropolitan vestries affecting the building of new houses, because old houses were one thing, and new ones were another, and they ought to know if the Act was carried out, and if not, why not. The Act laid down certain processes to be gone through when a new house was being built, but they wanted to know how much security this really afforded; he was afraid it was but very little. Whatever difficulties there might be in regard to old existing houses—but even those he did not despair of overcoming—they did not exist as regards new buildings. It was a duty on the part of the legislature to see that a new city was not growing up daily in as bad a condition as the old. Vestries did not appreciate the work, and they had not nearly force enough, and they did not like to spend the ratepayers' money in appointing more officers, and supplying a sufficient staff. In Birmingham, where he (Sir H. Cole) was at present residing, he found, notwithstanding the democratic tendencies usually attributed to that place, very large powers were in force, and carried out with a vigour and efficiency which, he thought, might fairly be copied in this metropolis. Birmingham acts with a promptness and activity in dealing with sanitary evils, which a life-time in South Kensington would not redress.

Mr. Lumley, Q.C. (the legal adviser of the Board), asked if it were not the duty of the district surveyor to look after this matter, and was he not paid fees for doing it?

Sir Henry Cole said it was certainly his duty, and he was paid for it; but no one man could look after the proper drainage of hundreds of houses.

Mr. Sclater-Booth remarked that anything affecting the carrying out of the Metropolitan Management Act did not come within his province, but that of the Secretary of State for the Home Department. The functions of the Local Government Board in connection with the health of the metropolis were limited to what was called the Nuisances Removal Act, which did give it a certain power of interference; but, strictly speaking, any question of the amendment of the Metropolitan Management Act would rather be a matter for the Secretary of State. The Metropolitan Board of Works was charged with the construction of these main sewers, and this work they had well accomplished; and then the vestries and district boards were charged with the management of the smaller drains, whilst the owners and occupiers were under an obligation to drain into these drains. That was the scheme. No doubt there was a great deal of imperfection in carrying it out, but he did not think it was any part of his duty to collect the information which had been asked for. At any rate, it was a return which any member of Parliament might move for, and, if it were agreed to, then the proper quarter from which to obtain it would easily be found.

Sir Henry Cole said he had thought in his ignorance that all matters touching the public health came within the province of the Local Government Board. The Secretary reminded him that it was of no use going to the Metropolitan Board of Works, as they had already done so ineffectively; therefore they must endeavour to attract attention in some other quarter. The third suggestion he was going to make was that the Metropolitan Board of Works be authorised to receive public complaints of defective house drainage, to investigate and report on the same. In referring to the question of health, he might say that not only in the metropolis, but wherever a system of water-closets existed, there was an almost entire ignorance on the part of the public with regard to the evil effects of sewer gas. All classes suffered from it, for he never went to a place in which he did not hear something of it. He had lately taken up his residence in Birmingham, and he had not been in his furnished house a couple of days before he discovered that there was a direct communication between the cellars and the drains, and the sewer gas came up into the house. That was remedied, but then it was reported that the same stench was noticed at the top of the house. The waste-pipe from a water cistern went direct into the drain, and thus again the sewer gas was introduced. That, of course, was soon remedied; but he wished to direct attention to the extremely wise and, if he might so term it, despotic action in a democratic place like Birmingham. He had another grievance arising from bad water; he asked the authorities to analyse it, when they reported that it was not potable, and advised him never to drink a drop of it, at least without taking a variety of precautions. He then wrote and asked them if they could not give him the town water. He heard no more about the matter, but he had a practical illustration of how a population of 400,000 could manage their own affairs; for he found one day a number of men were sent in, and laid on the corporation water; two or three days afterwards another set of men came and pulled down the pump; and, in a few days more, some men came and filled up the well. And on meeting the agent for the house, he told him he knew the work had been done, because the bill had been sent in. He ventured to think that what was done in Birmingham might be done in London; but, if he sent in such a complaint with regard to his house, he should probably die before he got an answer to his letter. All this seemed to point to the necessity for these questions being taken up by the Government; but certainly, as a ratepayer, he did not approve of being turned over to the Home Secretary, simply because he lived in London, and would much prefer to come to that department for redress. In conclusion, he would mention one other subject, somewhat connected with that of drainage, which, he believed, did come within the purview of the department, and which had been referred to in the report of the Society of Arts. In the report made by the committee of the Local Government Board middens were universally condemned, and he believed it was intimated pretty clearly, if not stated in express words, that they ought to be got rid of as soon as possible. In the report of the Society of Arts, it was emphatically recommended that middens and cesspools, and all those abominations, should be prohibited by law. There would be no despotism in this, because there were other and more scientific modes of collecting these materials, such as were practised in many towns. He had only now to thank the President of the Board for listening so attentively to his statement.

Mr. Sclater-Booth, in reply, said:—"Well, gentlemen, I am not sure that I am able to make you any lengthened reply. I have listened, of course, with great interest to what Lord Alfred Churchill and Sir Henry Cole have so ably laid before us; but you do not come here, I think, with any very specific objects which would be exactly within my province to carry into effect. What you have said illustrates very well the imperfections which still exist in some parts of our system, and which are suggestive of improvements which we may make by-and-bye as time goes on. But it must always be remembered, when you complain of the unsatisfactory condition of the sanitary law of the metropolis, that the metropolis was, in a sort of way, a pioneer upon the subject, and that sanitary authorities existed in London long before they existed in the country. I do not say before the municipal institutions of the country provided similar measures, but certainly before any such general legislation existed in the provinces, and I believe the Sanitary Acts, as carried out in the City proper, have always been considered to be particularly stringent. The law with regard to the public health, as applicable to the metropolis, has been consolidated into a separate Bill, which I think it may probably be necessary to pass through Parliament this year or next; and it may give an opportunity for considering some of these points. But undoubtedly the imperfections you have pointed out arise from the want of anything like a comprehensive system of sanitary government for London, and an authority to see to its application. I am not one of those who are disposed to find fault with the government of London; I think it is much more easy to find fault than to suggest remedies which are not in themselves full of difficulty and evil; but I am quite ready to admit that the administration of these things in London does certainly proceed on the assumption that every man must act for himself, and thoroughly understand such a thing as the evil influence of sewer gas, and the absolute necessity of doing the best one can, quite irrespective of the efforts of the municipal authorities, to secure one's self against the attacks of that enemy, and on the other hand to filter the water which you are supplied with, irrespective of the filtration effected by the water company. If every man had the ability and means to secure himself as you or I may be able to do, I do not think the public means for securing the sanitary condition of towns are so bad as you would suggest; but undoubtedly it does rest on the presumption that individuals must look after themselves to a greater extent than you seem to think quite safe, or than perhaps ought to be permitted hereafter. The returns that you spoke of I will look over, and if I should see that by a little modification they could with propriety be submitted to Parliament, and moved for by any member, I will communicate to you again, and you will probably think it best to ask some metropolitan member to move for them. At all events I will point out the shape in which they should be put, assuming that they are practicable returns. You rightly judge that we are exercising our authority and influence, as far as practicable, to get rid of what is called the midden system, but in the north of England the water supply and the means of flushing the drains are very imperfect, as compared with what we are familiar with in London, and the Commissioners do not go so far as to suggest that interference of a peremptory character should take place. Nevertheless, whenever we have sent an Inspector down to a town in the north of England or the midland counties, he has always put his foot down on this system and advised its discontinuance. I should, no doubt, be able to show, if necessary, that an immense deal is continually being done, and has been done during the last few years, to bring about a better system, but we cannot in all cases insist on the flushing of drains when the means of doing so is not at hand. Short of that there is a great deal that may be done in the improvement of what may be called the dry system, and many towns are exerting themselves with considerable effect in that direction. You spoke of the entire ignorance of the public on some of these sanitary subjects, sewer gas, for instance. But really from this office floods of information have been poured forth from time to time, through the newspapers and by means of reports, and I should have thought we had pretty well saturated the public mind with information on the subject. It is one thing, however, to have the information available, and another thing to apply it in a particular case, and it is very likely that there may be plenty of room for improvement in that respect. I do not know that I need detain you any longer. I will look through the suggestions you have laid before me, and if I see my way to putting them in a practicable shape I will communicate with Lord Alfred Churchill.

Lord Alfred Churchill desired to add that in the parish of St. Martin's-in-the-Fields, in which the Society of Arts' house is situate, containing 2,320 houses, according to information derived from the Vestry Clerk, they had plans of the drainage only of 320, and knew nothing whatever of the drainage of the remainder.

Mr. Sclater-Booth said he was very much surprised by such a statement, though he had no doubt that the connections were very imperfect in many cases.

General Cotton added that this was the case in many new houses. In fact, his complaint was that a new town was growing up with all the sanitary defects of the old one. In parishes where there were many hundreds of houses built annually, nobody could say whether the drainage was in a good state or not. The parish authorities were nominally responsible, but practically they were not.

Mr. Sclater-Booth said the interpretation of this was that the Metropolis Management Act was passed 22 years ago, before these matters were so well understood as they are now. He had had experience both of a new and an old house, and found one as bad as the other.

After a remark by **Sir Henry Cole**, that middens might be abolished, even if there were not a supply of water, the earth closet, or pail system being substituted, the deputation withdrew.

PATENT-LAW MEMORIAL.

The following memorial was submitted to the Lord Chancellor before the introduction of the Patents for Inventions Bill. The number of signatures is 1,145:—

To the Right Honourable the Lord High Chancellor of Great Britain.

The Humble Memorial of the undersigned,

Sheweth,—

That under the provisions of the "Patent-law Amendment Act, 1852," the Lord Chancellor, the Master of the Rolls, and certain law officers of the Crown therein named, together with such other persons as her Majesty the Queen should appoint, are made Commissioners of Patents, with full powers, as therein specified, to conduct the business of granting Letters Patent for inventions, and to make regulations for the administration of the Patent-office.

That up to the present time the provisions of the foregoing Act, authorising the appointment of one or more persons as Commissioners of Patents, in addition to the *ex-officio* Commissioners, have not been acted upon, no additional Commissioners as contemplated by the Act have been appointed, and thus the whole business of the Patent-office falls upon the *ex-officio* Commissioners, who are already overburdened with other important and heavy duties.

Your memorialists, while admitting that great improvement has been effected by the energy and zeal of those who have been employed in the office, desire respectfully to urge upon your Lordship the importance of acting upon the provisions of the Act of 1852, nd carrying it out in its integrity, by appointing such additional Commissioners as are contemplated by the Act.

Your memorialists venture to think that if such additional Commissioners were appointed, duly paid, and made responsible for the effective working of the Patent-law as it at present exists, a large amount of beneficial reform would be obtained, and many of the objections now made, if not all, would be got rid of without any further legislation, at all events for the present.

Your memorialists, therefore, humbly pray your Lordship to cause the provisions of the Act of 1852 to be put into force by the appointment of one or more additional Commissioners of Patents, to whom might be entrusted the full carrying out of the duties of the office, and who should be responsible for the same, and that no further legislation be attempted until after such Commissioners shall have been appointed, and the system contemplated by the Act administered in its integrity."

Walter Abbott, B.T. surveyor, 140 Great Donald's road, New Cross
Chas. D. Abel, 20 Southampton buildings, W.C.
Jno. Hny. Abel, Birkbeck Institution, W.C.
Alf. Wm. Acton, 41 Princess street, Manchester
Henry Adams, 8 Great George street, S.W.
Robert Adams, Pow street, Workington
Thomas Adams, Works of the "Ant and Bee," Manchester
Joseph Adamson, engineer, Hyde
Joseph Adamson and Co. boiler makers, Hyde, near Manchester
W. Adamson, Crewe
Townley Akroyd, Old lane, Halifax
Alfred Alexander, Cirencester
Edward P. Alexander, consulting engineer, 14 Southampton buildings, W.C.
Joseph Alexander, 22 Chancery lane, London
John C. Allan, Port Glasgow
Alexander Allen, Scarborough
Saml. B. Allport, 50 Whittall street, Birmingham
Geo. J. Anderson, Sheffield
Charles Andrews, Lower street, Deal
J. F. Andrews, 32 King street, Covent garden
Ward Andrews, Shelf, near Halifax
Lewis J. Apps, 21 Water street, E.C.
A. E. Argall, Breage, Helston
Emma L. Argall, Breage, Helston
Wm. Argall, Breage, Helston
Fred. Armitage, Longwood
William Armitage, Heeley
John G. Armstrong, Swindon
David N. Arnold, Midland Wagon Co., Birmingham
Thomas Ashbury, 424 Stockport road, Manchester
Ashby, Jeffery, and Luke, Stamford
Edward Atkinson, M.I.M.E., Moresby, Whitehaven
Richard Atkinson, 11 Frederick street, Hampstead road
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Alfred Austin, 17 Gracechurch street, E.C.
William Austin, civil engineer, 62 Dartmouth terrace, Bermondsey park
J. Austine, New Malden, Surrey
Thos. Aveling, Rochester
Jas. J. Aves, 16 Salisbury place, Halifax
Harrison Aydon, Whitton, Hounslow
John Baggot, Hon. Sec. Dublin Chamber of Commerce.
W. A. Bagley, 24 Ladbroke grove road, W.
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John Bamford, 71 Paddock Brow
Richard Banks, solicitor, Preston
R. E. Banks, 2 Bridge street, Workington
Joseph H. Bannah, A.I.C.E., M.I.M.E., Middlesborough
Barber and Snowdon, 14 Park row, Leeds
H. Donald Barclay, 138 Regent street, W.
Barclay and Son, 138 Regent street, W.
James Bardsley, Crossbank street
Alfred Barlow, 17 Pakenham street, W.C.
Charles Barlow, 23 Southampton buildings, W.C., patent agent
Alfred Barnard, Upper King street, Norwich
Emile Barrault, 17 Boulevard Saint Martin, à Paris
Fred. Barrett, 74 Grove lane, Camberwell
Richd. H. Barrett, 2 Wilton villas, Forest hill, S.E.
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John Barrow, Clayton
Joseph Barrow, Victoria Foundry, Leeds
J. Wolfe Barry, 23 Delahay street, S.W.
E. J. Bartlett, 30 Great St. Helens, E.C.
R. S. Bartleet, The Shubbery, Redditch
R. Harvey Barton, 2 Great St Helens, E.C.
Hy. Batchelor, Bute dock, Cardiff
T. C. Batchelor, 6 Dumfries place, Cardiff
Joseph Bate, Carr house, Huddersfield
Alexr. Battle. 7 St. Martin's terrace, Dover
Alfred J. Beale, Banbury
W. G. Beattie, Nine elms, S.W.
Fred. Beaumont, 7 Grosvenor mansions, S.W.
Thomas Beck, 39 Gore road, Victoria park
John Henry Beckwith, Knot Mill Iron Works, Manchester
Thomas Beeley, Hyde Junction Iron Works, Manchester
P. D. Bennett and Co., Spa lane Iron Works, West Bromwich
Thomas H. Bennett, Ashton road, Openshaw, Manchester
Arthur Benson, Junkell street, Workington
C. Bentley, Stamford
John Bentley, Dalton, Huddersfield
Henry Berry, Dalton
W. Biddington, Banbury
Wm. Bingham, 26 Brunswick terrace, Grosvenor park, S.E.
C. H. Binsteed, solicitor and notary, Portsmouth
John Birkmyre, Port Glasgow
Birmingham Plate Glass Co., Smethwick
W. Forsyth Black, 23 Back lane, Cannon street, E.C.
Fred. Blackburn, Edgerton
Jas. Blackwood, Pembroke dock
Thomas Blackwood, Port Glasgow
L. Blake, 147 Strand, W.C.
Thos. S. Blake, Pembroke dock
Horace A. Bluna, Kilnhurst
James Bolton, 4 Elizabeth street, Workington
Wm. Jas. Bolton, Elizabeth street, Workington
G. H. Booth, Gardiner street, Dublin
H, Booth and Co. machinists, Preston
William Booth, Fairview terrace, Ovenden
Yates W. Booth, Chapel street, Preston
Jno. Borrie, New Exchange buildings, Middlesborough
John Bostock, 17 Oxford street, Southampton
William Botly
Alfred Bovill, 14 Cockspur street, S.W.
Chas. Bowden, Pembroke dock
John Bower, Savile town, Dewsbury
H. N. Bowker, 24 Burchell road, S.E.
S. E. Bowker, 74 Boyson-road, Camberwell
L. Bowman, 2 Pow street, Workington
John Boyd, 211 King's road, Chelsea
W. Boyd, Wallsend Slipway Company, near Newcastle-on-Tyne
James Bradbury, 9 Henry street, Workington
Chas. Bradley, Middleton road
Antonio Brady, Kt. President Inventors' Inst. Maryland Point, Stratford, E.
Wm. Bragge, F.S.A., F.G.S., &c., Chairman of the Free Libraries and Museum Committee of the Borough of Sheffield, and President of Council of the Sheffield School of Art, Sbirlehall, Sheffield
Rev. C. Braithwaite, Wood green, Wednesbury
Charles C. Braithwaite, 28 Albion street, Leeds
F. J. Bramwell, 27 Great George street, Westminster
W. C. Brangwyn, 11 Beaufort buildings, W.C.
Chas. Brazier, 18 Magdalene terrace
Joseph Brearly, 125 Booth Town road Halifax
Mill Brebner, Aberdeen
Elias Brembridge, New Malden
Brewer and Jensen, 33 Chancery lane, W.C.
James Brierly, 30 Brown street, Bryanston square
W. Brierly. Hawkesley-terrace, Workington
Walter Brierly, Halifax and Blackburn
E. L. Brimdage, 37 Mount Preston, Leeds
J. T. Brindle, solicitor, Preston
J. Brindley, Nenagh, Tipperary
Thos. Broadbent, Huddersfield
W. Brodie, Aberdeen
Henry Bromhead, Stamford
Edward Brook, Middlesborough
Mark Brook, Mold green
Walter Brook, Dumbarton
H. R. F. Brookes, Banbury
William Brookes, 62 Chancery lane
R Heygate Brooks, hon. secretary, Banbury Mechanics' Institute
A. B. Brown, Rosebank Iron Works, Edinburgh
William Morgan Brown, 38 Southampton buildings, Chancery lane
R. C. Browne, Newcastle-on-Tyne
J. C. Brown, Pembroke dock
Newnham Browne, 91 Queen street, Cheapside
Henry Browning, Stourbridge
James Brunlees, 5 Victoria street, S.W.
M. Buckley, Lockwood road
William Bull, F.L.S., King's road, Chelsea
Alfred A. Bumpus, Loughborough
Henry Cris. Bunkell, Burton cottage, Wood green, N.
John Burgess, Ash villas, Huddersfield
N. P. Burgh, 80 Cornhill, E.C.
James Burham, 50 Wigmore street, W.
W. E. Burn, 171 Portland road, Newcastle-on-Tyne
Burnett and Co., 17 Surrey street, Strand, W.C.
J. E. Burnett, 21 Crossley street, Liverpool road, N.
Arthur P. Bursham, Marine Parade, Brighton
H. K. Burt, Woodlands villas, Lee, S.E.
Sydney Burwash, 69 King William street, London, E.C.
Wm. Bury, 5 New London street, E.C.
Harry Butterworth, Manchester road
Thomas Caile, 16 Duke street, W.C.
Jas. Campbell, Port Glasgow
James Campbell, Hunslet Engine Works, Leeds
Thos. D. Carpenter, West town, Dewsbury
Arthur Carpmael, 24 Southampton buildings, W.C.
William Carpmael, 24 Southampton buildings, W.C.
Alfred Carter, 9, Dynevor villas, Richmond
James A. Carter, 3 Clara street
J. H. Carter, 82 Mark-lane, E.C.
W. C. Carthew, Pembroke dock
E. A. Carttar, Crewe
William Carruthers, 16 Pow street, Workington
Andrew Cassels, 51 Cleveland square, W.
Wm. A. Casson, City of London College, 52 Leadenhall street, E.C.
Richard Chrimes, Rotherham
R. Calvert Clapham, Earsdorc, near Newcastle
Fred. H. Chadderton, Coppice street, Oldham
Edwin Chadwick, East Sheen, Surrey, S.W.
C. E. H. Chadwyck Healey, 7 New square, Lincoln's inn
Andrew Chalmers, 120 Manchester road, Oldham
George Chaloner, 12 Fetter lane, Fleet street, E.C.

A. Chambers, Baker street Station, [illegible]
J. N. Chambers, 44 Salisbury place, Akroydon, Halifax
Rufus Chambers, 28 South Darley street, Halifax
James T. Chance, Four Oaks park, Sutton Coldfield
Chance, Brothers, and Co., Alkali Works, near Birmingham
Chance, Brothers, and Co., Glass Works, near Birmingham
T. Chapman, Stourbridge
J. W. Charlesworth, Crossland moor
Charles Charlton, 28 Oxford street
Henry Charlton, Gateshead-on-Tyne
Thomas Chatwin, Great Tindal street, Birmingham
Saml. Chatwood, Lancashire Safe and Lock Works, Bolton
C. F. Chew, 7 Rackham street, W.
Edward Chitty, Wellington house, Deal
James D. Churchill, 12 Belgrave-road, Highgate, N.
Clayton Chambers, 28 South Darley street
A. M. Clark, 53 Chancery lane
R. Clark, 9 George street
William Clark, 53 Chaneery lane
W. G. Clarke, Warwick square, E.C.
William Clay, Birkenhead Forge
James Cleminson, 5 Westminster chambers
E. Clifton, Stamford
J. Clifton, Crown Hotel, Stamford
Thomas Clifton, Lower street, Deal
William Clifton, Lower street, Deal
Thomas Close, Silver street, Haley hill, Halifax
H. R. Cloud, 610A Mile end road, E.
B. Francis Cobb, 3 Royal Exchange buildings, E.C.
David J. Cobie, Port Glasgow
Charles Cochrane, The Grange, Stourbridge
Thos. R. Cocker, 16 Pepler road, Old Kent road
James Cocks, Pembroke dock
R. J. Coke, Tapton grove, Chesterfield
Geo. F. Cole, Birkbeck Institution, W.C.
Henry Cole, 83 Thurloe square, South Kensington
Henry Coley, Whitefriars street, Fleet street
G. Colquhoun Scones, 63 Princes square, W.
Hiram Coltman, Loughborough
M. Compton, 4 Victoria street, S.W.
W. H. Congreve, 6 Devonshire road, N.
T. S. Conisbee, F.C.S., 74 York road, Lambeth
W. Conisbee and Sons, Herbert's buildings, S.E.
Charles Conolly, 64 Manchester road
N. Constantine, 8 Heathcote street, Mecklenburgh square
R. H. N. Cook, Newcastle
W. Cooke, 43 Southampton buildings, W.C.
Henry S. Copland, 1a Duke street, Adelphi, W.C.
Thomas Corbett, Perseverance Iron Works, Shrewsbury
Wm. Corbitt, 18 Hartley street, Oldham
J. T. Cornish, 5 Darnley crescent, Hackney
J. Coryton, 1 Essex court, Temple, E.C.
George B. Cottam, Farrier street, Deal
Samuel Cottam, F.R.A.S., Manchester
Francis M. Cotton, C.E., Wimbledon, S.W.
Fred. Cotton, Major-General, R.E. 13 Longridge road, S.W.
J. B. Cottrell, Eddington Iron Works, Hungerford, Berks
L. Cottrell, Eddington Iron Works, Hungerford, Berks
W. C. Cottrell, Eddington Iron Works, Hungerford, Berks
Robert N. Cottrell, Bolton
G. W. Coulman, Sheffield
E. A. Cowper, 6 St. George street, Westminster, S.W.
F. C. Coxhead, 27 Leadenhall street, E.C.
Seville Crampton, Gloucester street
R. E. P. Craven, Buckingham Works, Armley
Thos. E. Craven, Hall grove, Hyde park road, Leeds, and 24 Victoria chambers
John Frederick Crease, Major, R.M.A. Eastney barracks, Portsmouth
Ed. T. Crippin, Brynn, Wigan
C. J. C. Crocker, 68 Gracechurch street
Thos. Crossley, 17 Pleasant street, Halifax
Crossley Brothers, Manchester
William [illegible]
W. H. Cullen, jun. [illegible], square, Barnsbury
Matthew Curtis, J.P. and ex-Mayor, Manchester
Bramwell Dallon, Fieldhouse
Henry Dalton, Stamford
Jas. Dance, 139 Leadenhall street, E.C.
H. T. Daniels, Stamford
W. Daniels, Stamford
Albert Danielson, 147 Strand, W.C.
T. J. Danson, M.Inst. M.E., Newcastle-on-Tyne
Abraham, Darby, Treberfydd, Brecon
Charles E. Darby, Brymbo
C. E. Devenport, Stourbridge
Henry Davey, Sun Foundry, Leeds
Davey, Paxman and Co., Colchester
D. R. Davies, Manchester
George Davies, patent agent, 4 St. Ann's-square, Manchester
Wm. Davies, Newton
J. H. Davis, Patricroft
Samuel Daw, 1 Parade, Cardiff
George Dawley, Sheffield
Benjamin Dawson, engineer, Haswell Colliery, Fence house, near Durham
J. T. Dawson, 5 York buildings, Adelphi, W.C.
Natham W. Dawtrey, 45 St. Thomas street, Halifax
St. John V. Day, 166 Buchanan street, Glasgow
George F. Deacon, Municipal Offices, Liverpool
Deakin, Parker, and Co., Sandon-street Works, Salford
Wm. Dean, Great Western Railway, New Swindon
De Bergue and Co. Limited, Strangeways Iron Works, Manchester
Wm. Delght, 48 Elizabeth street, Workington
William Dempsey, 26 Great George street, Westminster, S.W.
L. H. P. Dennis and Co. Chelmsford
Thos. S. Derham, 15 Blenheim terrace, Leeds
J. G. Desborough, Stanford
Henry Devine, 24 Basinghall street, E.C.
Chas. Dick, Crewe
Thomas A. Dillon, Sherrard-street, Dublin
William H. Disset, 18 Canonbury park square, N.
C. J. Dobbs, Middlesborough
Benjamin Alfred Dobson, Bolton
G. G. Dobson, Stannary hall, Halifax
Robert Donkersley, Lockwood, Huddersfield
J. C. Dorne, Coppin street, Deal
Peter Doran, Manchester
George Dove, Redbourne Hill Iron Company, near Brigg, Lincolnshire
George Dove, Stanwix, Carlisle
Clement Dowling, 15 Duke street, Adelphi, W.C.
Henry Drake, Woodland terrace, Booth town
James Dredge, 37 Bedford-street, Strand (*Engineering*)
Richard Drury, Paddock
A. Dudgeon and Co. 4 Mitre street
Morris Duggan, Glasneven
Archibald Duncan, Port Glasgow
Robt. Duncan, Port Glasgow
Thomas Duncombe Eagles, 23 Fenchurch street, E.C.
Squire, Dunkelly, 49 Suffolk street, Freehold
James Dunkerley, Werneth, Oldham
John M. Dunlop, Windermere
David Dutton, Fieldhouse
A. L. B. Dwot, 2 Copthall buildings, E.C.
Robert Dyson, Rother Iron Works, Rotherham
H. Wells Eames, 29 Cockspur street, S.W.
C. J. Lambe Eames, 4 Rockley road, W.
Thomas Eamunds, 14 Park street, Islington, N.
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J. Howard Earle, 16 Buckingham street, W.C.
W. L. Earnshaw, Folkestone
W. Eavey, John Brown & Company, Limited, Sheffield
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Charles Edwards, Pemhroke dock
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Henry [illegible] City of London College, Leaden-
Morris Evans, 7 John street,
W. Ewer, Birkbeck Institution
Thomas Eynon, Pemhroke dock
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Max Eyth, Steam Plough Works, Leeds
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Jas. K. Fahie, Leinster square, Rathmines, Dublin
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James C. Fell, Oxford Iron Works, Ashton-under-Lyne
William Fells, Beach street, Deal
H. Fenn, Amblecote
W. Fenn, Stourbridge
J. M. Fergnson, 50 Lincoln's inn fields, W.C.
Ab. Field, 50 Leadenhall street
Edward Field, C.E., 22 Buckingham street, W.C.
Frederick Field, F.R.S., Lewisham
J. C. and J. Field, Lambeth
Walter Field, C.E., 3 The Grove, Balham, S.W.
William Field, Brompton, S.W.
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Edward J. Fisher, 10 Market place, Workington
William Fisher, Breage, Helston
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John Fletcher, 64 Pow street, Workington
Thos. Fletcher, Seaton, Workington
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Charles B. Fowler, Loughborough
George Fowler, Basford hall, Notts
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J. Francis, New River head, Clerkenwell
James Frank, jun., Chenies, Bucks
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E. Frankland, 14 Lancaster gate, N.W.
John Fraser, Aberdeen
Geo. F. Freeman and Co., 21 Cooper street Manchester
Hy. Thos. Freshwater, New Malden, Surrey
W. Fritxke, Brettell lane
W. Froude, Chelston Cross, Torquay
Albert Fry, Bristol
John Fullarton, Port Glasgow
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G. W. Gardner, 43 Friargate, Preston
Jas. Wm. Garnell, 14 Lorn road, Brixton, S.W.
G. F. Garrett, 249 Manchester street
Jno. George, Pembroke dock
George Gibbs, Haley Hill, Halifax
R. T. Gibson, B.T. surveyor, St. Katharine Dock house
Henry March Gilbert, 26 Above Bar, Southampton, on behalf of 700 members of the Southampton Polytechnic Institution at Southampton
Alex. O. Gill, Aberdeen
Wm. Gillead, 21 Wellington row
Augustus W. Giraud, Wellington road, Deal
George Gilroy, Hindley Hall and Ince Hall Collieries, Wigan
John Gjers, Ayresome Millworks, Middlesbro

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David Gordon, Port Glasgow
J. Graham. Akroyd place, Dewsbury
Richard B Grantham, 14 Randolph crescent, Paddington
John Gray, Aberdeen
J. M. F. Gray, 127 Queen's road, Peckham
Matthew Gray, Gray's lodge, St. John's park, Blackbeath
T. Gray, Chester le street
William Graves, Peat street, Mark lane
Henry Gren, gas engineer, Preston
F. Green, Stourbridge
John Green, Bath street, Oldham
W. Alford Green, Grove lodge, Bow, E.
Joseph Green and Nephew, Globe Iron Works, Leeds
Alfred Greenwood, Lewisham
Walter Greenwood, 62 Copley street, Halifax
Geo. F. Grcey, Golden street, Deal
Andrew O. W. Gresham, Port Glasgow
Gresham and Craven, Craven Works, Manchester
John Gribbin and Co., spindle makers
Robert Grierson. Rocbdale road, Manchester
J. Griffith, 14 Marsden street, Manchester
Wm. Griffiths. Pembroke dock
Rob. Griggs, 11 Gray's inn square, W.C.
Josiah Grimshaw, Albert Nail Works, Leeds
Thos. Grindrod, 11 Plough Croft lane, Halifax
Illingworth Grindrod, 71 Plough Croft lane, Halifax
Fred. Gronictt, Victoria road. Wisbcach
J. E. A. Gwynee, C.E., M.Inst. C.E., Essex street Works, Victoria embankment
James Haigh, Spring street
William Henry Haigh, 3 Queen court, Orange street
G. J. Haines, 15 Duke-street, Charing cross
Richard B. Hagart, Port Glasgow
W. Haldroyd, Hillhouse
J. C. Hales, 18 Pow street, Workington
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Richard Hallam, 30 King street, Cbeapside, E.C.
Druitt Halpin, Victoria Graving Docks
Harry Halstead, Trinity street, Huddersfield
John Hamer. engineer, Preston
John Hamilton, Port Glasgow
Benj. Hancock, Pembroke dock
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William Hardwick, 7 Range lane, Haley Hill, Halifax
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Geo. Harr, Stamford
Chas. A. Harri, Prospect place
E. Swinfen Harris, 15 Duke street, Adelphi, W.C.
J. W. Harris, 12 Lower street
R. H. Harris. Malvern Link, Upper Tooting
Thomas Dunbar Harris, Pembroke dock
W. Henry Harris, 18 Great Ormond street, W.C.
William Harrison, 33 Temple street, S.E.
Wm. Harrison, 4 Snaw street, Asbton-under-Lyne
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Wilson Hartnell, Rodborough, Stroud
H. T. Hassall, Freeman street, Birmingham
John A. Haswell, Gateshead
G. Hatchmen. Stamford
J. B. Hatfield, Stamford
T. Hawkes, Stourbridge
J B. Hawkins, Cardiff
Philip Hawksworth, spindle maker, Bolton
Wm. Hawthorn, Newcastle-on-Tyne
William Hayes, 12 Bank parade, Preston
Jeremiah Head, Middlesborough
Laurance Headley, 4 Newnham-terrace, Cambridge
William Heap, Rumford place, Liverpool
E. Heav, Denmark street
Hempstead and Co., Limited, Grantham
M. le Heng, Royal Arsenal, Woolwicb

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Heppenstall, Clara street, Huddersfield
S. C. Hepworth, Dewsbury
Hugh M. Herbert, Park Bridge Iron Works, Ashton-under-Lyne
E. Edwards Hewitt, engineer, High conrt, Sheffield
John Hicks, Stamford
A. Hildebrandt, civil engineer, Manchester
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Henry W. Hill, Hampden street, Nottingham
Franklin Hilton, Ebbw Vale, Monmouthshire
Robert Hilton, 46 Pelherney road, West Ham
Hermann Hirsch, C.E., 15 Craven street, W.C.
C. B. Hoad, Clapham road
James Holdsworth, 19 Golden square, Regent street
Wm. Holdsworth, Leeds Iron Foundry
Timon Holgate, 50 Strand, Walmer
John Holiday, Oakfield lodge, Booth street, Handsworth
Alex. T. Hollingsworth, 37 Bedford-street, Strand
M. D. Hollins, Wbitmore hall, Staffordshire
Chas. Holloway, Stourbridge
W D. Holloway, Stourbridge
James Holmes, Hillhouse, Huddersfield
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Chas. H. Holt, 1 St. Ann's churchyard
Francis Holt, locomotive department M. R., Derby
H. Holt Butterfield, M.I.M.E., 213 Regent street, and 15 Humber Dock street, Hull
Henry P. Holt, Royal Insurance buildings, Leeds
Charles S. Homer, Caverswall Castle, Stoke-on-Trent
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Jas. Hooper. Germal, Helston
W. Hooper, 31 Lombard street, E.C.
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John Hopkinson, London road Works, Manchester
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Enoch Horton, Almo Wappy, Dorchester
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Robert Luke Howard, 85 Upper Whitecross street, London
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R. Howson, Middlesborough-on-Tees
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Wm. Howe, Clay Cross
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Henry Hughes, Loughborough
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Thomas S Ingbam, Bedford street
Fred. Ingham, 1 Chatham street, Halifax
Charley Ingrey, 22 Buckingham street, W.C.
Henry Iredale, 32 South William street, Workington
Jonathan Ireland, Manchester
Jos. Iredale, 15 Pow street, Workington
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E B Jackson, Manchester road
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David Jacob, M.D., Maryborough, Tipperary
David Jagger, 4 Corkickle
Edwd. Jakeman, Banbury
G. F. James 29 Spencer street, Battersea
J. James, Langley, Stamford
J. James, 40 Princes street
John James. Breage, Helston
James and Ricbards, Sheffield
R. G. Jaquet. 27 Victoria square, S.W.
George R. Jebb, M.Inst. C.E., Shrewsbury
Edwd. Jeffreys, Low moor Iron Works
Fleming, Jenkin, F.R.S., 3 Great Stuart street, Edinburgh
George Jennings, Stangate, S.E.

eter Jenson, 33 Chancery lane
John Jobson, Derby
Horatio Johns, Pembroke dock
Edmund Johnson, 3 Castle street, Holborn
Edward Johnson, 20 Harbour street East. E.
John Johnson, St. James's road, Upper Tooting
J. Henry Johnson, 47 Lincoln's inn fields
George W. Jones, Newport, Monmouthshire
John Jones, Loughborough
John Jones, Stamford
Jos. Jones, 7 Westminster chambers, Victoria street, Westminster
J. W. Jones, Palmerston buildings, E.C.
W. Jones, H.M. Dockyard, Pembroke dock
Charles Kay, 120 Fishergate, Preston
Harry Kay, 86 Pellon lane, Halifax
William Kedge, 147 Strand
John Keene, 1 Scott's square, Bush lane
John Keith, Aberdeen
J. E. Kellsall, 8 Napier street west, Oldham
C. Kelvington, Manchester
J. W. Kemp, Park road, Dewsbury
Kendall and Gent, Victoria Works, Salford, Manchester
G. E. Kendrick, 681 Commercial road, E.
James Kennan, 19 Fishamble street, Dublin
James Kennedy, Crepington park, Liverpool
Archd. Kenwick & Sons, West Bromwich
Robt. L. Kerr, 41 John Dalton street, Manchester
Godfrey Kettlewell, Longroyd bridge
J. T. King, 4 Clayton square, Liverpool
Alex. Kirby, 14 Great Winchester street, London, solicitor
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Ernest W. Kitching, Bradford road, Huddersfield
Jos. W. Kitley, New British Iron Company, Corngreave's Iron Works, near Birmingham
Elijah Kitson, 9 Thorp street, Halifax
Jas. Knight, 13 Loughborough park
Henry Knott, 7 Clarendon terrace
Henry W. Knott, 26 Brook street, Holborn
Francis Charles Knowles, Bart., Mayfield, near Ryde
W. D. Lambe, Wilson street, Workington
H. Lambert, Stourbridge
Charles Lancaster, 151 New Bond street
Austin Lane, 27 Haley Hill, Halifax
W. L. Langton, New Malden
Chas. E. Lankester, 163 Long lane, Bermondsey
Edwin Lawrence, Lancaster gate
Richd. Laybourne, Rhymney, Mon.
John Leader, 95 Hereford road, Bayswater
P. T. Lee, West park villas
William Lee, Gospel Oak Iron Works, Tipton, Staffordshire
The Leeds Forge Company. Limited, per Mr. Fox, Secretary, New Wortley, Leeds
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Lette, Edwards, and Norman, Euston road, London
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Bedford Lemere, 147 Strand, W.C.
James Letby, Stamford
J. H. Levy, 13 Edgecombe road, S.E.
John Linton, 15 Mill street
Wm. Lithgow, Port Glasgow
G. A. Little, Manchester road, Oldham
Thomas L. Little, Werneth lodge
Peter J. Livesey, 24 Queen's chambers, 5 Market street, Manchester
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E. R. Lloyd, Birmingham
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Wm. Lockwood, Sheffield
W. Lodge, Thorpe street
Walter Lodge, Plough Croft lane, Halifax
William Logan, Langley park Colliery, Durham
Valentine Longbottom, Fartown
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William Longridge, Boyne grove, Maiden head
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Walter F. Lyon, 50 Lincoln's-inn-fields
Geo. Henry Maberly, 35 Randolph crescent, W.
Chas. McBryde, Port Glasgow
Angus McCall, Pembroke dock
J. M'Call, 2A Church lane, Essex road
Edward McConn, 9 College street
D. Macdonald, Port Glasgow
Walter Macfarlane, 22 Park circus, Glasgow
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Joseph C. S. McLay, 26 Martin's lane, E.C.
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M. P. Manfield, Northampton
William Mannock, Green street
Richard C. Mansell, Ashford, Kent
Wm. Marrevilo, Grafter's place, Huddersfield
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F. C. Marshall, Newcastle-on-Tyne
George Marshall, 3 Silver street, Haley Hill
James Marshall, Gainsborough
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W. J. Mastbury, Oldswinford Hospital
J. Matthews, Sutherland gardens, W.
James Matthews, engineer, Broad street, Bristol
Thos. Matthews, Riversbrook, Woodgreen
Thomas W. Matthews, Broughton road Iron Works
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Joseph Mawle, Banbury
Samuel Mayer, Willaston
Fred. Meller, 79½ Gracechurch street, E.C.
Thos. Meller, 12 Cornhill, E.C.
Will. Melling, St. Ignatius square, Preston
Edward Mellor, Spring street
James Mellor, Hedholtham, Huddersfield
Saml. Mellor, Fitzwilliam street, Huddersfield
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John Miller, Aberdeen
John H. Millingship, Stourbridge
A. H. Mills, Manchester
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Wm. Muir and Co., Brittania Works, Manchester
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H. H. Murdoch, 7 Staple inn, W.C.
John Murray, George street
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James Nelson, Sunderland
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Clarkson Nottingham, Stalybridge
Nussey and Co., Park Works, Leeds
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James Owen, Pembroke dock
William Owen, Clifton house, Rotherham
M. W. Packer, Stamford
J. I. Packington, 31 Union grove, Clapham
Benjamin C. Page, Lower street, Deal
Arthur Paget, Loughborough
J. Hinde Palmer, Lincoln's-inn
John J. Parker, 3 Leadenhall street
Thomas Parker, 5 New town, Halifax
George Fred. Parratt, 23 Auley road, S.W.
Edw. Parrett, Pembroke dock
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Thos. Patterson, Savile town, Dewsbury
James Paxman, Colchester
Benjamin Payne, 63 Park street, Halifax
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E. Peddle, 30 Montpelier road, Peckham
George Peel, Soho Iron Works, Manchester
John Pendlebury, Bradford road, Huddersfield
Penhouse Parkes, Tipton
J. P. Pepper, Stamford
John Peregrine, Pembroke dock
Loftus Perkins, Seaford street, Regent square
Thomas J. Perry, Bilston
William Perry, Wednesbu
Perry Brothers, Castleton Foundry, Leeds
W. J. Petherick, Birkbeck Institution, W.C.
J. Phillips, Putney
W. C. Phillips, Breage, Helston
Geo. F. Pickering, Loughborough
Edward Platt, Sowerby bridge
James Platt, Gloucester
John J. Pledge, Hope house, Deal
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Lewis Powell, 22 Oxford street
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F. Price, Stamford
John Price, Jarrow-on-Tyne
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Robert Charles Ransome, Ipswich
Robert James Ransome, Stoke hall, Ipswich
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G. Rhifton, Neyland
B. Richards, Regent square
Ewindsor Richards, Middlesborough
J. H. Richardson, Victoria road, Peckham
L. Richards, Pembroke dock
W. Hosken Richards, Regent square
John Richardson, 2 Back Corkiole
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James Rickett, Stamford
J. C. Rider, Stourbridge
Richard Ridge, Wilson street, Workington
John Rigby, 24 Suffolk street, Dublin
Arthur Rigg, 21 Sutherland gardens, W.
James Rippon, 28 Goulborn road
Joseph Ritson, St. Peter's-square, Manchester
J. Roach, M.D., Dublin
Chas. F. Ro ds, Queen street West
J. A. S. Roatch, Pow street, Workington
W. T. Roffe, 9 Bredgar terrace, Upper Holloway
A. H. Robinson, Merrion, Dublin
Charles W. Robinson, Duke street
Fletcher Robinson, 6 Milton terrace, Halifax
Henry Robinson, C.E., 7 Westminster Chambers
John Robinson, Manchester street
John Ryley Robinson, Dewsbury
R. C. Robinson, engineer and ironfounder, Preston
Wm. Robinson, Holden street
A. Roberts, 2 Gonduit street, Regent street
Brookloy Roberts, 9 Arthur road, N.
Thos. Roberts, Crewe
W. Roderick, treasurer, Chamber of Commerce, Llanelly
Tho. W. Rogers, 23 Leadenhall street
J. Rooke, 90 Leadenhall street, E.C.
J. H. Rose, 352 Oxford street
Wm. Rose, Port Glasgow
S. Rosenbaum, 1 Bloomsbury square
Geo. F. Rossitor, Stourbridge
Joseph Rothey, 10 Curwin st. Workington

William Routledge, Blackfriars, Manchester
John Rowbottom, 48 Manchester road
Owen Rowland, *Morning Post*, and Highgate
E. A. Roy, 1 Lady Margaret road, N.W.
John Royce, Stamford
Alfred Rumball, 13 Parliament street, Westminster
Thos. Rumball, 18 Buckingham street, W.C.
Joseph Russell, Port Glasgow
J. W. Russell, 65 Connaught street, Hyde park square
Joseph Ruston, J.P., Lincoln
William J. H. Ryder, Newcastle-on-Tyne
Alfred L. Sacré, 26 Parliament street Westminster
George Salt, Saltaire
Lyons Sampson, North London Iron Works, **London, N.**
B. Samuelson, 56 Princes gate
Fred. R. J. Sandcraft, Lower street, Deal
W. Sanderson, 34 Jackson road, N.
W. H. Sargeant, Birkbeck Institution
Andrew Sarll, 62 Oakley road, N.
G. T. Saunders, Wilson street, Workington
W. J. Saunders, Pembroke dock
J. W. Schofield, 33 Coppice street, Oldham
W. Scholefield, 158 Manchester road
Joseph Scholefield, Dewsbury
John Schooling, 11 Alban terrace, The Grove, Hammersmith
Fred. W. Schroder, Old Swan chambers, E.C.
James W. Scorer, Wryde Croft, Thorney
Wm. Scorer, 7 Burleigh street, Strand, London, W.C.
Joseph Scott, Newcastle-on-Tyne
Major General H. Y. D. Scott, F.R.S. Royal Albert Hall
T. C. Seary, 3 Took's court, Chancery lane
Walter De Seaton, Loughborough
J. F. Seddon, Gt. Harwood Collery, Accrington
J. Seery, Newton
G. T. Selby, 1 Caton square, London
Robert Semple, Aberdeen
Robert Sergeant, 174 High street
Chas. Sewell, Louvaine road, Clapham Junction
Sharp, Stewart and Co. Limited, Atlas Works, Manchester, per Nath. Cartwright, Secretary
Edwin Shaw, 3 Robert street, Halifax
John Shaw, North Watts street, Wokington
Thos. Shaw, President of Halifax Chamber of Commerce, Allangate, Halifax
Thos. Sheard, Clifton terrace, Stockport
S. Sheppard, Stourbridge
P. J. Sherlock, 179 Liverpool road, N.
Sep. Short, Sheffield
James N. Shoolbred, 3 Westminster chambers, S.W.
Alfred Shotter, New Malden
James Silk, 7 New North place
John Simmons, 90 Shardeloes road, New Cross
W. Simpson, Birbeck Institution
J. Hope Simpson, Birmingham
James Sinclair, Aberdeen
A. Sinnott, Coppice street, Oldham
W. H. Sissons, 27 Leadenhall street, E.C.
Wm. W. Sixton, 103 Albany road, S.E.
Henry Skoines, 7 Argyle street, London, W.C.
Edward Slaughter, 4 Clifton park
John S. Smaile, 5 Victoria park, Whitby
Alex. Smith, Aberdeen
Alfred Smith, Longsight, Manchester
Arthur Smith, Stamford
Chas. Smith, Hartlepool
Charles Smith, Frederic Johnson, Chairman and Honorary Secretary of the Faversham Institute for the Encouragement of Literature, Science, and Art, on behalf of the Directors, Faversham, Kent
C. J. E. Smith, 30 Canonbury road
E. Fisher Smith, the Priory, Dudley
Geo. Smith, Pembroke dock
Geo. Fereday Smith, Grovehurst, Tunbridge Wells
Henry Smith, 25 Peter street
John Smith, Miles Platting
Joseph Smith, Stamford
W. Ford Smith, Gresley Iron Works, Manchester
Smith, Beacock, and Tannet, Victoria Foundry, Leeds
Smith and Coventry, Gresley Works, Manchester
William Somer, Manchester
Thos. Sopwith, M.A., F.R.S., M.Inst. C.E., 103 Victoria street, Westminster
Matthew A. Soul, 23 St. Mary Axe, E.C.
Arthur Spademan, Stamford
W. M. Sparrow, Albrighton hall, Shrewsbury
Joseph Spence, 144 Queen street
William Spence, 2 Quality court
John Henry Spencer, 67 Park street, Halifax
Joshua Spenceley, Taylor street, Halifax
A. Speed, Stamford
John Spiking, Dewsbury
James Stabler, 75 Upper Ground street Blackfriars road
William Stableford, Broadwall house, Oldbury
A. Stacey, 400 Old Kent road, S.E.
T. Neville Stack, 10 Upper Sackville street
W. J. Stanbridge, 72 Portland road, Notting hill
R. Stainer, Stourbridge
S. Stainer, Stourbridge
David Stansfield, 42 Darley street, Halifax
R. W. Sterry, 143 Peckham park road
Arthur J. Stevens, Uskside Iron Works, Newport, Monmouth
Charles P. Stewart, 92 Lancaster gate, W.
William Stewart, Port Glasgow
James M. Stocks, 11 Poultry, E.C.
F. W. Stoker, The Moor Ironworks, Stockton-on-Tees
Allen Stott, Lindley
P. S. Stott, Wykeham place, Middleton road
Jos. F. Strong, C.E., Avenue road, Southampton
George Stuart, Wilson street, Workington
Thos. Sturgeon, Park place, Leeds
Joshua Sualon, Sir street, Oldham
Thos. Sugden, Calder Works, Leeds
J. R. Sumbum, watchmaker, 34 Curwen street, Workington
Henry Sumpton, Market place, Workington
Thos. Surnburn, 12 Wilson street, Workington
Frederic J. N. Sutcliffe, Bowling Iron Works, Bradford, Yorkshire
Hartley Sutcliffe, 7 Lewis street, Stannary, Halifax
Shaw S. Sutcliffe, Stannary, Halifax
Walter Sutcliffe, 4 Old lane terrace, Halifax
Thos. Sutton, Pembroke dockyard
W. J. C. Swales, Sheffield
Ben Sykes, 11 Martin street, Halifax
John Sykes, Northumberland street, Huddersfield
William Sykes, Commercial road, Halifax
G. G. Tabraham, Hon. Sec. Mechanics' Institute, Wisbeach
Robert Taggart, 79 Scotch street
Philip Tait, Middleton road
James Tangye, Aviary cottage, near Redruth, Cornwall
William Tasker, Halifax
A. N. Tate, 32 Blessington road, Lee
William Taylor, 32 Dunkerley street
Emanuel Taylor, 93 Coppice street, Oldham
Edwin T. Taylor, 14A Cardington street, N.W.
G. Taylor, 2 Fair street, South Stepney
Henry E. Taylor, 15 Newgate street, Chester
Josh. Taylor, Corinthian villa, Acock's green, Birmingham
Percyvale Taylor, M. Inst. M.E., Panther Lead Works, Bristol
Samuel Taylor, 254 Manchester street
Walter Teedale, Paddock
Michael Tempest, 103 Booth Town road
Seymour Teulon, Finchley park, Limpsfield, Surrey
Alfred Tharpe, Queen street, Huddersfield
C. Thiele, Savile town, Dewsbury
F. Edmund Thode and Knopp, Dresden, Saxony
Edw. Thomas, Pembroke dock
Geo. P. Thomas, Pembroke dock
Joseph Lee Thomas, 16 Holland road, Kensington
A. M. Thompson, Crewe
James Thompson, Wilson street, Workington
W. L. Thompson, 11 Queen Victoria street, E.C.
W. H. Thornthwaite, 416 Strand, W.C.
Arthur Thorp, 5 Booth Town, Turner's court
George A. Thrupp, 111 Maida vale
R. A. Todd, Canal Steel Works, Sheffield
G. W. Tomlinson, 24 Queen street, Huddersfield
James Tomlinson, Clara street, Huddersfield
Edmund Tonks, B.C.L., Birmingham
Francis Toombs, 21 Rathbone place, W.
W. Towness-Burton, 38 Avenham lane
Thomas Townley, Pembroke dock
Joseph Travis, 93 Windsor road
Henry Trevena, Pembroke dock
J. F. Trevitt, The Homestead, Hackney common
F. W. H. C. Tuck, 11 Fitzwilliam street
George Tucker, 7 Marquis road, Stroud green, N.
And. W. Tuer, 50 Leadenhall street, E.C.
E. Carleton Tufnell, 26 Lowdnes square
T. R. Tufnell, 1 Whitehall gardens
Edmund Turnbull, President of the Hartlepool Chamber of Commerce, West Hartlepool
L. R. Turnbull, 5 Bredgar terrace
Albert Turner, Walton le dale
Frederick Turner, St. Peter's Iron Works, Ipswich
Henry Turner, 7 St. Peter's square, Manchester
John Turner, 55 Friargate, Preston
Samuel Turner, Sheffield
Ralph H. Tweddell, 14 Delahay street, Westminster, S.W.
Joseph Twibill, Manchester
J. Tyers, Stamford
J. E. Underhill, 1 Starked street, Preston
Robert Urquhart, Vice-President, ditto
C J Valentine, Bank field, Workington
J. R. Vaughan, Pembroke dock
John Vierr, 22 Wilson street, Workington
J. Waddell and Co., 11 Queen Victoria street, E.C.
W. H. Walenn, 74 Brecknock road, N.
A. E. Walker, Stourbridge
Bernard P. Walker, Eagle Foundry, Birmingham
Chas. Clemt. Walker Lilleshall, Old Hall, Salop
Frederick W. Walker, Lockwood, Huddersfield
Geo. Walker, 95 Leadenhall street, E.C.
John Walker, 24 Pow street, Workington
Wallingham, 21 East Surrey grove, Peckham
J. Wallis, 8 Derby villas, New Malden
Joseph Wallis, Clarence house, Deal
Walter and Stokes, 40 Chancery lane, E.C.
Jas. Walton, 292 Strand, W.C.
Wm. T. Walton, Yorkshire Foundry, Leeds
James Warburton, Savile town, Dewsbury
John C. Ward, The Retreat, 23 Haverstock hill
J. R. Ward, Stamford
John Ward, Manchester road
William Ward, Stamford
Walter E. Warden, Phœnix Bolt and Nut Works, Birmingham
Frederic P. Warren, 20 Clarence parade, Southsea
Richd. S. Warrington, New Malden, Surrey
Thos. A. Warrington, 30 King street, Cheapside, E.C.
John Waterhouse, York road
W. D. Waterhouse, Dame street, Dublin
C. Waterson, 2 Bishop's road, South Hackney
Richd. Watkins, Canal Iron Works, Millwall, E.
H. D. Watson, Aberdeen
R. Waywood, 13, Catherine square, E.C.
Geo. N. Weatherhogg, 274 Strand, W.C.
F. W. Webb, Crewe
Henry Webb, Irwell Forge, Bury
Richard Everard Webster, 2 Pump court, Temple
C. O. Weeks, Blenheim villa, Blenheim grove, Peckham, S.E.
E. G. Welling, 181A Lower street
H. J. Wells, 87 South street, S.E.
W. J. Wernham, 34 Union square, Islington
A. Westhead, 174 Friargate
Wm. Westhead, 3 Chapel street, Preston
Percy Westmacott, Benwell Hill, Newcastle-on-Tyne
F. R. Wheeldon, Wolverhampton
William Whieldon, 190 Westminster bridge road
Jas. Whitehead, Birkbeck Institution
Robert White, Union street
Wm. W. White, 16 Union street, Deal
J. L. Whitehead, 196 Manchester road

James Whitfield, Linhouse terrace, Workington
Joseph Whitley, Hunslet road, Leeds
Robt. W. Whitlock, solicitor, Workington
Thomas S. Whittem, Wyken Colliery, near Coventry
Richard Whittington, M.A., St. Peter's upon Cornhill
W. Whitwell, Saltburne-by-the-Sea
Joseph Whitworth, Manchester
John R. Wigham, Capel street, Dublin
R. H. Wilding, 17 Lime street, Preston
W. M. Wilkinson, 44 Lincoln's inn fields
D. E Williams, 24 Basinghall street, E.C.
E. P. Williams, 66 Holland road, Brixton, S.W.
R. Price Williams, 9 Great George street, Westminster
S. Williams, Secretary Newport Chamber of Commerce, Newport, Monmouthshire
C. Williamson, Port Glasgow
A. Wilson, Middlesborough
Henry Wilson, Stockton-on-Tees
John C. Wilson, Avonside Engine Company, Bristol
Peter Wilson, 13 Pow street, Workington
Stephen Wilson, Wearmouth Colliery, Sunderland
William Wilson, Port Glasgow
Fred. Chas. Winby, Cardiff
T. B. Winter, C.E., 53 Moorgate street
Fred. Winterbottom, Lockwood
W. Lloyd Wise, Chandos chambers, Adelphi, W.C.
Wishart and Lloyd, 21 Coventry street, W.
Walter Withall, 18 Bedford row
H. T. Wood, Society of Arts, Adelphi, W.C.
Joseph Wood, 18 Washington street, Workington
Walter Wood, 147 Strand, W.C.
Jno. P. Woodhead, 16 Tib lane, Manchester
Edward Woods, 3 Great George street, Westminster
J. W. Woodward, Stourbridge
Thomas Woolly, 3 Alma road, Bow
Ralph Worden, 13 Cross street, Preston
T. W. Worsdell, Crewe
Matthew Wray, 15 Ackroydon, Halifax
Charles Wren, Laurel house, Highgate
Joseph Wright, Neptune Forge, Tipton
Theodore R. Wright, 12 Gower street, W.C.
W. Wright, Stamford
Wm. W. Wynn, C.E., Pease's buildings, Leeds
Fred. C. Wyvil, Longclose Works, Leeds
G. W. Yapp, 8 Albion road, S.W.
James A. Youl, Clapham park
Chas. F. T. Young, C.E., consulting engineer for patents, 112 St. Donatt's road, New cross, S.E.
Thomas Young, Port Glasgow

THIRTEENTH ORDINARY MEETING.

Wednesday, February 28th, 1877; The Rev. MARK PATTISON, B.D., Rector of Lincoln College, Oxford, in the chair.

The following candidates were proposed for election as members of the Society:—

Comber, Arthur, C.E., Town-hall, Kidderminster.
Danvers, Juland, India-office, S.W.
Falshaw, Sir James, Bart., Lord Provost of Edinburgh.
Griffin, Charles, 22, Garrick-street, W.C.
Hastings, Henry Mitchell, F.C.S., 10, Vicarage-gardens, Campden-hill, Kensington, W.
Hearder, William S., 195, Union-street, Plymouth.
Hill, Captain P., Kingston-on-Thames.
Jennings, Francis W., Brookfield-house, Cork.
Lawrence, Edward, 47, Maddox-street, Regent-street, W.
Leslie, Walter Alexander, 9, Thurlow-road, Hampstead, N.W.
Reed, George, M.D., Royal Infirmary, Manchester.
Roberts, Henry Croydon, 27, Royal-crescent, Notting-hill, W.
Roberts, Hugh Lloyd, 1, Pump-court, Temple, E.C.
Stokes, Colonel John, R.E., Brompton Barracks, Chatham.
Tyrer, Thomas, Garden Wharf, Battersea, S.W.

The following candidates were balloted for, and duly elected members of the Society:—

Bower, John A., 1, St. Paul's-terrace, Brockley-road, S.E.
Brown, Henry William, 124, Lower Thames-street, and 102, Grove-lane, Camberwell, S.E.
Blyth, Alexander Wynter, Barnstaple, North Devon.
Cheshire, Frank R., Avenue-house, Acton, and 168, Camden-street, N.W.
Chevassus, Henry, 106-8, Old-street, E.C., and 20, Montem-road, Forest-hill.
Forster, Anthony, Finlay-house, St. Leonards-on-Sea.
Graham, Harry Robert, 15, Warrior-square, St. Leonards-on-Sea.
Hughes, Henry, Tintern-house, Leicester.
Josolyne, John Augustus, Belmore-lodge, Herne-hill.
Manser, Alfred, Lampits, Hoddesdon, Hertford.
Owen, R. Brisco, M.D., F.L.S., Mayor of Beaumaris.
Preston, John, J.P., Mayor of Belfast.
Salter, Frank, B.Sc. (Lond.), A.I.C.E., 4, Glengall-terrace, Old Kent-road, S.E.
Samayoa, Señor Don José Maria, Hotel de Bade, Paris.

The paper read was—

ON MIDDLE-CLASS EDUCATION IN HOLLAND.

By John Yeats, LL.D., &c.

It is only natural that a Society like this, which has promoted, and in some cases initiated, a series of exhibitions of industry and skill applied to material objects, should also cause inquiries to be instituted into those less apparent intellectual and moral forces, which are, after all, the mainsprings of industrial excellence. And it is but just to suppose that those forces would be found, if anywhere, in systems of public instruction; which, therefore, might well reward investigation, and might usefully lead to international comparisons.

There is, however, a prejudice against systems, especially when they are supposed to originate in what is called "centralisation," or bureaucratic influence. The advocates of one, at least, are reproached with a wish to destroy the liberty of the subject by the enactment of compulsory codes, however impartially administered, or imperatively required. And of others as meritorious it is said that, aiming at the prevention of wrong, they have really a tendency to increase it, by shifting the sense of moral responsibility from the consciences of those who are watched to those of the watchers, and by encouraging a standard of morality which leads a man to esteem himself innocent because he has never been shown to be guilty.

But if we reflect that system is essential to all business in which an approach to precision of action is desirable—and that without system the administration of a railway, the Post-office, or the Bank of England would be impossible—we shall hardly consider an application of the idea to public instruction as ill-timed or out of place. In England, boys and girls are brought up carefully and expensively, yet it often happens that when wanted for work they are found ill-fitted for the posts assigned them. Whose fault is it? Why do mistakes occur so frequently in this fitting of qualifications to known requirements? It is perfectly unintentional on the part of parents and of employers, and its long continuance can only be traced to want of system. Any good system of public instruction would ensure, at least, the possession of qualifications, in certain degrees, amongst scholars; or it would enable inquirers to judge for themselves as to ignorance and incapacity. It would establish the best known processes everywhere, and it would publish reliable results. Let us for a moment suppose a case of emergency—a threatened invasion. Help is wanted in the general telegraph or in the medical department. With a fair system of instruction as a resource, the Government official goes to the Education-office and makes known his requirements. He is at once told how many pupils have recently left the Polytechnic or other science schools throughout the country. If the want continues parents are apprised. They in turn inquire at the Education-office as to the preliminary examinations for admission to a Polytechnic or to a special science school, and are informed that all pupils who have passed through particular classes of certain schools are admissible at once. These schools are in every district, but have lesson-plans of uniform principle, therefore pupils, whose parents change place of residence, can pass from one into another freely, and pursue an uninterrupted course of study, notwithstanding household removals. Is not this a public convenience? Can it be truly said that the same ends are secured by other means? Competition is serviceable for purposes of selection, but hardly for the production of talent, and in emergencies, when most required, it cannot be enforced. Besides, what is to become of unsuccessful candidates? What has been called the residuum of society must be fed and clothed at the expense of their superiors, unless they can be rendered self-supporting by system. From the disuse of apprenticeship, and the decline of industrial control on the part of the city guilds, there seems to be a greater necessity for system in public instruction than ever before.

Once every maker of metallic screws had his own pattern; the consequence was that, with varying excellence, few were alike. Misfits in work and in repairs, going on all over the world, were endless, and the loss and annoyance serious, until Sir Joseph Whitworth designed a normal screw that should be used exclusively in his business. Gradually it has passed into general adoption, and in most contracts these screws are expressly specified. We should all regret, I am sure, to liken pupils and teachers to screws, but a screw-driver at their head like Sir J. Whitworth might be a national gain. By the scholarships bearing his name, he is initiating reforms which are full of promise. Here an objection may be made that the best results of education are incapable of registration, or of any mechanical form of expression; that they are visible and perceptible only when it is found out that the energies of the mind rise in proportion to the exigencies of its situation, &c. Granted. But the adoption of system does not preclude the preparation for this highest stage; on the contrary, it would prove a most valuable auxiliary. Training for such a condition is contemplated even in workshops and factories where there is any good system. As a proof of it, we are told of the late Henry Maudslay, that he had a peculiar way of indicating the capabilities of those who came to him. The highest order of man was marked in his own mind at 100°, and by this ideal standard he measured others, putting them down at 90°, 80°, and so on. A very first-rate man he would set down at 95°, but men of this rank were exceedingly rare. Of others, he would say to his attendant Nasmyth, "That man may be set down at 45°; but he may be worked up to 60°."

Now, disregarding Mr. Maudslay's motives or his methods, it is obvious that he had a system which enabled him to put every man in a proper place (no mis-fitting), and to provide for the development of all his latent energy and ability. A Minister of Public Instruction could do no more; and he ought to do no less. The essence of his system would be manifest in such a result. It is eminently characteristic of the national system before us to-night, and may partly be accounted for from the following peculiar circumstances.

All round the coasts of Holland embankments are raised, varying in magnitude with the power of resistance required. Skilled attendants are constantly on the alert. The tidal pressure is known to a nicety; at most points the "peil," or water-gauge, is set up and watched; in prospect of disaster, all the manly, and even the womanly, strength of the population has to be called out, and the most fervid appeals made to their sense of duty and devotion to the cause of humanity. Dutch history teems with instances of disinterestedness and self-sacrifice in hours of peril.

Although in the ordinary avocations of life extreme exertion may seldom be required, yet our own engineers, naval officers, and commanders of military outposts are aware that it is necessary to know the reserve of force—mental, moral, and material—that can be called forth on emergency.

Our Society takes its fair share of exertion in this direction. It has devised a scheme of examinations to indicate the merit, more or less, of any operative, foreman, or manager who chooses to be tested; and beyond that, if he is willing to be "worked up" a few degrees higher, it shows how and where the thing may be done, and offers premiums to stimulate exertion. But what the Society of Arts does on a comparatively small scale, and with great trouble and expense to its worthy managers, the Minister of the Interior in Holland can accomplish systematically and cheaply for the whole population.

I know that in the Privy Council-office, Downing-street, there is an Education Department, larger, and even more expensive, than our own in Adam-street. But my belief is that neither of them effects so much, at a cost so small, as is easily done in Holland by a Minister of the Interior responsible for instruction. Yet there are men to be found in the United Kingdom as patriotic and as well fitted for this important post as any that little Holland has produced.

I do not use the epithet little in any other sense than as applicable to the relative size of her territory. Allow me to quote from the latest edition (1871) of the "Dictionary of Commerce, &c.," by J. R. McCulloch, the following brief description of Holland, and his summary of the position of the Dutch:—"A country not more extensive than Wales, and, naturally, not more fertile—conquered, indeed, in great measure from the sea, from the irruptions of which it is defended by immense dykes, constructed and kept up at a vast expense—has accumulated a population of upwards of three millions and a half (1874), has maintained wars of unexampled duration with the most powerful monarchies; and, besides laying out immense sums in works of utility and ornament at home, has been enabled to lend hundreds of millions to foreigners. * * * Even at this moment, after all the vicissitudes they have undergone, the Dutch are beyond all question the most opulent and industrious of European nations."

I submit this statement with the greater confidence, because Mr. McCulloch was accustomed to comparative estimates. Their colonial possessions are said to cover an area of 666,756 English square miles, and the number of inhabitants to be 24,386,991, or six times as many as they are at home. When we reflect that London is as near to Rotterdam, by water, as it is to Liverpool by railway, and that Amsterdam is no further off than our own city of York by the Midland line, nothing need be added to facilitate reference. To furnish a rough mode of comparison, I may venture to say that four of our eastern counties, Yorkshire, Lincolnshire, Norfolk, and Suffolk, when combined, are equal nearly, in area and population, to the eleven provinces forming the kingdom of the Netherlands, or, as it is most commonly called, Holland. Whether they are on equality in other respects remains to be considered. In the fifteenth century, we are told, one of them—Norfolk—was by far the wealthiest of our English counties, not even Middlesex excepted. Half the shipping of the nation was owned in the great ports of Lynn and Yarmouth, that were the direct roads by which the wool of East Anglia and the bordering districts found its way to the low countries.

Not much can be done well within one brief hour, but in my endeavour to give an outline of of middle-class education in Holland, I purpose touching principally upon—What it is—How it came about—What it does—and, What there is for it to do still.

First, however, at the risk of anticipating some parts of the narrative, let me say that no locality can be without ample school accommodation, easily accessible, and open to all the inhabitants. No person, male or female, may enter on the duties of a public or a private teacher without having passed prescribed examinations before legally constituted authorities. No public or private school can be exempt from official inspection. Dutch national instruction is not compulsory; it is not gratuitous; it is not sectarian.

WHAT IT IS.

The general statistics of instruction corrected to 1st January, 1874, are the following:—Population, 3,600,000; total of pupils in all schools, 500,059, or one pupil to seven inhabitants; of these, 265,815 boys; a proportion of school-going boys exceeded only in some parts of Prussia, Scotland, and Switzerland.

Lower Instruction (*Het Lager Onderwys*).

Public schools ..	2,669	Private schools..	1,121
Public schoolmasters	6,519	Private schoolmasters	2,472
Public schoolmistresses	727	Private schoolmistresses	1,745
Public pupils ..	382,146	Private pupils ..	117,913
Of these—boys..	212,995	Of these—boys..	52,820
„ girls..	169,151	„ girls..	65,093

Middle Instruction (*Het Middelbaar Onderwys*).

Schools, 90, not special, with pupils, 7,826; also 3 trade schools, with 336 pupils; 10 for navigation, with 400 pupils; 1 agricultural, with 9 pupils; 1 for horticulture, with 21 pupils; the Polytechnic School at Delft, with professors 23, and pupils 220.

Higher Instruction (*Het Hooger Onderwys*).

Gymnasiums or Latin schools, 55, with pupils, 1,185; universities, 3, with professors 78, number of students 1,635; the Athenæum of Amsterdam—professors 22, and students 373.

To avoid any confusion in marking the divisions above, I have purposely omitted statements concerning adults, or others not absolutely school-boys or school-girls. But in the official report of 1872 mention is made of 95 public schools and of 132 private schools, or a total of 228 schools for adults, with 555 teachers and 11,051 pupils. In several large towns there are good drawing schools, which do not figure in that report.

In the public schools it will be seen that there is a larger proportion of boys than of girls; in private schools the reverse is the case, but for a fair explanation, reference must be made to the special report of middle-class schools for girls in the appendix.

The appendix contains the general provisions of the law as to the distinctions between public and private instruction; and those also relating to public middle-school instruction for lower or day burgher schools and day and evening burgher schools; for higher burgher schools; for agricultural schools; for the Polytechnic School; its teachers and the general management.

It also contains an abstract of the report of 1876 on lower burgher schools, public or communal; their scholars, staff of teachers, instruction, material appliances, and the special drawing schools (1874).

It further contains an abstract of the report of 1876 on higher burgher schools—Government, communal, or non-subsidised—their scholars, staff of teachers, the subjects taught, examinations, apparatus and other appliances.

To these are added, a report on the Polytechnic School; an account of middle-school instruction for girls; the cost of middle-school instruction, and how divided; the success of the higher burgher schools.

Here let me remark that lower, middle, and higher instruction, though parts of one system, are yet distinct and complete organisations. They are designed to suit the tastes and supply the wants of different ranks of society. Their courses of study are determined in duration by the average length of attendance at school. Instruction is graded according to varying circumstances. The schools in each are identified mainly by the work done in them; and so designated by law. Middle-class education takes place, of course, chiefly in the middle schools, yet not entirely, for these make no provision for a university career; hence middle-class education comprises more than an account of middle schools. These include two kinds of burgher schools for general purposes, four or five special schools, and finally the Polytechnic School at Delft, for which preparation is made in the higher burgher schools.

The large table will show where the middle schools for general instruction may be seen at work; the kinds of school in each commune; the time when each school was opened; the duration of the school-course of study; the fees demanded; the population of each commune in 1874; the attendance of scholars and the number of teachers.

I have not yet met with an adequate definition of middle-class education. Perhaps the phrase expresses a requirement rather than a reality. In the Dutch statute-book there is not a full definition even of middle schools, or of middle instruction, though the meaning is clear. The boundary lines of lower and of higher instruction (*Het lager en het hooger onderwys*) are drawn; and all that is over the one and under the other may be claimed for the middle.

For a considerable number of the next generation of citizens, the groundwork of culture and the elements of knowledge are held to be sufficient. But for others, special information on matters pertaining to the future calling in life must be provided. Besides these two, there is a third group, seeking in the middle schools a course of study that shall be auxiliary to higher instruction hereafter.

Hence, middle-school instruction comprises not merely means for general development and culture, carried to such extent as to enable a youth to enter upon a civic calling successfully, but also the elements of special knowledge, and, lastly, a course of study that shall be preparatory to further training at a polytechnic or other scientific institution.

In these schools such provision is made that manufacturers and merchants can not merely obtain clear notions of the requirements for their future career, but also full qualification for it, without being exposed to demoralising influences of any kind.

The qualification for giving middle-school instruction is obtainable in three ways—by the possession of a degree from one of the universities; by a diploma from the Polytechnic School; or by a certificate from the Board of School Examiners—the *jus docendi.*

Of these three, the first and second seem to be preferred to the third, and the first to the second. It is felt that university training affords the best security for the broadest form of culture, for the greatest liberality of thought, as well as for solidity of judgment. It is a complaint that the mere passing of a series of prescribed examinations does not produce good scholars or apt teachers. Desultory study is insufficient for posts so important as the directorships of higher burgher schools, and the director is only one of the working staff; *Primus inter pares.*

As the townspeople, in contradistinction to country people, form a larger proportion of the population in the Netherlands than in any other country in Europe, the middle-class element preponderates, and influences education generally. This circumstance will serve to explain some prominent features of the Dutch system, but not the whole of them. All classes seem to have been desirous of the realisation of a few principles not very difficult to distinguish; *e.g.*, in their original social construction (Grondwet) as also in their schemes for national instruction, the Dutch provide very carefully for religious freedom, and for self-government. Next to these two principles a popular craving for unity, nay more, for unanimity—from the want of which they have suffered so much—is apparent. I mean that sentiment which prompts them to try to prevent discord and to promote true patriotism. Then follows the desire for possessing real knowledge rather than for classic learning. Lastly, the Dutch have a marked industrial bias, and habits of strict economy.

Among other points of interest is the dominant opinion that the rising generation in town or country should be kept together, and on a footing of mutual respect, as long as possible; that the broader and deeper the common foundations of culture are laid, the larger will be the circle of ideas within which the different members of society can make themselves mutually intelligible. Again, in as much as the daily avocations of life are felt to be less fixed and stable than formerly, parents seem anxious rather to make their children self-helping and self-reliant than to prepare them for any of the old-established occupations or professions. They wish the rising generation to become acquainted with this world in which they will have to live and labour; and to try to lead them to beware, lest through ignorance or prejudice they attempt physical impossibilities, mistake proper means, overlook aids afforded by nature, or shrink from the faithful discharge of every known duty, individual or social.

Beyond instruction in the middle schools, middle-class education comprises part of the curriculum of a gymnasium, very often; therefore, I mention that in 1876, the new law relating to higher instruction (*het hooger onderwys*) was passed. It provides for the gymnasia as institutions preparatory to the universities.

Art. 5. In all the gymnasia instruction shall be given in, *a*, the Greek language and literature; *b*, the Latin language and literature; *c*, the Dutch language and literature; *d*, the French language; *e*, the German language; *f*, the English language; *g*, history; *h*, geography; *i*, mathematics; *k*, physics; *l*, chemistry; *m*, natural history. Optional subjects are—*n*, Hebrew; *o*, gymnastics.

Art. 6. In every gemeente (township or district), with a population of more than 20,000 souls, one gymnasium shall be established and maintained. As many more as necessary may be established. Or in case of there being no need for any gymnasium, the Crown can exempt, &c.

Art. 7. The instruction in gymnasia shall be included within a six years' curriculum; but after the fifth year a division shall take place into the literary and the scientific courses, &c.

About one-third of the time and strength of the pupils in the higher burgher schools is given to mathematics and the physical sciences, one-third to languages, and the remaining third to history, geography, political and commercial sciences, and drawing.

It has been seen that even in the gymnasia or Latin schools great attention is paid to the modern languages and to science. The Dutch student reads Horace and Homer, but does not take up Lucretius and Æschylus; he substitutes English and chemistry. A knowledge of French for conversational purposes is so much a matter of course, from early childhood, that special mention of it is unnecessary here. Next, perhaps, come purely industrial subjects,* the study of raw and of wrought materials, commercial history, political and social economy. Time fails, or I should be very glad to show the extent to which these last are carried. Libraries and laboratories are being provided; so is good gymnastic apparatus. Private schools are not opposed, but excepting a few excellent ones for special aims, they are principally denominational, and dear, and inferior to the public ones.

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* In two reviews of the operation of the laws of Lower and of Middle Instruction issued by the Society for the Promotion of the Public Good, 1875-1876, great stress is laid on the extension of industrial teaching, on the foundation of special schools for "den Handel," trade; "de Nyverheid," industry; "den landbouw," agriculture: and for "Ambachtsscholen," handicrafts; with "Voortgezette ambachtsscholen," extended ditto.

How it Came About.

We have seen that the middle schools sprang out of the lower schools; what did these originate in? What was the process of their organisation? What influence had it on middle-class education?

The training of the young had been a subject of care—as the statutes show—from at least 1581, to several of the stadtholders, or rulers of the seven united provinces; but at the close of the last century—however great the need for reform, and however earnestly and imperatively it was urged—educational measures demanding general assent passed the States-General slowly, and with difficulty. Ministers had enough to do, in that time of political storm and trouble (1806), with other matters, and left the representation and regulation of schools to private enthusiasm. For a short period, it seemed that there was no well-organised party to watch over the interests and the progress of education, no one to control or bring about unity of aim and effort. At last, a few of the societies of learned men in the land—such as the scientific associations of Haarlem and of Vlissingen—endeavoured to fix public attention on the matter. I cannot particularise them or their work closely, but one nearly akin to our own—the Society for the Promotion of the Public Good, *Maatschappy tot Nut van het Algemeen*—was foremost, and is so still. Its activity commenced in 1784. Yet even when earnest and liberal-minded men had done their utmost, with their pens and on public platforms, it was found that no real advance could be made without the aid of the teachers. It was in the heads and hearts of these too long neglected men and women that the real *renaissance* took place. They needed aid as well encouragement; but very soon, without the adoption of any far-sounding system, each individual commenced work in his or her own school, removed what was wrong, or defective by comparison, and introduced in its stead the means or the method that seemed most serviceable. There was no centralisation at first, observe; scarcely any organisation, until a later period. The requirements of localities were carefully discussed, and gradually provided for. As many parents as possible were induced to frequent the schools, and to keep up friendly and regular intercourse with the managers. Valuable hints were given and received on both sides, and progress manifested itself in exact proportion to the public interest awakened and revealed. Of course, errors were committed, and some of them serious ones, through old indifference, new impatience, or sectarian distrust; but, as many of the teachers had a natural liking for the work, and as others gained greater knowledge of their duties, both acquired fresh self-respect and greater self-reliance.

Unhasting but unresting, final assistance was rendered by legal enactments respecting their attainments and requirements, and a fair promotion of their interests:—

a. By the division of the teachers into ranks or classes, according to age and capacity.

b. By the regulation of schools, and the classification of instruction as lower, middle, or higher.

c. By the introduction of competition for all public appointments, and the prevention of favour in bestowing them.

d. By provisions concerning neglect of duty, illegal practices, or bad conduct.

e. By precautions against interruptions to school duties from teachers or from parents.

f. By improvement of the stipends of teachers, and grants of pensions to the aged, their widows, or orphans.

Gradually public teachers became highly-valued civil officers, and as such were esteemed and remunerated by the State. Properly speaking, there is no national system of pedagogy to be found among the Dutch; nothing, at any rate, comparable to the productions of the German Campe, Niemeyer, Denzel, Hergenroether, Schwarz, Curtman, &c., but from the prize essays published by the great societies already named, and from the works of Nieuwold, Van den Ende, Floh, Visser, Prinsen, Brugsma, Suringar, Goerlitz, de Raadt and Kramers, a valuable digest might be drawn up.

Having said so much concerning teachers who are entrusted with the training of the young, and are responsible for minute registration of their conduct and capacity, let me now ask your attention to that which supplements instruction—namely, inspection.

No part of the Dutch system seems to me better worth study. It provides for a constant circulation of intelligence and energy in schools, a constant diffusion of hope and trust at home. It is the real "working up" of the whole of them, and it costs comparatively little. The local and district inspectors, on whom most depends, serve gratuitously. The honour of district inspectorship is a social distinction; it implies public confidence, it involves some scholarship, varied attainments, the love of education, and the possession of moral qualities that old and young must alike esteem. It is not meant to check official returns, or payments by results, but to animate, to chasten, and to cheer.

An inspector in South Holland describes the system thus:—"The control over these public schools is exercised (*a*) by Local School Boards, elected by the Town Council. In all places containing less than 3,000 inhabitants, the burgomaster or mayor, and his two *échevins*, or aldermen, exercise the functions of the School Board. This board has to visit all schools—public and private—to advise the Town Council on all educational matters, to send in an annual report to the corporation and district inspector, and to afford the Government authorities all information required. Its duties are, too, to provide for the due application of the law, and to give notice to the higher authorities whenever it is infringed.

"(*b*) The district inspector is a Government official, appointed by the Crown. It is an honorary post, and not salaried; but idemnification is granted for travelling expenses. It is generally much sought after by gentlemen of good position, as it procures local influence. In general a district inspector has between thirty and forty schools under his supervision, and sometimes as many as fifty or sixty. The duties of this office are manifold. The holder of it corresponds with his chief, the provincial inspector, with the corporations in his district; examines the candidates for head masterships, as referred to above; is a member of the Board of Examiners for certificating teachers; and has to send in every year a report of the state of his district, to the provincial inspector and the States of the province. He must visit all schools in his district at least twice a year, and communicate everything of importance to the provincial inspector.

"(c.) The provincial inspector is a salaried officer of the Crown. In each of the eleven provinces of Holland there is one inspector. He is in direct communication with the Minister of the Interior, who is chief of the Educational Department; with the States of the province, who take his opinion on all educational measures; with his subordinates, the district inspectors, and all the corporations in the province. Besides this, he visits the towns and villages in his province, controls the work of the district inspectors and local boards, and enforces, conjointly with the States of the province, the law. In all disputed cases an appeal lies to the Crown. The inspector, too, proposes all measures he thinks necessary to the Minister, and sends Government an annual report of his proceedings and the state of the province—containing in some cases half a million souls. In fact, the inspector represents the Minister, under whose direct orders he stands, and to whom he refers personally all matters of importance; acting otherwise on his own responsibility. The law enjoins expressly, that at least once every year all the inspectors shall meet under presidence of the Minister, in order to confer with him on educational measures to be taken in the country."

To complete this summary of what Dutch public instruction is, and how it progressed. The system was inaugurated in 1806, hence the lower schools are upwards of seventy years old. They were extended in scope at different times, considerably; and at length brought to their present form in 1863, to meet a loudly expressed popular demand. But only the long experience acquired in lower instruction—the large number of trained teachers available—the enthusiasm and patriotism of inspectors and parents combined, made the establishment of so many middle schools possible within so short a period.

What it Does.

Restricting my remarks to one section of the community only, the finest fruits of culture are to be seen in the general diffusion of intelligence and morality, in the minimum of pauperism and crime, in the law-abiding decorous character of the inhabitants, young and old, in their comparitive immunity from extremes of wealth or poverty, in their patriotism, in the cheapness, and efficiency of their public instruction. Holland, moreover, is an asylum of liberty; a place of refuge for the persecuted or the proscribed, as in the days of the Pilgrim Fathers, who went from its shores.

One of Her Majesty's Secretaries of Legation reported in 1870:—

> "In Holland alone perhaps in all the world, we find a perfect realisation of that beau-ideal of the masses, a Government of the people, by the people, and for the people. The Government and population of each district form a perfect sample of organised self-rule for the good of all, robbery and violence unknown, the rich ecure, the poor content, one law for rich and poor alike, innumerable charitable institutions amply endowed for the maintenance of the sick, the aged, and the destitute, making an aggregate of peace and good-will upon earth that no other land can show such a percentage of upon its total population."

Though the position of Holland on the western fringe of Europe is an exposed one, and necessitates both vigilance and courage to enable the inhabitants to live securely, they have, and have long had, rare advantages for inland intercommunication.* To this may be ascribed much of their former prosperity. Let us see how it came about.

When the Dutch were making their famous brown linens, or bleaching the webs of the rest of Europe; when the black cloths of Leyden and the crimson velvets of Utrecht were everywhere in request; when their ship-building yards were the largest, and their export trade in machinery the most important in the world, their sole motor-force, the only one known, was wind or water. The mechanism of all their factories was set in motion from wind-mills or water-mills, mostly the latter, and consequently, was limited to the dimensions which these cannot practically exceed. One owner might possess two or more mills, but they could hardly be situated side by side. Combination of power or skill, to anything approaching our present factory system, was impossible. Usually each factory had its own mill, under the management of a foreman or the proprietor; and improvement or enlargement was hardly expected. But every stream or fall that turned a mill-wheel flowed into a canal that was connected with a seaport or an inland town; and thus the Dutch manufacturers and merchants possessed perfect facilities for export and import, as well as for carrying on the home trade; while most of the petty States of Europe were inaccessible except to mounted horsemen, and their rulers rather boasted of the existence of this state of things than lamented its long continuance. Gradually, however, highways were constructed and canals cut. England took the lead in such work, and thenceforth benefitted so much by the inventions and labours of her Brindley, Wm. Smith, Telford, McAdam, and others, that increased enterprise was strongly stimulated. The master mind of Watt at length applied steam to the raising of coal, for which machinery propelled by steam created a demand, so fast and so urgent, that tramways became a necessity, and by-and-by the railway.

England then outstripped the world by her stupendous motor force, soon applied to locomotion, by land and sea.

The Dutch seemed intuitively to recognise the fact that henceforth the competition of industry must be a competition of intellect. They renewed their educational efforts, and resolved to raise the working-power and skill of every man and woman in the land, to the highest possible pitch of perfection.

Notwithstanding great exertions and no inconsiderable expense, the agricultural schools have thus far proved a comparative failure. The fact is, land is so divided in Holland, that farms cannot be found large enough for the employment of skilled superintendents; but villagers welcome itinerant lecturers on agricultural chemistry! The best of the schools for navigation is at Amsterdam; yet none are remarkable; indeed, since the general introduction of steam, the Dutch have lost a large part of their transport trade. The technologists trained at Delft have suffered from the late general stagnation in business; there have been fewer openings for men whose capital lies chiefly in brain-power, industry, and enterprise. More's the pity! They throng the colonies; some go to Dutch India and are successful, but if they stay there and enrich themselves they seem to degenerate.

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* Utrecht is as nearly as possible equi-distant from London, Paris, Frankfort, and Berlin.

Like ourselves, the Dutch have to contend with altered conditions of labour. The inter-oceanic telegraph has revolutionised commerce by annihilating time and space; railways have accelerated and intensified the intercourse between maritime and inland populations. The Hollanders, however, have faith in culture, and never cease to proclaim:—"Whatever we would expect to have in the national life, let us make good provision for in the national schools." Not long ago, in anticipation of these being undermined, one of their greatest statesmen cried—"We rescued our Fatherland from the billows of the ocean; we must also make it safe against the inroads of ignorance!"

A fair estimate of their system of instruction should give both its relative and its absolute worth. But by what standard can we compare systems? Or how shall we gauge and note the qualitative and quantitative excellence—the 'potential energy'—the self-regulating power of each, and its adaptation to the varying requirements of life?

And supposing we had in view that which was on all hands admitted to be the best, and giving the greatest satisfaction, who could foresee the trials awaiting it, or foretell how long it would continue to form the basis of social security, and of social progress?

We must not, however, close our eyes to the light of contemporary history. The people's schools of this century, more than any other human agency, have to be credited with direct instrumentality in preparing, if not promoting, the remarkable advances of the age. Art, science, manufactures, commerce, do not originate in school-rooms; but the motor-forces of industry and enterprise are stimulated and strengthened there.

The great "Cultur-Kampf," now going on in Germany, Austria, Hungary, and Italy, is partly a school question, that was settled, as far as Holland is concerned, more than seventy years ago; and the settlement was confirmed anew in 1848. Church and State are separated there. No ecclesiastical element exists in the Dutch Councils of State; and there is no direct clerical influence in the Dutch public schools. No clergyman can become a school inspector, or enter a public place of education unless in a lay capacity.

On the 6th January, 1877, a Bill for the revision of the Law of the 13th August, 1857 (Staatsblad, No. 103), relating to lower instruction, was published. Its novel features are projected concessions to sectarian influences. The clergy advance claims as to the consideration of their interests (*a*) in the distribution of time in lesson-plans; (*b*) in recognition of private (denominational) schools, where additional public schools are proposed; (*c*) in the amount of school fees imposed by the parishes or townships (*gemeenten*). These matters are important only as they show the incessant but hitherto fruitless activity of Ultramontanes on the one hand, and adherents of the creed of the Synod of Dordrecht, High Calvinists, on the other.

There is little to fear. The public teachers are now sufficiently numerous to form a great intellectual and moral force in the Fatherland. Amongst them may be found not a few men of European celebrity,* who by their researches have enlarged the boundaries of human knowledge, men who "calmly take their seat upon the bench of science, and extend the right hand of fellowship to whomsoever they meet, without asking as to his country or his creed."

As to their alumni. The love of scientific investigation increases rather in a geometrical than in an arithmetical ratio among the pupils of the higher burgher schools. These youths may be expected to succeed (I speak of the male sex only for the moment) better in science than in literature; they suffer somewhat perhaps from the *indigesta moles* of facts, yet will at least have learned what all true science teaches—to observe accurately, to interpet rationally, and to apply profitably.

The Dutch desire for unanimity manifests itself in the striking, perhaps the erring, uniformity of their schools. It is indeed desirable that a whole population should understand one language, the expression of one sentiment; it is also desirable that social distinctions should depend more upon personal qualifications than on the mere control of pecuniary capital; yet a divergence of social aims must take place, sooner or later. Exclusive schools may be an evil, and split up a people, but education has to adapt itself to the requirements of life; and division of labour is one of these.

A serious consequence of the want of variety in schools is that there must be a greater variety of subjects introduced on the lesson plans. The course of instruction is commonly of five years' duration; rarely less than three or four, yet it is crowded, and among teachers the complaint of *multa* instead of *multum* is too common. A school should be a place for mental and moral discipline, not for the mere accumulation or enumeration of facts: the effort to retain these paralyses the brain, while a patient study of their simple relationship would strengthen it. The remedy for this is difficult to find. Dutch public schools, by their comprehensive courses of study, and by the cheapness of their instruction, are ruining private ones, and thus preventing wholesome competition.

Into the strife respecting the utter absence of Latin in middle schools I cannot enter. Rather let me quote a few clear-headed manly words from a director of a German realschule, prefixed to his programme of the public examinations in April last. He says—"No one can prize and honour gymnasial culture which rests on the old classical studies and on history as a basis, more than I; no one can more deeply deplore the rapid decline of those classical tongues which for so many years have been the source and the current of our own culture—the bond of union between the past and the ever upspringing present—than myself. But we must have the moral courage to admit, that every age has its rights; that nothing earthly can lay claim to immortality. In the place of the Greeks and the Romans other people have come, with culture superior to theirs in every respect; with other forms of art, science, and jurisprudence. Theirs could not and would not suffice for the wants of the 19th century."

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* A. C. Oudemans and Mulder, chemists; Bosscha and van den Waals, physicists; Donders and Heynsius, physiologists; Harting, microscopist; Buys Ballot, meteorologist; Bierens de Haan, Baehr, and Korteweg, mathematicians; Caland and Stieltjes, engineers; C. A. J. A. Oudemans, Hugo de Vries, Trueb, Suringar, botanists, &c.

How should the physician, the theologian, and the statesman of our time confine his range of study to the classic languages or literature? Were any one of these to overlook the experience of the past half century even, would he not be unpardonably negligent? How much more then if he neglect the advances made over all the eighteen centuries previous?

Thirty or forty years ago Latin was spoken fluently and constantly in the Dutch grammar schools, public or private, as it used to be also in Hungary. If any gentleman be at all curious to see a relic of colloquial Latin from a well-known teacher in Leyden, still living, notes of his lessons are on the table.

In criticising the seeming decay of scholarship among the pupils of the higher burgher schools, and even of the gymnasia, let us not be unmindful that Holland was the birthplace of Grotius and Borre, the statesmen; of Brandt and Hooft, historians; of Vondel, the poet, of Vossius, Gronovius, Heinsius, Erasmus, the eminent scholars; of Boerhaave, the naturalist and physician; and that to-day our own great men are joining the Dutch in an effort to do honour to the name of Spinoza. With regard to drawing. The universality of art forms bonds of union between all classes and all races; it is the language that all understand and enjoy, first and last in life. Need I speak of Dutch painters, or tell you that Haarlem gave birth to Wynants, and Berghem, Wouvermans and Hobbima; Leyden to Rembrandt, Douw, and Peter Gerard; Gorcum to Van der Heyden and Boemart; Utrecht to the brothers Both; Embden to Backhuysen; besides others whose birthplaces are less familiar—Mieris, Jan Steen, Paul Potter, Vandervelde, Cuyp, and Ruysdael?

WHAT HAS STILL TO BE DONE?

First and foremost, to uproot intolerance, the bane of the Netherlands! Perfectly conscientious men, there as elsewhere, forget that intolerance generates insincerity, and leads to hypocritical pretences instead of manly utterance. The honest convictions of religious minds are to be used for self-guidance, not abused for the attempted guidance or governance of other minds: still less for their coercion. Dogmas may be good for intellectual boundary-marks, but they become bad when they are raised so high as to be barriers to progress, and to obstruct light. Thank Heaven they can do no more; for even in the shade "Ilka blade o' grass caps its ain drap o' dew."

It was sad to see, as the net result of the terrible struggle ending in 1648, the recognition of but one principle among sovereign rulers—*Cujus regio, ejus religio*, whoever governs you his religion shall be yours—but it is sadder still to see towards the close of the nineteenth century the adoption of a kindred principle among abject multitudes, that of sacerdotalism,—or political priesthood,—and the assertion of its supremacy. It is strange, too, as sad, that from this cause a whole population must be divided, hold little communication with each other, seldom intermarry, never forget old feuds, and, although near neighbours, live in continual distrust, and almost defiance. Who can wonder at the earnest efforts of statesmen to get rid of these animosities by accustoming the rising generation to study the beneficent laws of Nature; or, Christian precept and practice, without doctrine and dogma?

The Dutch teacher and the preacher are alike civil servants; to the one is confided the kind of instruction which adapts itself to the ever varying requirements of social life; to the other is confided the preservation of principles that are permanent, and underlie the fabric of society.

Finally, let both remember that:—

> There are other standards of greatness besides vastness of territory, and other forms of wealth besides mineral deposits or agricultural exuberance. Though every hill were a Potosi, though every valley, like that of the Nile, were rank with fatness, yet might a nation be poor in the most desperate sense: benighted in the darkness of barbarism and judgment-stricken of Heaven for its sins. A State has local boundaries, which it cannot rightfully transcend; but the realm of intelligence, the sphere of charity, the moral domain, in which the soul can expand and expatiate, are illimitable—vast and boundless as the omnipresence of the Being that created them. Worldly treasure is of that nature that rust may corrupt, or the moth destroy, or thieves steal; but even upon the earth there are mental treasures which are unapproachable by fraud, impregnable to violence, and whose value does not perish, but is redoubled with the using. A State, then, is not necessarily fated to insignificance because its dimensions are narrow, nor doomed to obscurity and powerlessness because its numbers are few. Athens was small; yet, low as were her moral aims, she lighted up the whole earth as a lamp lights up a temple. Judea was small; but her prophets and her teachers were, and will continue to be, the guides of the world. The narrow strip of half-cultivable land that lies between her northern and southern boundaries is not the Netherlands; but her noble and incorruptible men, her pure and exalted women, the children in all her schools whose daily lessons are the preludes and rehearsals of the great duties of life and the prophecies of future eminence—THESE ARE THE STATE.

APPENDIX.

Extracts from the Law of 2nd May, 1863, *on Middle-school Instruction.* (*Staatsblad No.* 50.)

PART I.—GENERAL PROVISIONS.

Art. 1. Middle-school instruction includes all such branches as are taught in the schools to which this law applies.

Art. 2. The schools of middle instruction shall be distinguished as public and private schools. Public schools are those established and maintained by the communes, the provinces, and the Government, severally or in common; all others are private schools. Subsidies may be granted to private schools on the part either of the commune or of the province under such conditions as the communal or provincial authorities, or the sovereign may deem necessary. Schools thus supported shall, like the public schools, be open to all children without distinction of religious creed.

Art. 3. Middle-school instruction given to children of not more than three families conjointly, is to be considered as private instruction.

Art. 4. Nobody is allowed to give middle-school instruction, who does not possess the certificates of

TABLE OF MIDDLE SCHOOLS.

D.B.S. ...Day Burgher Schools.
D.E. ...Day and Evening Burgher Schools.
M. ...Do. for Modelling.
I.S. ...Industrial Schools.

G. ...Government.
C. ...Communal.
S. ...Subsidised.
N.S. ...Non-subsidised.

LOCALITIES.		BURGHER SCHOOLS.								HIGHER BURGHER SCHOOLS.						
Provinces.	Communes.	Specification of the Schools.	When Opened.	Length of Course of Study.	School Fees for Course.	Number of Pupils in			Teachers in each School.	Specification of the Schools.	When Opened.	Length of Course of Study.	Annual School Fees.	Communal Population in 1874.	Attendance per 10,000.	Teachers in each School.
						1868	1871	1874								
				Years.	Florins.							Yrs.	Florins.			
North Brabant.	Bois-le-Duc ...	E.B.S.	1869	3	0	...	104	58	7	G.	1867	5	30	24,190	30	13
	Tilburgh	,,	1870	2	1 50 to 5	...	94	106	8	,,	1866	5	30	24,747	12	12
	Breda	,,	1867	2	6	24	16	89	6	S.	1867	5	50	15,335	42	10
	Helmond	...	...	...	...	...	...	...	...	G.	1866	3	30	6,875	40	11
Guelderland.	Arnhem	,,	1866	3	6	58	55	37	9	S.	1866	5	60	36,004	28	13
	Nymegen	,,	1865	3	4	30	54	48	10	S.	1865	5	60	22,929	31	13
	Zutphen	,,	1864	4	4	90	113	130	12	S.	1864	5	40	14,421	76	12
	Tiel..............	,,	1870	2	6	...	24	26	6	S.	1870	5	50	8,601	45	9
	Winterswijk ...	...	...	...	...	...	...	...	...	G.	1870	3	30	7,771	37	7
	Wageningen...	...	...	...	...	...	...	...	...	S.	1869	3	40	6,005	63	9
	Zalt-Bommel..	...	...	...	...	...	...	...	...	G.	1867	3	30	3,947	64	9
South Holland.	The Hague ...	D.B.S.	1866	2	12	39	47	60	6	N.S.	1865	5	60	97,565	19	16
	Rotterdam......	1st M,&c	...	9	1 50 to 5	703	647	1030	37	S.	1865	5	60	129,239	13	21
	,, ...	2nd I.S.	1870	3	5	...	108	161	23							
	Leyden	E.B.S.	...	5	3 to 16	196	170	158	16	S.	1864	5	60	40,249	35	16
	Dordrecht	,,	1866	5	3	60	146	121	9	S.	1865	5	54 to 72	25 823	58	16
	Delft	,,	1864	3	0	105	171	124	8	S.	1864	5	70	23,366	45	14
	Schiedam	,,	1869	4	4	...	60	61	10	S.	1869	5	60	21,103	33	12
	Gouda.	,,	1866	5	2	94	90	111	8	G.	1865	3	30	16,576	24	8
	Gorinchem ...	,,	1871	2	6	...	33	24	7	S.	1871	5	50 to 60	8,982	82	10
North Holland.	Amsterdam ...	D.E.	...	...	10 to 15c.	143	87	130	12	S.	1865	5	60	286,932	10	20
	,, ...	...	1868	2 to 3	1·50	26	36	67	...	N.S.C	1869	3	180			14
	Haarlem	E.B.S.	1864	4	4	100	78	89	9	S.	1864	5	60	33,364	45	14
	,, ...	...	...	...	...	...	...	...	...	N S.	1874	3	40			11
	Zaandam	E.B.S.	1866	4	5	38	59	36	8	S.	1866	4	60	12,346	40	10
	Helder	I.S.	...	4	3	...	90	121	5	...	...	...	...	...	...	...
	Alkmaar	E.B.S.	1869	4	0	...	30	45	6	G.	1867	5	30	11,980	48	12
	Hoorn..........	...	...	...	...	...	...	...	...	S.	1868	4	40 to 50	9,603	23	8
	Enkhuizen......	,,	1870	2	6	...	26	27	5	S.	1870	3	20 to 30	5,488	33	6
Zeeland.	Middelburgh...	,,	1867	3	3	44	62	59	9	G.	1865	5	40	15,926	62	14
	Flushing	,,	1869	2	4	...	65	39	4	...	...	...	...	...	...	...
	Zierikzee	,,	1869	3	4	...	88	65	5	S.	1869	5	40	8,043	73	11
	Goes	,,	1865	3	4	21	22	25	10	S.	1865	5	40 to 50	6,239	117	10
Utrecht.	Utrecht	D.E.	...	...	12	245	283	343	20	G.	1866	5	60	64,271	20	16
	,, ...	...	1866	2 to 4	2	...	...	...	...							
	Amersfoort ...	E.B.S.	1871	3	2	...	44	25	9	S.	1871	5	40	13,402	52	11
Friesland.	Leeuwarden ...	D.E.	...	...	8	15	41	53	7	G.	1867	5	50	27,003	34	13
	,,	...	1868	2 to 3	2	...	...	...	...							
	Harlingen	E.B.S.	1865	3	5	31	60	43	6	S.	1865	4	40	10,840	32	7
	Sneek	...	...	...	...	...	...	...	...	S.	1864	5	30 to 50	9,651	53	10
	Heerenveen ...	...	...	...	...	...	...	...	...	G.	1870	3	30	...	...	8
Overyssel.	Zwolle	E.B.S.	1868	3	6	172	268	301	6	G.	1867	5	50	21,329	39	14
	Deventer	,,	1865	5	1·50 to 12	277	285	431	18	S.	1864	5	50 to 60	18,132	61	15
	Kampen.........	,,	1868	2	0	20	30	22	10	N.S.	1868	5	30	16,047	44	14
	Enschedé	...	...	...	...	...	...	...	...	S.P.	1863	5	70 or 35	5,394	85	8
	Almelo	...	...	...	...	...	...	...	...	S.	1874	3	25 to 50	4,171	117	7
Groningen.	Groningen......	D.E.	...	...	8	...	...	...	...	G.	1864	5	50	39,835	36	17
	,, ...	...	1866	2 to 3	5	39	34	66	9							
	,, ...	E.B.S.	1869	3	2	39	56	48								
	Veendam	...	...	...	...	...	...	...	...	S.	1866	5	20 to 50	9,749	66	9
	Sappemeer......	...	...	...	...	...	...	...	...	G.	1868	3	30	4,301	116	11
	Warffum	...	...	...	...	...	...	...	...	G.	1868	3	30	2,036	64	8
Drenthe.	Assen	...	...	...	...	...	...	...	...	G.	1868	3	30	7,269	42	9
Limburgh.	Maestricht	E.B.S.	1867	2	4	60	67	58	8	S.	1864	5	30	28,650	34	16
	Roermond	...	...	...	...	...	...	...	...	G.	1864	5	30	9,609	71	13
	Venlo	...	...	...	...	...	...	...	...	S.	1866	3	18 to 24	8,240	71	6

N.B.—Twelve florins equal one pound sterling, nearly.

capacity and morality required by this law. Foreigners require, besides, sanction from the Crown.

Art. 5. The preceding provisions are not applicable to those who give middle-school instruction to children of one family exclusively; or to those who, not making a profession of middle-school instruction, but willing to be employed without any pecuniary remuneration shall have obtained permission from the Crown to give such instruction.

Art. 6. Any person giving middle-school instruction without being duly qualified, shall for the first offence be punished with a fine of twenty-five, and not exceeding fifty florins; for the second offence with a fine of fifty and not exceeding a hundred florins, and imprisonment for eight and not exceeding fourteen days, cumulatively or separately; and for each subsequent offence with imprisonment for one month and not exceeding one year. Any person giving middle-school instruction beyond the limits of his qualification shall be liable to half the amount and duration of the above-mentioned punishment. From these provisions are excepted teachers of either sex at a middle school, who, during a vacancy, or in the absence of a colleague, take upon themselves the temporary fulfilment of certain duties, provided such substitution does not exceed the term of six months.

Art. 8. The qualification to give middle-school instruction ceases for any person condemned (*a*) for crime, (*b*) for theft, swindling, perjury, breach of crime, or immoral conduct. In case of scandalous conduct, or, when in teaching any teacher propagates doctrines inconsistent with morality, or tending to excite disobedience to the laws of the country, such a teacher may be declared by the Crown to have forfeited his qualification to give instruction.

Art. 11. The provisions of this law are not applicable to military or naval schools, neither are they applicable—so far as they regard the qualification for giving instruction—to the school for deaf mutes or for the blind, which schools are, however, subject to supervision. In cases of dispute whether a school belongs wholly or partly to elementary, middle-school, or university instruction, the question shall be decided by the Crown.

Part II.—Public Middle-school Instruction.

Art. 12. Public middle-school instruction shall be given in (*a*) burgher schools, (*b*) higher burgher schools, (*c*) agricultural schools, (*d*) the Polytechnic School.

§ Of lower middle-school instruction, in day and evening, and in evening burgher schools.

Art. 13. Burgher schools, chiefly designed for prospective tradesmen or mechanics and agriculturists, are day schools and evening schools. Day schools shall have a curriculum or course of two years. In the day schools instruction shall be given in (*a*) mathematics, (*b*) the rudiments of theoretical and applied mechanics, and the knowledge of machinery, (*c*) of physics and chemistry, (*d*) of natural history, (*e*) of technology or of agriculture, (*f*) the elements of geography, (*g*) of history, (*h*) of the Dutch language, (*i*) the rudiments of political economy, (*k*) freehand and rectilinear drawing, (*l*) gymnastics. The communal council decides whether the rudiments of technology or of agriculture shall be given; both may be admitted. It may, moreover, add to the above, modelling, and any foreign language that may be thought proper. The same council decides, too, which of the branches of instruction mentioned in this article shall be taught in the evening school.

Art. 14. In every commune with a population of above ten thousand souls, the communal council shall establish at least one burgher school—a day and evening school. It may be in combination with a public elementary school. In those communes of above ten thousand souls, where the population is so scattered that attendance at a burgher school would be doubtful, or, if the want be supplied in any other manner, then such a commune can be exempted by the Crown from the provision of the first clause of this article. Should it appear that an evening burgher school sufficiently meets the requirements of any commune, dispensation may be given by the Crown from the obligation to establish a day school; but each time only for a certain number of years. In this case the instruction at the evening school is distributed over a course of two years; and the Crown decides, after having heard the communal council, which of the above mentioned branches of instruction shall be taught.

Law, May 2nd, 1863 (*Staatsblad* 50).

§ Of Higher Middle-school Instruction, Arts. 15—22.

Higher Burgher Schools.—Arts. 15—18. The higher burgher schools are distinguished into schools with a five years' curriculum, and schools with a three years' curriculum.

Art. 16. The instruction at the schools for three years shall include (*a*) mathematics, (*b*) the rudiments of physics and chemistry, (*c*) the elements of botany and zoology, (*d*) of political economy, (*e*) of book-keeping, (*f*) of geography, (*g*) of history, (*h*) the Dutch language, (*i*) the French, (*k*) the English, (*l*) the German, (*m*) penmanship, (*n*) freehand and rectilinear drawing, (*o*) gymnastics.

Art. 17. The instruction at the schools with a five years' curriculum shall include (*a*) mathematics, (*b*) the elements of theoretical and applied mechanics and machinery, besides technology, (*c*) physics and their chief applications, (*d*) chemistry and its chief applications, (*e*) the elements of mineralogy, geology, botany, and zoology, (*f*) the elements of cosmography, (*g*) an elementary knowledge of the communal, provincial, and Government institutions, (*h*) political economy and statistics, especially of the kingdom of the Netherlands, and its colonies and possessions in other parts of the world, (*i*) geography, (*k*) history, (*l*) the Dutch language and literature, (*m*) the French ditto, (*n*) the English ditto, (*o*) the German ditto, (*p*) the elements of the commercial sciences, including knowledge of raw and wrought materials, and book-keeping, (*q*) penmanship, (*r*) freehand and rectilinear drawing, (*s*) gymnastics.

Art. 18. There shall be at least fifteen Government higher burgher schools to be established in different communes in various districts of the kingdom. At least five of these shall be schools with a five years' curriculum.

Agricultural Schools.—Art. 19. There shall be a Government agricultural school, if the want of such a school be not supplied in some other way. Subsidies may be granted by the State to private agricultural schools.

Art. 20. The instruction at the Government agricultural school includes (*a*) political economy, (*b*) applied mathematics, such as land surveying, mensuration, levelling, and gauging, (*c*) mechanics as applied to agriculture, and machinery, (*d*) agricultural engineering, (*e*) rectilinear drawing as applied to architecture and machinery, (*f*) physics, chemistry, and meteorology as applied to agriculture, (*g*) farming technology, (*h*) mineralogy and technology as applied to agriculture, (*i*) botany and zoology, general and special, (*k*) anatomy and physiology of plants and animals, (*l*) animal physiology, the external forms, races, diseases, and treatment of domestic animals, (*m*) general and special farming, husbandry, grazing, kitchen gardening, horticulture, and the culture of trees and fruit-trees (nursery gardening), (*n*) rearing of cattle, including poultry, bees, and the dairy, (*o*) book-keeping applied to husbandry, (*p*) farming and farming economy, including the culture of woods and forests and the treatment of stock, (*q*) colonial agriculture and forestry.

Art. 21. In burgher schools, higher burgher schools, and agricultural schools established by provinces, communes, or private individuals, with or without Government subsidies, the scheme of education as rendered obligatory in the communal or Government schools by Arts. 13, 16, 17, 20, may be modified, abridged, or extended. The regulations for middle schools for females, to be established by communes, provinces, or individuals, shall be left to the founders, barring conditions attached to subsidies.

Art. 22. Whatever concerns the admittance of pupils to the Government higher burgher schools and agricultural schools, or the duties of director and teachers, and the regulation of the tuition, shall be settled, as far as it is not ruled by this law, by our Minister of the Interior.

(Arts. 23-35 refer to teachers. Arts. 36, 37, 38, to expenditure).

Law of the Polytechnic School.

Art. 39. The Polytechnic School is destined for the training of:—

1°. Individuals for industrial or technical pursuits, who require a higher degree of theoretical and technical knowledge, than can be obtained at a higher burgher school with a five years' curriculum.

2°. Such as desire to qualify themselves for:—(*a*) civil engineer, (*b*) architect, (*c*) naval engineer, (*d*) mechanic engineer, (*e*) mining engineer.

Art. 40. The instruction at the Polytechnic School embraces:—(*a*) Higher algebra, (*b*) spherical trigonometry and analytical geometry, (*c*) descriptive geometry and its applications, (*d*) differential and integral calculus, (*e*) land surveying, mensuration, and levelling, (*f*) theoretical mechanics, (*g*) applied mechanics, (*h*) mechanism, (*i*) mechanical technology and agricultural machinery, (*k*) applied natural philosophy, (*l*) chemistry, applied, practical and analytical, (*m*) chemical technology, (*n*) modern manufactures, (*o*) mineralogy and geology, (*p*) applied geology and mining, (*q*) metallurgy, (*r*) hydrostatics, hydraulic engineering, road, railroad, and bridge building, (*s*) civil architecture, (*t*) ship-building, (*u*) rectilinear and free-hand drawing, applied to the various branches of science, (*v*) practical use of tools and the turning lathe, (*w*) construction of models of machines, and engines, (*x*) political economy, (*y*) commercial jurisprudence, (*z*) administrative jurisprudence, relating to engineering, public works, mining, and manufactures.

Art. 41. Every pupil entered at the Polytechnic School pays at the commencement of each school-year a sum of 200 florins. He obtains thereby access to all the lessons of the school. Those who desire to attend single lessons only, shall pay likewise at the commencement of each school-year, for lessons given—once a-week 10 florins; twice a-week 20 florins; thrice a-week 30 florins; four times or more 40 florins. The sums mentioned in this article shall be paid into the public treasury.

Of the Teachers.—Art. 42. The professors and other teachers of the Polytechnic School shall be appointed, suspended, and dismissed by us. To them also is applicable the provision of Art. 31.

Of the Management.—Art. 43. The management of the Polytechnic School shall be committed to a director, to be appointed by us, and a managing council, composed of the professors of the school. The functions and authority of the director, and of the managing council, their relation to the rest of the teachers, and the internal regulation of the school, as far as they are not settled by law, shall be regulated by special decrees.

Abstract of Report (1876) *on Burgher Schools.*

There is no instance of a commune claiming the right allowed by law to combine the burgher school with an elementary school. As for the scope of the instruction, the programme for all day burgher schools is as fixed by the law. In evening burgher schools the tuition generally comprises mathematics, mechanism, physics, chemistry, technology, the Dutch language, history, geography, the rudiments of political economy, and freehand and rectilinear drawing. Instruction in the workshop is not given in any of these, with the exception of the Industrial School at Rotterdam; in this establishment it embraces the handicrafts of the carpenter, the smith, the joiner, bricklayer, stonecutter, &c.; the pupils of this school attend the drawing lessons of the Academy. Instruction in agriculture is not given in any of the burgher schools.

The Scholars.

From the returns, the pupils seem to be fitted for the lower school classes rather than the higher; their numbers, too, are small in comparison with the population of the communes. As to age, 21 were under 12 years, 185 from 12 to 14, 125 from 14 to 16, 20 from 16 to 18, and 5 above 18 years of age; 126 were children of operatives, 52 of small dealers and vendors, 52 of architects and artists, 108 of official teachers and military men, 54 of parents either dead or without any profession.

Most of the evidence seems to indicate that the day burgher schools are, in general, not attended by that class of the population for which the Legislature intended them, for these establishments were to be day schools for boys of the labouring classes, who, after leaving the elementary school, might pass a couple of years at a middle school. During the debates on the law, in the States-General, a fear was expressed beforehand that these schools would not be numerously attended, and, perchance, not by the very persons for whom they were designed; but it was thought best to make a trial.

The results of the evening burgher schools, and of institutions of the same description, at Rotterdam, Leyden, and Helder, give more favourable results, for, in the last seven years, the total number of pupils rose from 2,565 to 4,148. Of these 3,307 were already practicising some trade; among them were 1,582 carpenters, joiners, wainwrights; 472 smiths, gunsmiths, instrument-makers, braziers; 236 stonecutters, masons, plumbers; 170 sculptors, stucco-workers, goldsmiths, engravers, lithographers; 320 painters, glaziers, varnishers; 58 architects; 254 of sundry other trades; and, lastly, 215 office-clerks and juvenile teachers.

Of the 841 pupils exercising or learning no trade, the parents of 408 were operatives; of 158, dealers or vendors; of 53, architects or artists; of 103, officials, teachers, or military men; while of 119, the father or both parents were either dead or without any profession.

From this statement it appears that the evening burgher schools were actually attended by those pupils for whom the Legislature intended them; and that even a good many young people of the labouring class, who were already beyond the usual age for attending school, still eagerly profited by the opportunity for acquiring theoretical knowledge that might be useful in the exercise of their callings.

The Staff of Teachers.

In the burgher schools of both kinds, and in the institutions on a par with them, there are 348 teachers. As to their salaries, nearly sixty per cent. do not amount to quite 400 florins. Of the day and evening burgher schools alone, the average is 1,021 florins; for the evening burgher schools and other institutions, 415 florins for each teacher.

The Instruction.

Admission to the classes is preceded by a simple examination, which is limited to reading, writing, and ciphering. At the commencement of the year 1874–75, the number of applicants was 1,505, of whom, however, 442, that is, 29 per cent., were refused; in the preceding years tho numbers failing had been 27 and 32 per cent. The chief cause of this unfavourable result, notwithstanding the moderate demands, and the absence of all severity, is to be attributed to the fact, that most of the boys do not go to the burgher school immediately after quitting the elementary school. The law affords opportunity for examinations on leaving; these comprise the branches taught in the school, and are held by a board consisting of one of the members of the local board for middle-school instruction as chairman, and the teachers of the school. They have been held several times in the communes where day and evening burgher schools exist; an exact specification of the number of pupils examined, and the results may be dispensed with.

School Rooms and School Appliances.

In most of the communes the buildings previously in use as drawing and industrial schools have been rebuilt or modified. The best appliances, especially for drawing, are everywhere provided. For the academy of the plastic arts and technical sciences at Rotterdam, a large building has been erected by the commune, at a cost of more than 100,000 florins.

Drawing Schools and Industrial Schools in 1874.

In some communes, where no day or evening burgher schools have been established, the drawing schools and other similar institutions have been allowed to remain. The number of these amounted in 1874 to 32, with 120 teachers, and 2,500 pupils. In 22 of these schools the instruction comprised freehand and architectural drawing; in the others mathematics were added; in a few also physics, mechanics; and at three of them modelling. A detailed account of these schools may be dispensed with here. Only mention must be specially made of the Royal School for the plastic arts at Bois-le-Duc, with 8 teachers and 320 pupils; the Academy for the plastic arts at the Hague, with 14 teachers and 310 pupils; the Industrial School at the Hague, with 11 teachers and 69 pupils; the Industrial School at Amsterdam, founded by the Society for Operatives, with 14 teachers and 88 pupils (in both these schools instruction is also given in the workshop); and a second school (without instruction in the workshop) of the same society, destined solely for the sons of members, with 11 teachers and 109 pupils.

Abstract of Report (1876) *on Higher Burgher Schools.*

Number and Specification of Higher Burgher Schools.

The first higher burgher schools were opened at the commencement of the school year 1864-65. There are 17 Government higher burgher schools, of which 9 have a five years' curriculum, and 8 a three years' curriculum; 22 higher burgher communal schools with a five years' curriculum, 20 of which are subsidised by the State; 3 subsidised communal higher burgher schools having a four years' curriculum, agreeing pretty well with the four lower classes of a complete school; 4 subsidised and 1 non-subsidised communal higher burgher schools having a three years' curriculum; 1 subsidised private higher burgher school having a five years' curriculum; and 1 non-subsidised communal commercial school with a three years' curriculum; total, 49 higher burgher schools. The amount of the 28 public grants is 197,750 florins.

The Scholars.

In the last two columns of the table the population of the communes for the 31st December, 1874, is given, and the number of pupils shown to every 10,000 inhabitants. The proportion of these numbers diverges considerably; in the smaller communes it is generally more favourable than in the larger ones. This is to be accounted for satisfactorily in several ways. The disparity disappears for a great part when we regard each province separately, and compare the number of pupils with the provincial population; the result is that the higher burgher schools are attended in Drenthe by 2·4, in North Brabant by 4·5, in Friesland by 6·7, in Guelderland by 9·2, in North Holland by 9·3, in Limburgh by 9·7, in Utrecht by 11·0, in Groningen by 11·5, in Zeeland by 12·5, in South Holland by 12·7, in Overyssel by 13·6, and in the whole country by 9·7 per 10,000 inhabitants.

Each class has a course of one year; there are none having, like many realschulen and gymnasia in Germany, a course of two years. Therefore, the school with a five years' curriculum can be gone through in five years; only a portion of the pupils may require a longer space of time if at the close of the school year they have not made sufficient progress to be admitted into a higher class.

With respect to ages, it is a rare case for pupils to be admitted to the higher burgher schools under 12 years of age; as a rule this only occurs at establishments having a preparatory division attached to the lowest class. Of 3,874 pupils attending, the ages of the pupils at the beginning of the year 1872-73 were as shown in the following table:—

Classes.		Number of Scholars at the Higher Burgher Schools, of the ages								
		Below 12 years.	From 12-13 years.	From 13-14 years.	From 14-15 years.	From 15-16 years.	From 16-17 years.	From 17-18 years.	Above 18 years.	Total.
Scholars for the entire instruction.	1st Class	57	235	375	259	151	43	4	3	1,127
	2nd Class	2	32	132	229	266	160	50	14	888
	3rd Class	...	1	27	136	212	181	98	42	697
	4th Class	...	...	...	19	66	104	96	80	365
	5th Class	...	...	...	1	13	48	76	119	257
Total		59	268	534	644	711	536	324	258	3,334
Scholars for single branches..............		14	7	11	30	64	105	102	207	540
General Total		73	275	545	674	775	641	426	465	3,874

If we reckon the average ages of the pupils of each class at the commencement of the school year, we find for the 1st class, 13·8 years; for the 2nd class, 15·0; for the 3rd class, 15·9; for the 4th class, 16·9; and for the 5th, or highest class, 17·3. Of the pupils attending only single lessons, nearly half are above 18 years of age; therefore, above the ordinary age of those who follow the entire course of instruction. Since 1867, no change worth mentioning has taken place; for the years 1873 and 1874 we have not any statements concerning ages. At all the schools gymnastics are taught by special teachers. At most of them military drill, and the use of arms. The time set aside for this purpose varies from one to three hours a week. The lessons are mostly given before or after the ordinary school hours; lately, however, a commencement has been made to set aside half hours from the ordinary instruction for gymnastics.

Staff of Teachers.

The number of teachers employed in December, 1874, at the higher burgher schools, amounted to 558, of whom 135 were doctors in the mathematical and physical sciences, philology, or the law; 37 bachelors of the same; 203 held certificates of capacity by virtue of the law of 1863; 87, a certificate according to the prescriptions before 1863; 10 held a diploma as engineer, and, lastly, there were 13 without certificates, mostly teachers of penmanship. In the table the number of teachers at each school is to be seen; but it is not possible to give a table of the several branches they teach. As a rule the system of specialities has been adopted at our higher burgher schools, so that each teacher gives instruction only or chiefly in one branch, or it may be in a few allied branches; for instance, mathematics are sometimes combined with mechanics and physics, and sometimes with rectilinear drawing; the Dutch language, with history or geography; these two last are not unfrequently added to the political sciences; these again are often combined with the commercial course. At the larger schools there is generally a separate teacher for each of the languages, whereas at the smaller establishments one teacher often takes charge of two. If the teachers' posts be divided into five groups, it may be assumed that, of the 566 there are 182 for mathematics and physics, 118 for history and the political and commercial sciences, 147 for languages and literature, 72 for drawing and penmanship, and 47 for gymnastics. Of the 49 directors 15 are doctors of the mathematical and physical sciences, 14 doctors and 2 bachelors of philology, 2 engineers or retired officers, 7 have their qualification by virtue of Art. 90 of the law; 5 have a certificate by virtue of the law of 1863; and 4 a certificate obtained before 1863.

The teachers and directors have all fixed salaries, but no share in the school fees; 211 are employed at more than one establishment. Of 29 of these the remuneration for the additional post is included in the salaries given; the other 182 derive collectively an additional sum of 74,900 florins annually. If this sum be added to the 872,695 florins mentioned in the table, the result is an average of about 1,660 florins per teacher, or, by reckoning only what is derived from the higher burgher schools, 1,528 florins. The salaries at the Government higher burgher schools are higher than those at the communal schools; the average of the former, exclusive of the emoluments, is 1,691 florins, and for the communal schools 1,443 florins. In judging of the remuneration which several directors of the communal schools enjoy, it must not be forgotten that they derive a salary as already stated from the evening burgher schools. This latter is frequently considerable; the more so, as by virtue of law, such a situation entitles to a pension, which is not the case with the voluntarily erected higher burgher schools. In adding the two salaries together, the combined amount of the directors' salaries is, at Breda, 2,400 florins; Arnheim, 3,300 florins; Nymegen, 3,100 florins; Zutphen, 3,000 florins; Tiel, 2,600 florins; Schiedam, 3,000 florins; Haarlem, 3,500 florins; Zaandam, 3,000 florins; Deventer, 3,000 florins; and Kampen, 3,000 florins.

Subjects of Instruction.

The subjects to be taught at the higher burgher schools are fixed by the law, and are stated in §1. Though the law allows the communal schools to depart from the scheme prescribed for the Government schools, the scope of the instruction agreed pretty well at all the several schools. A standard programme, applicable to all, cannot be given, but only such a one as is followed in some, giving pretty nearly the average number of hours allotted to the different branches per week in schools with a five years' curriculum. Such a programme is given below, in which, for the sake of clearness, the subjects are designated by the same letters as in Art. 17 of the law:—

Branches of Instruction.	Number of Hours per Week in					
	Class 1.	Class 2.	Class 3.	Class 4.	Class 5.	Together.
a. Mathematics	7	7	7	4	4	29
b. Mechanics	...	...	...	2	2	4
c. Physics	...	...	2	2	2	6
d. Chemistry	...	...	2	2	2	6
e. Natural History	2	2	1	1	1	7
f. Cosmography	...	...	...	1	1	2
g. Government Institutions, of Netherlands	...	...	1	1	1	3
h. Political Economy	...	...	...	1	1	2
i. Geography	3	3	2	1	1	10
k. History	3	3	3	3	3	15
l. Dutch Language and Literature	4	3	2	2	2	13
m. French Language and Literature	4	4	3	2	2	15
n. German Language and Literature	4	3	3	2	2	14
o. English Language and Literature	...	3	3	2	2	10
p. Commercial Sciences	...	...	...	2	2	4
q. Penmanship	1	...	...	...	...	1
r. Free-hand Drawing	4	4	2	2	2	14
r. Rectilinear Drawing	...	...	1	2	2	5
Practice in the Physical and Chemical Laboratory	...	...	...	2	2	4
s. Gymnastics*						
Numbers of Hours per Week.	32	32	32	34	34	164

* Out of the usual School hours.

By dividing the subjects into a few main groups, it will appear that of the 160 hours really given to tuition (the practical lessons in the laboratory are not reckoned, any more than the gymnastic exercises), 54 are devoted to the mathematical and physical sciences, 52 to the mother tongue and three foreign languages, and 20 to drawing and penmanship. It may, therefore, be estimated that one-third of the time is given to mathematics and physics, one-third to languages, and the remaining third to history, geography, the political and commercial sciences, and drawing. The most important deviations are that at some schools more time is devoted to physics and chemistry, and that the study of the English language is commenced in the lowest class.

For promotion to a higher class—which can only take place at the conclusion of each school year—an examination is required, which is held by the director and teachers of the school, mostly in presence of one or more of the members of the local school board. These tests are rather strict.

Final Examinations.

The final examinations are held by provincial commissions, or boards, in each province possessing schools for middle-school instruction with a five years' curriculum. As a rule, members of the local school board, or directors of higher burgher schools, sometimes also the inspectors, assume the chairmanship; the examiners are commonly teachers at the higher burgher schools in the province, sometimes from other provinces, or from private establishments of the same kind. The tests are partly by writing and partly oral; the written exercises are done in the schools, and are the same for all the candidates throughout the kingdom. The object of these tests is expressed in the following words, which preface the programme as fixed by law:—"As the final examinations of the higher burgher schools must serve to determine whether the pupils who submit to them have fulfilled with credit the five years' curriculum of a higher burgher school, or have received an education equivalent to such a course of instruction, so the main objects of the higher burgher schools must be kept in view in these tests. * * * The exercises given will tend rather to elicit what the candidates really know, and to ascertain the degree of mental culture acquired in their studies, than to detect defects in less important details. A thorough acquaintance with the main facts respecting mathematics and the physical sciences, geography, universal history, literature, social and political science, may be considered as sufficient."

The School Buildings and Appliances.

The buildings of some of the higher burgher schools may be pronounced excellent. The same must be said of all the school appliances, especially for instruction in physics, chemistry, and zoology, for which there are large collections and laboratories. Most of the schools have a small garden attached, in which plants are reared for the lessons in botany. There is no want of maps for geography and history, or of materials for instruction in drawing. With the aid of Government a collection of over 200 models, both of ornaments and heads and parts of the human form, has been formed at the Polytechnic School; casts of these have been prepared for the Government schools at moderate prices; they are obtainable by the communal governments for their higher burgher schools, day and evening burgher schools, drawing schools, and similar establishments. All the Government schools and some of the communal schools possess, moreover, libraries for the use of the pupils and the masters.

Report on the Polytechnic School.

The only institution for higher industrial or technical instruction which existed in this kingdom before the introduction of the Law for the Regulation of Middle School Instruction, was the Royal Academy at Delft for the training of civil engineers. Up to that time there existed no national establishment for industrial education properly so called.

The Delft Academy was abolished by Royal decree of 20th July, 1864, and, as far as regards the engineering sciences, converted into the Polytechnic School, which was opened on the 1st of July, 1864. The pupils for the languages, geography, and ethnology of the colonies, then went over to the Government Institution, founded at Leyden for that purpose; some of them also to the establishment opened for the same purpose by the commune of Delft.

The Polytechnic School numbered, at the end of 1874, 13 professors and 7 teachers. Besides those mentioned, there were 5 more professors and teachers acting temporarily. The director's salary amounts to 4,000 florins, besides a dwelling rent free, the professors' to 3,500 florins, and the teachers' to between 1,500 and 2,500 florins. The instruction comprises all the branches prescribed by the law; subsequently, a course of gauging has been added. The management of the institution is committed to the director, with a board consisting of the professors. The fees for the lectures in all the branches is 200 florins each year; for single branches, as they are given once, twice, thrice, or four times a week, 10, 20, 30, or 40 florins per branch. The final examinations are held by boards appointed by the Minister of the Interior.

The diploma for technical sciences is obtained by two tests, one of which (A) is equal to the final examination of the higher burgher school; for a diploma as engineer three tests are required, the first of which (A) is the same as the final examination of the higher burgher school; a second (B) embraces more the theoretical branches; and the third (C) the practical branches. At present the tests (A) are no longer required, since as a rule all the young men attending the Polytechnic School for a diploma as technologist or engineer, have undergone the final examination of the higher burgher schools.

The course of instruction for engineering sciences is so arranged that it can be completely followed in four years; the one for technical science takes three years. The students for East India mining engineering are sent for a few months every year, as long as the course lasts, under the conduct of a competent monitor, to Germany, at the expense of the State, for their practical training.

In accordance with the law, a preparatory course was attached for two years after the opening of the Polytechnic School; and instruction was given in mathematics, physics, chemistry, natural history, commercial sciences, and drawing, as long as there was not a sufficient number of higher burgher schools in operation.

Branches of Instruction or Studies.	Number of Pupils in the School-year.										
	1864-65	1865-66	1866-67	1867-68	1868-69	1869-70	1870-71	1871-72	1872-73	1873-74	1874-75
Technologist	7	6	5	5	5	20	29	28	33	44	37
Civil Engineer	60	28	34	29	31	34	40	49	48	49	49
Architectural Engineer	3	2	..	2	1	..	..	..	...	1	1
Naval Engineer	1	1	...	..	...	..	2	3	4	2	6
Mechanic Engineer	8	10	17	21	12	10	7	8	13	17	24
Mining Engineer	2	4	4	5	7	3	5	4	3	7	10
Civil and Architectural Engineer	1	38	42	49	62	52	51	52	67	67	73
,, Naval Engineer	..		1	1	3	8	4	7	...	2	2
,, Mechanic Engineer	..	...	1	3	2	3	2	...	...	3	6
Naval and Mechanic Eng.	1	1	1	1	3	3	5	4	1	2	1
Architect	..	...	1	2	1	1	1	3	1	1	...
Hydrostatic Engineer	...	..	..	..	1	..	..	1	...	..	...
Machinery	...	...	3	4	6	3		...	1	1	...
Architectural and Mechanic Engineer	...	..	2	..	..	...	..	..	...	...	...
Gauger	..	6	t	4	6	2	..	6	7	8	9
Studies for a Certificate of Capacity for Middle School Instruction	3	3	4	5	4	6	4	7	6	8	13
Single Branches	5	5	25	25	33	23	14	17	14	7	5
Total	91	104	14	156	177	168	164	189	198	219	236
Number of Pupils in the Preparatory Class	76	52									

The number of students entered annually at the Polytechnic School since its opening, may be gathered from the preceding table.

It is remarkable that, during the last years, the number of pupils entered for the technical studies has considerably increased.

On Middle Schools for Girls.

Though the lawgiver assumed the possibility of the foundation of middle schools for girls, he did not proceed to legislate on the subject. This is simply accounted for by the circumstance that at that time the want of better organised instruction than what was obtainable at the existing schools for more extended elementary instruction, and the boarding schools, was not so generally felt or acknowledged.

In August, 1867, a communal middle school, with a five years' curriculum, for girls, was opened at Haarlem. The pupils admitted were mostly twelve years of age; the requirements for admission agreed pretty well with those at the higher burgher schools. The programme of the school, however, differed, as a matter of course, considerably. Similar establishments have been opened respectively in 1870 at Arnhem, in 1871 at Rotterdam and Dordrecht, and in 1872 at Amsterdam, Deventer, and Gronigen. The schools at Arnhem, Rotterdam, Dordrecht, Haarlem, and Groningen, are all with a five years' curriculum; those at Amsterdam and Deventer have only a curriculum of three years, but they are so arranged as to admit the girls at their fourteenth or fifteenth year into the junior class, while some knowledge of the German, French, and English languages is required. The three classes of these schools correspond pretty well to the three superior classes of the schools with a five years' curriculum. In September, 1875, another school with a five years' curriculum was opened at Leeuwarden, and one with a three years' curriculum at Utrecht. Of the arrangement of the schools with a five years' curriculum, an idea may be formed by consulting the following scheme, which, with a few unimportant deviations, is the standard of most of these schools.

Branches of Tuition.	No. of Hours per Week in					
	1st Class.	2nd Class.	3rd Class.	4th Class.	5th Class.	Average.
Dutch Language and Literature	4	3	3	3	3	16
French Language and Literature	4	3	3	3	3	16
German Language and Literature	4	3	3	3	3	16
English Language and Literature		4	3	3	3	13
Geography	3	2	2	2	1	10
History	2	2	3	3	3	13
Mathematics, including Arithmetic & Book-keeping	4	4	3	3	3	17
Natural History (Botany and Zoology)	2	2	2	1	1	8
Natural Philosophy (Physics and Chemistry)	..	...	3	4	4	11
Rudiments of the Political Institutions of Netherland, and Political Economy	.			.	1	1
Asthetics and Art-History	..	.		2	2	4
Free-hand Drawing	3	3	3	3	3	15
Needlework	4	4	2	2	2	14
Gymnastics	2	2	2	..		6
Number of hours per week	32	32	32	32	32	160

Of 54 pupils at Arnhem, three attended the lessons of mathematics, 13 of physics, six of chemistry, 12 of botany and zoology, three of political institutions and political ecocomy, eight of geography, nine of history, 14 of the Dutch language, 29 of French, 29 of German, 27 of English, 24 of drawing, and 19 of æsthetics, or art-history. Of the 179 girls, who presented themselves in 1874 for admission to one of the above-mentioned schools, 152 were admitted and 27 refused; the number of refused (15 per cent.) was, therefore, less than at the higher burgher schools for boys. Of the 355 pupils examined in 1874 for promotion to a higher class, 321 were promoted and only 34 were refused; the failures were, therefore, less than 10 per cent. At first the establishment of higher burgher school for girls met with considerable opposition from certain parties. Where, however, communal authorities founded them and organised them well, the population exhibited great liking for them. Government has also interested itself in the cause by granting a subsidy of 2,000 florins to the school of Haarlem, and promising support elsewhere, if aid be required. It is, therefore, very probable that the number of these establishments will increase in the next few years.

Finally another school is to be mentioned, which though of different description, is reckoned among them, namely, the Industrial School for Girls, founded in 1865, at Amsterdam, by the Society for the Public Good. First opened on a small scale, and with scanty means, this useful institution has grown to such proportions as to vie with the best schools of the kind abroad. The curriculum is of three years' duration; in the first two years theoretical and practical industrial instruction is given, and the third year is devoted exclusively to the teaching of trades for females. Instruction is given in drawing and colouring, in lithography and wood-carving, pasteboard works, further in fancy work and plain needlework, in lace-making, in the use of the sewing machine, and, lastly, in pharmacy; this latter that the pupils may pass an examination for the post of assistant apothecary. In 1870, for the first time, five pupils underwent this examination. Several of them have also obtained a certificate of capacity as teachers of free-hand drawing for elementary instruction.

In December, 1874, the number of pupils was 172, of whom 33 were in the 1st class, 52 in the 2nd, and 82 in the highest class; 40 of them were from 12 to 14 years of age, 45 from 14 to 16, and the other 87 above 16 years of age. The staff of teachers consists of one directress, three male teachers, and five female teachers of the various industrial branches. The salaries amount collectively to about 8,000 florins per annum; the collective expenditure of the school may be estimated at 1,200 florins per annum. The state, the province, and the commune have granted subsidies to a collective amount of 7,000 florins per annum. The school fees are from 20 to 25 florins.

Expense of Middle-school Instruction.

The yearly expenditure for the supervision by the State, the examinations, the polytechnic school, the Government higher burgher schools, perhaps subsequently, also, for the Government Agricultural School, as likewise the subsidies for communal and some private establishments, fall to the charge of the State. The communes bear the expense of the local boards, of their own higher burgher schools, of the burgher schools, of some drawing schools and similar institutions, as also of the subsidies granted to certain private establishments. The provinces also furnish a few subsidies to such establishments, and especially to navigation schools, horticultural and agricultural schools, and such like.

Year.	Contributions towards the Expenses of Middle School Instruction by				
	The State.	The Provinces.	The Communes.	School Fees.	Total.
	Florins.	Florins.	Florins.	Florins.	Florins.
1863	18,723	...	24,535	...	43,258
1864	101,239	...	168,317	35,593	305,149
1865	307,578	...	599,392	69,550	976,520
1866	440,107	...	398,356	111,868	950,331
1867	579,827	...	446,039	138,624	1,164,490
1868	597,319	5,000	470,678	152,663	1,225,660
1869	729,011	5,630	452,611	185,122	1,372,374
1870	667,663	11,630	458,269	199,244	1,336,806
1871	658,593	10,445	516,108	212,700	1,397,856
1872	658,392	12,280	551,113	239,615	1,461,400

From this it appears that the expenditure went on increasing till the year 1869, but thenceforth remained nearly stationary. It is not likely to increase very considerably in the ensuing years, as middle-school instruction, as has been said before, may be considered as completely organised. Only in the case of a Government agricultural school being founded, or of an important increase in the Government subsidies, would the annual Government expenditure exceed 700,000 florins. The expenses for school buildings, educational appliances, &c., will be less for the ensuing years, both for the State and for the communes, as since 1864 many school buildings have had to be erected and provided with school furniture and expensive instruments and apparatus. On the whole a sum of 3,358,716 florins has been expended on educational appliances during the years 1864 to 1872, of which 299,070 florins were devoted to the Polytechnic School, 1,290,194 to the Government higher burgher schools, and 1,769,452 to the communal higher burgher schools; thus an average of about 400,000 florins per annum. The expenditure both for the State and the communes will probably decrease, in consequence of the higher amount of the school fees: from the table it is evident that this amount is constantly on the increase, and it is to be expected that it will go on increasing considerably.

Success of the Higher Burgher Schools.

After speaking of the instruction at the higher burgher schools, it may not be irrelevant to add one or two observations concerning the uncommon development attained by them in a few years, as shown in preceding statements. When in 1863 the law came into operation, the Dutch Government flattered itself that a real and urgent want was about to be supplied, and that if the provisions of the law were liberally worked out, and if the communal government and the State acted in concert, the kingdom of the Netherlands would soon be equal to other Germanic countries, in which lately so much has been done for promoting middle-school instruction. But, however great the expectations were, in reality they have been far surpassed. It could hardly be expected that within ten years about fifty higher burgher schools, with nearly four thousand scholars, would be founded, while up to that time scarcely thirty so-called second sections of gymnasia had dragged on a feeble existence, and numbered only about seven hundred scholars. It may now be considered that this important part of middle-school instruction is completely organised. It is, indeed, possible that in course of time, with maturer experience, some modifications, either in the scheme of instruction or in the requirements of the final examinations, may be adopted; but these have little or nothing to do with the main principle. Middle-school instruction for the enlightened parts of the community is organised; it will maintain itself, and probably be extended.

DISCUSSION.

The Chairman said the consideration had been forcing itself on his mind, whilst listening to the paper, how advantageous it was to have a report on the schools of any country by a person who did not merely visit it as a stranger for the special purpose of the inquiry, but who was thoroughly acquainted with its social and political condition and history. Dr. Yeats had given them not merely dry statistics obtained from official sources, but he had seen the schools, and knew their position, and management, their influence, their merits, and defects. For many years we had not had in England any good account of the Dutch schools. In the year 1836, M. Victor Cousin was sent by the French Government to make a report upon them, and his report obtained a great reputation, and was translated and widely circulated in England. It was for many years the only source from which information on the subject could be derived. But though a great master of the French language, an eminent metaphysician, and a man of remarkable ability, M. Cousin laboured under one great disadvantage in preparing such a report, viz., that he did not know the Dutch language. Of course, going to Holland with official introductions, he was able to communicate with statesmen and politicians, who all spoke French, and to obtain a great deal of information; but in Holland, as in any other country, a man who prepared a report, relying merely on official sources for his knowledge, not being able to verify what he heard by his own inspection, might be easily misled and mislead others. He himself, in 1857, while engaged in reporting on the German schools, was much urged by the Education Department, under which he was acting, to visit Holland, and report on their method of instruction, and accordingly went there for the purpose. He had many interesting interviews with some of the most eminent men there, and learned much of their methods of instruction, but not being able to verify what he was told, he declined, on consideration, to make any formal report. Dr. Yeats' report was, therefore, most opportune, as it was based on the highest authority, and formed, in fact, the last word on the actual situation of Dutch education, and the religious, political, and social condition of the country.

Mr. Christian Mast, after thanking Dr. Yeats for his paper, said that, as far as his information went, he could endorse everything which had been said with the exception of two points, on which he should like to ask Dr. Yeats a question. He understood him to say that Latin was not taught in the middle-class schools; but, twenty years ago, there was a Latin school in almost every town, there being a strong tradition in Holland in favour of classical education. These schools were established by the towns themselves, but received Government assistance if necessary; and he should like to know if the system had been changed. Another point to which attention had not been directed, was the almost total absence of boarding-schools, forming a marked contrast to the custom, so prevalent in England, of sending children away from home.

Mr. Youl asked if there were a distinct system of elementary schools for the lower class, distinct from the middle-class schools?

The Chairman said he had heard that, during the last twenty years, the Catholic propaganda had made most alarming inroads in Holland, so much so that half the population were now Catholics; and that this was creating a new and serious embarrassment in the way of dealing with what is called in England the religious difficulty. He also understood that this arose, not from the ordinary form of Catholicism, as seen in France, but from the Jesuit propaganda in the most aggravated form. He should like to know if this was the case or not.

Dr. Yeats, in reply, said middle-class education comprised more than the instruction given in the middle schools. On quitting the middle schools, the pupils passed under higher instruction, which was regarded as preparatory to the University; and then, and then only, was Latin or Greek taught. The middle school system included seven different kinds of schools, adapted to the whole of the middle orders of society, and culminating in the Polytechnic. It was quite true that the Dutch had a great fondness for Latin. An old fellow-teacher of his own in Leyden used constantly to address his pupils in Latin, and require them to answer him in the same language, and on the table were some notes of these colloquial lessons. There were a few boarding-schools in Holland, but not so many as formerly. Still the private boarding-schools were so celebrated that the Crown Prince was sent to one, and the system of instruction was most excellent; so much so that education became quite a fine art. He had spent several years in Holland, becoming naturalised there, for the purpose of acquiring this art of teaching, and he might say that there were men there who took as much delight in the formation of a good pupil as an artist did in forming a statue out of a block of marble. These schools could not stand the competition of the public schools, and many of them had ceased to exist, but a few yet remained, at the head of which were some of the most intellectual men of the land. They never had to seek for pupils, but had more offered them than they could receive; they brought them up as their own children, and made men of them. With regard to elementary schools, he had not mentioned them, as not being within the scope of his paper, except to say that primary instruction was established in 1806, and it had never ceased to exist from that time. It had gone through a variety of stages, but at length had reached such a pitch of perfection, that in 1863 there was no difficulty in withdrawing from the elementary instruction a sufficient number of teachers to start the middle-class school system. It had created two generations of parents who were anxious that still more should be done, and thus the present system came into being. These primary schools provided perfect instruction for all up to the age of 12 or 13, after which there was a system of what was called "extended primary instruction." He might add that the Dutch had proposed to themselves the question whether the fathers and mothers in the lower grades of society would make such sacrifices of time and money as would push their children into the schools for the middle classes if facilities were offered, but he was sorry to say the experiment had proved a failure. The parent would not carry his child out of the class to which he belonged. The Dutch were perfectly self-governing; they paid for their instruction themselves; and managed it entirely themselves. The Minister had little or nothing to do with it beyond supplying the inspiration. The elementary instruction was admirable; it was working out the future of Holland, and making it almost the lode star of Europe, for what was now going on in Germany had perhaps originated in Holland. He had purposely avoided the question of the Catholic propaganda; he had dear friends who were Catholics, as he had others who were Protestants, and he could not see why they should not all be brothers and live happily together. For years he had received spiritual instruction in the same room in which his Catholic friends had held their mass only an hour before. They knew and respected each other as men, and did not interfere with matters of faith. But this was a rare state of things to arrive at, and it was not reached generally in Holland, for what he had said about people living in continual distrust and defiance of each other was but too true. He would not go further into this delicate question, because this paper might, no doubt, be read and discussed in Holland just as well as in England; but he might say that he believed if the Dutch were left to themselves there would soon be peace. It was the continual influx of a foreign element which did the mischief. One thing, however, was certain, that the Dutch would never permit the ecclesiastical element to enter their national or municipal councils, or their boards of education. It was rigorously excluded, but from no disrespect to religion. On the contrary, they were amongst the most God-fearing, earnest people with whom he had ever lived. But they would not allow the shadow cast by these partition walls to be thrown across their political life. Their idea was—let the young be brought up for a generation or two in unsectarian schools, and then, perhaps, these animosities might be forgotten.

Mr. Lydgate, as the successor of Dr. Yeats in one of the most important schools near London, desired to ask whether the system he found established there was due to Dr. Yeats himself, or if it was the same as was adopted in Holland. Although a teacher of twenty-five years' experience, he went to that school as a learner, and he found there a system of organisation such as he had never seen elsewhere. The school was divided into a number of separate divisions, each having a separate room and its own master, who was responsible for it; but the most admirable feature was the clear and distinct manner in which the home and the school were made to act and re-act on each other, as to the importance of which he need not say a word. The method of registration was so perfect that, if he wished to trace the history of any boy, he could do so from year to year, from month to month, from day to day, and even from hour to hour, and he wished to know if this was really a part of the Dutch system.

Dr. Yeats said the going back to these old days, when he was a teacher, as he should have liked to be to the end of his days, revived memories which were almost too much for him. He came to London, after having spent many years in Holland, and attempted to found a middle school. The press and his neighbours called it the muddle-class school; and he was called the meddle man; but he addressed himself to the task of showing his countrymen that if they did not know what was going on across the water, still at any rate the fruits were good. He proceeded to put in force not so much the Dutch methods as Dutch principles, because, as Pestalozzi used to say, systems were like suits of clothes; they only fitted one man, and he soon wore them out. He felt that he could do nothing except in accord with the parents, and, therefore, he commenced by endeavouring to create a demand for middle-school education. Then his aim was to inspire the parents with such an interest in what he was doing, that they should spend as many hours in the school as they could. They might come at any hour that was convenient to them and listen to the lessons that were going on. Then when the novelty of the thing wore off, and they relaxed their visits, he organised a system of reporting from the school to the home, such as existed in Holland, and to a great extent in Scotland. It was this intimate relation between the teacher and the parents in Scotland which had contributed more than anything else to the excellence of the instruction in that country.

Mr. Wm. Botly said he hoped this valuable paper would be studied, for it was calculated to do great good, not only to teachers and the public, but to our senators and Government officials. Some ten years ago, when the subject of education was discussed at the British Association, he concluded his remarks by saying that national education must eventually be compulsory and undenominational, and he was glad to see that this latter principle was so thoroughly appreciated in Holland.

The Chairman then proposed a vote of thanks to Dr. Yeats, which was carried unanimously.

Dr. Yeats having briefly responded, the proceedings terminated.

At the recent meeting of the Chambers of Commerce, a series of resolutions was passed on the subject of Patent-office administration. They were principally to the effect that more facilities should be given to the public in the way of indexes, abridgments, &c., for investigations into former inventions.

MISCELLANEOUS.

COOKERY IN SCOTLAND.

The following memorial has been issued by the cookery authorities who superintend the teaching of cookery in Schools of Public Elementary Education:—

"*To the Right Honourable the Lord President, the Lord Vice-President, and the Lords of the Committee of Privy Council on Education,*

"The Memorial of the School Board of [ ]

"Respectfully Showeth,

"1. That your memorialists consider a knowledge of food and cookery, as part of the education of girls in public day and evening schools, of the utmost importance.

"2. That your memorialists are of opinion that much waste, discomfort, and ill-health would be avoided in the homes of the people if girls were instructed in the theory and practice of cookery.

"3. That your memorialists regard with satisfaction the introduction of 'domestic economy' in the Education Code of 1876 as a compulsory specific subject for girls; but that it appears to your memorialists that abstract teaching in the branch of domestic economy connected with the subject of 'food and its preparation' would prove much more useful if accompanied with practical instruction in cookery, with such utensils as might be used in the homes of the working classes.

"4. That your memorialists would respectfully remind your Lordships that under the regulations of the Science and Art Department of the Committee of Privy Council the teaching of 'chemistry' is aided by payments both on theoretical and practical knowledge, which leads your memorialists to think that some analogous arrangement might be made for encouraging a theoretical acquaintance with the chemistry and physiology of food, as well as a practical knowledge of the most economical methods of its preparation.

"That your memorialists have noted with satisfaction the recent addition of the 'principles of agriculture' to the list of subjects aided by your Lordships through the Science and Art Department; and they think that an acquaintance with the principles and practice of cookery is quite as desirable in the education of girls as an acquaintance with the former subject is in the education of boys.

"Your memorialists would therefore humbly pray—

"(1) That besides enacting the introduction of domestic economy as a specific subject for girls in day schools, your Lordships would be pleased to provide that direct payments may be made to classes in day and evening schools on the results of instruction in practical cookery as a distinct subject, on the same principle upon which payments are now made through the Science and Art Department for instruction in various branches of elementary science and drawing.

"(2) That aid be given towards the proper fitting up and furnishing of places for practical instruction in cookery; and,

"(3) That female teachers be encouraged to pass special examinations with a view to the teaching of cookery.

"And your Memorialists will ever pray.

"Signed in name and on behalf of the Board by

[ ] *Chairman.*"

ADULT INSTRUCTION THROUGH PUBLIC MUSEUMS.

(Subsidised by Parliament.)

The following results, giving important information bearing on public education, are obtained as correctly as possible, from inquiry and Parliamentary returns, in the hope that they may hereafter be officially collected and published periodically, like the Registrar-General's returns. The number of visitors for the month of January, 1877, is stated. When they are counted by sight the letter "S" is used, when by turnstile the letter "M":—

Institutions.	Amounts voted in 1876.	Number of Visitors in January.	How counted.	Observations.
	£			
1. British Museum	108,947	29,358 (1)	S	Return refused. Open Mondays, Wednesdays, Fridays, and Saturdays. Closed, except to students, on Tuesdays and Thursdays. (1)
2. National Gallery, Charing-cross	6,898	161,616	S	Open Mondays, Tuesdays, Wednesdays, and Saturdays. Closed on Thursdays, and Fridays. Open from 10 to 4.30. (2)
3. Kew Gardens and Museum	22,622	..	S	Open on Sundays and week days. (3)
4. South Kensington Museum	39,058	70,254	M	Open Morning and evening till 10, on Mondays, Tuesdays, and Saturdays. Students' days—Wednesday, Thursday, and Friday, 6d. entrance. Open from 10 till Sunset.
5. Bethnal-green Museum	7,200	107,510	M	Ditto. (5)
6. National Portrait Gallery, South Kensington	2,000	..	M	Return refused. Open daily except Sundays. (6)
7. School of Mines and Mining Record Office, Geological Museum, Jermyn-street	8,947	4,300	M	Open daily, except Sundays and Fridays, and in the evenings till 10 of Monday, Tuesday, and Saturday. (7)
8. Patent Office Museum, South Kensington	..	18,102	M	Open daily, except Sundays. (8)
9. Edinburgh National Gallery	2,100	14,688	M	(9) Closed for the month.
10. Edinburgh Museum of Antiquities	..	17,059	M	(10) Ditto.
11. Edinburgh Museum of Science and Art	10,320	47,242	M	Open daily (10 a.m. to 4 p.m.) except Sundays, and Friday and Saturday evenings (6 to 9). Students' days—Monday, Tuesday, and Thursday; admission 6d.; other days, admission free. (11)
12. Edinburgh Botanic Gardens	1,750	2,213	M	(12)
13. Dublin Museum of Natural History	1,742	9,672	M	Open daily, and in the evening. (13)
14. Glasnevin Botanical Gardens and Museum	2,224	5,107	M	Open daily, including Sundays. (14)
15. National Gallery of Ireland	2,339	..	M	(15)
16. Museum of Royal Irish Academy, Dublin	300	..	M	(16)
17. Zoological Gardens, Dublin	500	3,559	M	Open daily, including Sundays. Number of visitors in July, 15,281. (17)
18. Tower of London	1,590	..	S	Open daily, except Sundays. (18)
19. Royal Naval College, including Greenwich Painted Hall	38,051	17,716	S	Open daily, including Sundays. (19)
20. Royal Naval Museum, Greenwich	1,055	2,863	S	Open daily, except Fridays & Saturdays. (20)
21. India Museum, South Kensington	..	1,914	M	Paid for by Indian Government. Open on Mondays, Tuesdays, Fridays, and Saturdays, 1d. admission; on Wednesday and Thursday, 6d. admission. (21)
22. Hampton Court Palace	7,475	..	..	Open on Sundays, and on week days except Fridays. (22)

(1) The numbers are those for the corresponding month of last year, as given in the Parliamentary return.

(2) 19 public days, from 10 to 4.30 o'clock. Trafalgar square, 922,720 (nine months); South Kensington, 298,334 (five months); total for the year 1876, 1,222,024.

(5) The numbers in this month and November were increased by the attraction of the Prince of Wales' East Indian objects.

(9) (10) (12) (16) No information as to opening.

2) As far back as 1855 returns of the number of visitors were made to Parliament and printed, but this practice, for the present at has been suspended. The statistics published by the Board of Trade every three years give returns.

PATENT-OFFICE.

In the House of Commons, on Monday last,

Mr. Reed asked whether it was true that steps had been or were being taken, at the Patent-office, for the destruction of the printed specifications of expired patents, five copies only of each being reserved; and, if so, whether the remonstrances which had been expressed against this course would be attended to, and an ample number of copies of all existing specifications be preserved.

The Attorney-General answered—In pursuance of an order recently issued, which carried out the recommendation contained in a Treasury Report of last year, the printed specifications from the earliest period to the end of 1860 have been examined, and the damaged and surplus copies eliminated, care being taken to retain a sufficient stock for the requirements of the public. The number of copies of each specification reserved in good condition, exclusive of ten copies supplied to the sale-room, and other copies reserved for the use of the gentlemen who are preparing the classified abridgments of specifications, is as follows:—Specifications under the old law from 1617 to 1852, five copies of original and 12 of second editions; under the new law, from 1852 to 1856, 10 copies of original and 15 of second editions; 1857 to 1860, 20 copies of original and 25 copies of second editions; and 50 copies of patents which have expired since 1860 have been kept. It was stated in a leading journal in January last that the greater part of the stock of expired specifications was in constant demand. This is an exaggeration. Ample provision has been made for the supply of any demand which may probably be made. The accumulation of specifications had, owing to the system formerly adopted in the Patent-office, become so great that it was absolutely necessary to adopt the course which has been pursued.

CORRESPONDENCE.

COFFEE-HUSK.

I have abstained from noticing the remarks of "J. F. D.," published in the Society's *Journal* of the 29th January, in my letter regarding *Kishr*, or coffee-husk, until the receipt of replies from the best authorities at Aden. These having now come to hand, I am enabled to supplement my former communication on the subject.

"J. F. D." describes correctly the mode of gathering the coffee at Ceylon; also the removal of the outer pulp, filament, and silver integument from the berry by decomposition and subsequent washing. On this head one of my correspondents writes:—"Ceylon being a damp climate, and the coffee fruit succulent, it is gathered when at maturity, otherwise, like cherries, it would mould on the trees. It is then placed in heaps for a day or two, and the pulp allowed to ferment, in which state it is removed by washing. The pulp so washed off is only fit for manure. On the other hand, the climate of Arabia being dry, the fruit is allowed to ripen and drop off of itself. In this case, the pulp and other coverings dry on the berry, and is often not removed for months after. It is from these husks that the *Kishr* is made; or, to speak more correctly, this husk is the *Kishr*, a decoction of which is used generally as a beverage throughout Arabia. The parchment and silver skin of the coffee amount to a mere nothing; but the dried husk of the Arabian berry amount on an average to twenty per cent."

The following is the receipt supplied me for making ten Arab coffee cups—about two of our ordinary te cups—of the *Kishr* decoction:—"Take a handful of raw husks, or coffee shells, bruise them gently, put them into hot water in an earthen or other jar or pan, and place the same over a slow fire. Add a few bruised cardamums, with a little dry cinnamon or ginger, let the decoction simmer for half an hour, when it will be ready for use, and be found a pleasant beverage."

The *Kishr*, or coffee-husk, is sold at Aden at about two shillings for 28 lbs. weight.

The same correspondent communicates the following on coffee-leaf decoction:—"The leaves of the coffee plant are used in the western part of Sumatra instead of the seeds or berries. They are prepared for use by quick drying, much in the same manner as the leaves of the tea plant. In this state they are said to contain a larger proportion of caffeine than the beans of our shops."

George Percy Badger.

CHINESE v. ENGLISH INFUSIONS FROM TEA.

Permit me to make a few observations on the vast difference between the Chinese and English methods of obtaining a fragrant and pleasant beverage from tea, while the subject is so prominently before the public as it is.

The upper classes in China, from very long experience in the matter, select the very choicest tea which they can afford—generally the young leaves from old trees. A few of these leaves are put into a cup, and water, a little short of the boiling point, is added. As soon as it is sufficiently cool, which does not take many seconds, for the cups are very small, the beverage is quaffed, much after the same manner as the Turks do coffee, so hot that it is commonly asserted they drink it boiling. By the above quick method, they skim, as it were, only the superficial flavour of the leaf, which is very capable of yielding up, when required, a bitter extract, which they avoid. This is the prime source where the "used leaves," spoken of by analysts, come from. In England, on the other hand, every resource which science can conceive is brought to bear on the opposite extreme, viz., to take out every atom of extractive matter, if possible, to the last iota. Now, the infusion from choice tea may be compared to those scents which in their concentrated form are offensive, but when diluted are very fragrant and exhilarating. The march of science, therefore, is driving the British public in a wrong direction—one in which ladies and men with delicate or nervous constitutions so suffer that medical men here and there peremptorily put a stop to the use of tea at all.

A very pleasant and delicately-flavoured beverage is virtually withheld from the mass of the British public, because they are taught to make tea on a method which now appears to have been brought at the very extreme point of the wrong end of the matter. Putting aside the mere chronological order of successive discoveries, they are taught as follows:—1. A round and smooth teapot is recommended as the most scientific shape, to prevent the radiation of heat. 2. They are recommended to pour boiling water over the tea, taking every care that it should be boiling. 3. The pot must be placed close to the fire, if not put a "cosy" over it. 4. Let it stew for about a quarter of an hour, so as to obtain as much of the bitter extract as possible. 5. Use plenty of tea, for a want of liberality implies meanness. 6. Take care and purchase the oldest leaves, or strongest tea, from the oldest of tea trees. 7. Before using it, have it crushed, by means of a hydraulic press having a pressure of 80 tons to the inch, which will so enable you to extract everything extractable in the tea-leaf that nothing but pure vegetable fibre will be left. 8. As the infusion is certain to be very strong and nauseous, add milk to it, to precipitate the tannin so carefully extracted, and make use of its albuminous matter to neutralise this, that, and the other of chemical constituents so faithfully and conscientiously obtained from the secret recesses of the tea-leaf. 9. Add sugar, so that the above compound fluid may approach that degree of palatableness to suit the British taste. 10. A little lemon will still further improve it. 11. Never drink it except in conjunction with food—say, at meal-times—for, if such a practice be continued too long, the complexion will become yellowish, like the Chinese, who drink it morning, noon, and night; and rouge would be required to apparently rectify it. Lastly. When you feel nervous, or palpitating, or hysterical, send for a physician; and take care that he be at the head of his profession, for, otherwise, young men might ascribe it to the undue amount of electricity pervading the British Islands at most seasons of the year, and you be sent into an early grave. Alas!

My humble opinion, sir, is, that it is much better to buy the very choicest tea, at 10s. a pound, and use only a few of the leaves, after the Chinese method—it would last three weeks—than 4 lbs. of "strong tea, at 2s. 6d. per lb."—to last one month—after the English plan of utterly spoiling a choice beverage.

J. F. D.

Feb. 16, 1877.

REARING OF SILKWORMS.

I have read with much interest Mr. Cobb's valuable paper on "The Rearing of 'Grain' or Silkworms' Eggs," and quite agree with him that the cultivation of this insect in England should be solely carried out for the purpose of obtaining "grain," and that the production of silk should be left to other countries. There is no doubt that there are many more mulberry trees in the neighbourhood of London than may be suspected, and those I know of appear to thrive well, but it should be remembered that they are chiefly (if not entirely) of the black sort, which is grown for its fruit, and not the white quality which is grown in Italy for its leaves, and probably is better adapted for food for the silkworm.

In Lombardy, some sericiculturists even go to the extent of attributing the diseases to which the silkworm is liable to the degeneration of the mulberry trees, and advocate, as a sovereign remedy, its "re-acclimatisation" in Europe.

Without going to this extreme, it appears to me that if the silkworm, like any other living being, is supplied with healthy and nourishing food, it will be in a better position to resist the effects of hereditary disease, like *pébrine*, or an epidemic like *flacherie*, which may, in almost all cases, be attributed to unhealthy leaves.

As much care ought to be taken in procuring good, sound, healthy trees, as in the selection of races of silkworms, and for this reason I strongly urge upon intending cultivators the "re-acclimatisation" of the mulberry tree not only in England, but also in our colonies, and not the propagation of the old stock now grown in that country.

From what I have seen in the North of Italy of trees grown from seed imported from China, there is no doubt left upon my mind as to which are the best. These trees, when I last saw them, were of most luxuriant growth, they yielded an abundance of large, dark-coloured, firm and healthy leaves, and formed a most favourable contrast to those usually grown in that district, which looked poor and insignificant beside the re-acclimatised plants, and bore out to some extent the history of the advocates for the re-introduction of the mulberry, that this tree, from its long exile from its native land (North China) has become impoverished and has degenerated, and for this reason is no longer a fit food for the silkworm.

Whether this be the case or not, it is very evident that, were as much attention paid to the selection of its food as in that of its grain, no difficulty would be found in rearing a healthy stock of silkworms, which would yield from year to year an abundant harvest, to supply other countries (such as Italy and France) better adapted for the production of silk, and that English "grain" would acquire a certain *prestige* on the Continent, and would be eagerly sort after by sericiculturists of all nations, to the great benefit of those who have had the courage to embark in this new industry for England.

An Anglo-Italian.

Italy, February 1st, 1877.

TECHNICAL AND HAND-CRAFT TEACHING.

The present appears to me a suitable time for directing attention to the need of a regular system of technic and hand-craft training for the young. Much mi be said about the undoubted fact, that the present ra of progress of the industries of the kingdom is not wha it has been. Especially from the Philadelphia Exhibitions comes the hint, that others are fast coming abreas of us, and that to maintain the leading position of ou country in the markets of the world, an united national effort is needed. As the *Times* has shown, the foreign artisan has so educated and qualified himself, as to be able to equal, and even in some directions to surpass ours. We should then allow nothing to hinder the acquisition of technical training by every English child.

The country is now more ready for a special effort than it was six years ago. Thanks to the education scheme in operation, each English child will soon be endowed with elementary education at least. It was the want of the latter among the artisan class that caused the amiable efforts of such men as Brougham, Birkbeck, and Channing in the past generation to fail. To enable the generation now in the School Board schools to benefit in the greatest degree, and increase the nation's wealth with the results of their talents, it is requisite that the children's education shall be supplemented by enough practical instruction in technical subjects to give them, before they leave the schools, a taste for and power in the particular craft suited to each of them.

Signs are apparent that this is now very generally recognised, and efforts are being made in various directions to introduce technical training, this Society being notably in the front rank. But what is now called for is a regular scheme, directly applied, that shall reach, if possible, all the children now in the schools, and not those few only who afterwards are led by choice or other influence to apply themselves to self-culture. Such a scheme may be briefly sketched out in its leading features under t heads:—

General.—Measures for affording the whole body children the means of early displaying and nurturing incipient tastes or talents in special directions.

Special.—Measures for strengthening, developing, and perfecting such displayed tastes or talents, so that they may become applicable to the carrying on of corresponding hand-crafts.

Under the first head, much could be made of periodical experimental lectures, exemplifying the physical world in its leading features, that all might have opportunities of gaining ideas of subjects, not to be learned within the school walls. Subjects, such every-day ones as watches, clocks, furniture, pumps, engines, looms, lathes, shuttles, porcelain, cutlery, paper, &c., &c. Whatever body took up this public service should arrange a regular cou lectures, and send qualified lecturers the rou schools, to each once a month or so, and c selected course with models and practical demonst At stated periods too, every six or twelve months the children should be examined in the course, with prizes of text-books in each subject selected. This would bring into notice for further training the intelligent ones of their number.

Under the second head the children of promise being thus brought to the front, means should be sought to develop their talents, so that these may be practically employed. Among the greatest difficulties a working man has is that of placing his son, who promises well, where his talents will be well employed. What with his own means to advance a premium, the indifference of many masters, and the barriers raised by trades' unions, he is too often baffled in his endeavours to raise his son above the life of mere drudgery that otherwise awaits him, unless indeed the boy himself is one of those prodigies who, like Thomas Edward, make of every obstacle an additional condition of success.

The means of supplying this want, I fully believe, are attainable. What are required are training shops, either attached to the schools or in the central situations, where the selected boys shall be taught while young to handle the tools, carry on the craft, and acquire in any one direction. It will be enough to suggest that classes be opened for carpentering, turning, iron-work, smith work, casting in iron and brass, as applied to building and engineering construction, and similarly for other hand-crafts. Such shops might be always full of boys from various schools, who would be allotted regular time for training, so that each might be exercised two or three times a week, or as often as could be arranged. The boys beginning young, with suitable and sufficient superintendence, should quickly learn and develop skill enough by the time they leave to have a capacity that will find them ready employment. If funds allowed of premiums to the most proficient, or even of scholarships, enabling them still further to pursue to the highest point their chosen crafts, the better.

There may be two objections raised, impracticability and finance. The first may be dismissed at once by merely stating the fact, that such a system is largely in operation in Germany, through the agency of the trade-schools, in which the workshop and the class-room are combined, so that a German lad possesses great advantages over an English one. In one instance at least here (King's College) too, there are courses of "workshop evening classes," attended by young men preparing for colonial life, pupils in engineers' offices, &c., classes strictly for practice and training in the leading hand-craft. Employers would willingly take lads from such workshops, for they would be somewhat proficient, and the great difficulty of placing boys now is that, though there may be abundant work, employers cannot spare time to teach them the rudiments.

The second objection may appear a more serious one. Where is the money to come from, if not from increased taxation? This might be a judicious course, and even [illegible] the end actually economical, certainly nationally so. [illegible] there are quarters from which assistance could first of all be asked. For example, the City Guilds, which once were the foster-parents of the national industries, why should they not once again take up their worthy task? These bodies have for a long time been progressing in wealth, and diminishing in practical utility. Let them bestir themselves. There is public spirit enough in the City of London, as many a crisis has shown over and over again, when necessity has arisen. Can it be believed that the Goldsmiths, Clothworkers, Drapers, Turners, and the other 70 or 80 wealthy corporations, with an aggregate income of £1,000,000 a year, will not assist liberally in promoting technical training in their respective crafts? Indeed, there are [illegible] signs that they are so disposed, and were a *modus vivendi* matured, they would largely co-operate.

[illegible] to hear of our Society taking the initiative [illegible] a national work.

HAHNEMANN EPPS.

Hampstead, Feb. 1st, 1877.

GENERAL NOTES.

Coffee-Taverns.—At a meeting held recently at the house of Mr. Ernest Hart, at 59, Queen Anne-street, it was resolved to attempt the formation of an association in London to provide the working classes, in the densely-populated neighbourhoods in which they reside, with places of resort where they may find unintoxicating refreshment, plain food, warm, well-lighted rooms, and the opportunity of spending hours of leisure removed from the temptations of the gin-palace. The meeting resulted in the formation of a limited company for the purpose, under the presidency of the Right Hon. Cowper-Temple, with the Duke of Westminster, Earl Cowper, Viscount Portman, and Sir Harcourt Johnstone as vice-presidents, and with a board of directors including Mr. Thomas Hughes, Q.C., Mr. Pope, Mr. Ernest Hart, and a representative of the Church Temperance Society. About £1,500 has been privately subscribed. Arrangements are in progress for working the business under the same managers who have been superintending a similiar series of houses in Liverpool. The directors accept no remuneration, and Mr. J. C. Barnard, solicitor, of 15, Lancaster-place, Strand, gives his services as secretary. The capital required is about £10,000.

NOTICES.

PROCEEDINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday evenings, at 8 o'clock. The following arrangements have been made:—

March 7.—Lecture on "The Growth and Present Position of the Science of Machines," by Professor A. B. W. Kennedy, C.E.

March 14.—"The Treatment of Town Refuse and Sewage," by Prof. Ansted, F.R.S.

March 21.—Lecture on "Vital Air," by Dr. W. B. Richardson, F.R.S.

African Section.

Tuesday evenings, at 8 o'clock. The following arrangements have been made:—

March 13.—"Our Commercial Relations with West Africa, and their Effects upon Civilisation," by James Irvine, Esq., of Liverpool.

April 10.—"The Social State and Prospects of the South African Communities," by Robert Richards, Esq., of Grahamstown.

April 24.—"The Trade and Resources of Morocco," by Dr. Arthur Leared.

Indian Section.

Friday evenings, at 8 o'clock. The following arrangements have been made:—

March 2.—"The Progress of Trade in Central Asia," by Sir T. Douglas Forsyth, C.B., K.C.S.I. Sir Rutherford Alcock, K.C.B., will preside.

March 16.—"The Native Indian Press," by Dr. George Birdwood, C.S.I. Andrew Cassels, Esq., will preside.

April 20.—"The Existing and Possible Commercial Communications between Persia and India," by Major-General Sir Frederick John Goldsmid, C.B., K.C.S.I.

May 4.—"Thaumato-dendra, or the Wonders of Trees," with illustrations from life, by Wm. Tayler, Esq.

Chemical Section.

Thursday evenings, at 8 o'clock. The following arrangements have been made:—

March 8.—"The Sizing of Cotton Goods," by W. Thompson, Esq., F.C.S., of Manchester. W. H. Perkins, Esq., F.R.S., will preside.

April 12.—"The Cinchona Alkaloids; their Sources, Production, and Use," by Dr. B. H. Paul.

April 19.—"Spontaneous Combustion in Factories and Ships," by C. W. Vincent, Esq., F.C.S.

April 26.—"Phosphor-Bronze and its Applications," by Alexander Dick, Esq.

May 10.—"A New Process for the Production of Carbonate and Caustic Soap, without the Formation of any Noxious Waste and the Recovery of the Sulphur," by George E. Davis, Esq.

Science Lectures.

These will be given on the following Wednesday evenings, in place of the usual paper and discussion. The rules for admission will be the same as for the Cantor Lectures. Each member can admit ONE friend by giving the usual order from the book supplied at the commencement of the Session:—

March 7.—Professor A. B. W. Kennedy, C.E., "The Growth and Present Position of the Science of Machines."

March 21.—Dr. B. W. Richardson, F.R.S., "Vital Air."

April 18.—E. J. Reed, Esq. C.B., M.P., F.R.S., "The Modifications which Ships of War have Undergone during the last 20 Years."

May 2.—J. Baillie Hamilton, Esq., "New Musical Instruments."

May 16.—Professor W. K. Clifford, F.R.S.

Cantor Lectures.

Monday evenings, at eight o'clock. Second Course, "On the Chemistry of the Manufacture of Coal Gas," by A. Vernon Harcourt, Esq., F.R.S.

Lecture I.—March 5.

Formation and chemical nature of coal. Changes produced by the application of heat. Solid, liquid, and gaseous products. Coke—its advantages as a fuel. Separation by condensation of liquids from permanent gas. Composite nature of tar. Process of tar distillation.

Lecture II.—March 12.

Ammoniacal liquor; its composition, treatment, and valuation. Purification of gas from ammonia. Scrubbers and washers. Probable effect upon gas of prolonged contact with tar and ammoniacal liquor. Purification from carbonic acid and sulphuretted hydrogen. Use of lime and of oxide of iron.

Lecture III.—March 19.

Composition of coal gas. Common impurities—carbonic acid, carbon bisulphide. Products of the combustion of gas containing sulphur. Question as to the injurious effect. Modes of purification. Action of calcium sulphide. Effect of contact with heated surfaces. Tests for sulphur.

Lecture IV.—March 26.

Principal constituents. Hydrogen, carbonic oxide, marsh gas, olefiant gas. Value for heating and for illumination. Luminous flames. Development of the illuminating power of coal gas. Burners. Gas compared with other illuminants. Different qualities of gas. Photometry. Standard burner. Unit of light.

Each member can admit one friend to these lectures. No special tickets are now required for the purpose; the tickets issued to members at the commencement of the session are available for the Cantor Lectures, as well as for the Ordinary and Sectional Meetings.

MEETINGS FOR THE ENSUING WEEK.

Mon. ...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. A. Vernon Harcourt, "The Chemistry of Gas Manufacture." (Lecture I.)
Farmers' Club, Caledonian Hotel, Adelphi, W.C., 5½ p.m. Mr. W. E. Bear, "Providence and Pauperism."
Royal Institution, Albemarle-street, W., 2 p.m. General Monthly Meeting.
Society of Engineers, 6. Westminster-chambers, 7½ p.m. Mr. J. Walter Pearse, "The Mechanical Firing of Steam Boilers"
Medical, 11. Chandos-street, W., 7 p.m. General Meeting.
Victoria Institute, 10. Adelphi-terrace, W.C., 8 p.m. Rev. Canon Birks, "The Bible and Modern Astronomy."
London Institution, Finsbury-circus, E.C., 5 p.m. Prof. Bentley, "Palms."
Social Science Association, 1, Adam-street, Adelphi, W.C., 8 p.m. Mr. Cornelius Walford, "Fire Inquests a Necessity."

Tues....**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 7 p.m. Mr. H. T. Wood, "The Patent Law Amendment Bill."
Royal Institution, Albemarle-street, W., 3 p.m. Prof. Garrod, "The Human Form; its Structure in Relation to its Contour." (Lecture VIII.)
Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Continued Discussion on "The Sewage Question."
Pathological, 53, Berners-street, Oxford-street, W., 8½ p.m.
Biblical Archæology, 33, Bloomsbury-street, W.C., 8½ p.m.
Zoological, 11, Hanover-square, W., 8½ p.m. 1. Prof. Owen, "Notes on the *Ornithorhynchus paradoxus*, by George Frederick Bennett, in a Letter from Dr. G. Bennett, to Prof. Owen, with remarks by the latter." 2. Lieut.-Col. R. H. Beddome, "Description of Three New Uropeltidæ from Southern India." 3. Mr. A. G. Butler, "Descriptions of New Species of Heterocerous Lepidoptera in the Collection of the British Museum."

Wed....**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Science Lecture.) Professor A. B. W. Kennedy, "The Growth and Present Position of the Science of Machines."
Geological, Burlington House, W., 8 p.m. 1. Prof. H. G. Seeley, "The Vertebral Column and Pelvic Bone of *Pliosaurus Evansi* (Seeley), from the Oxford Clay of St. Neot's, in the Woodwardian Museum of the University of Cambridge." 2. Mr. A. J. Jukes-Brown, "Supplementary Notes on the Fauna of the Cambridge Greensand." 3. Mr. F. G. Hilton Price, "The Beds between the Gault and Upper Chalk, near Folkestone."
Entomological, 11, Chandos-street, W., 7 p.m.
Microscopical, King's College, W.C., 8 p.m. Rev. W. H. Dallinger, "Additional Note on the Identity of *Nivacula crassinervis*, *N. rhomboides*, and *Frustulia Saxonica*."
Pharmaceutical, 17, Bloomsbury-square, W.C., 8 p.m. 1. Dr. Paul. "A New Source of Borax." 2. Dr. A. Senior, and Mr. A. J. G. Lowe. "Notes on the Action of Chlorine upon a Beam of Light," and "The Preparation of Liquid Chlorine."
Archæological Association, 32, Sackville-street, W., 8 p.m.
Obstetrical, 53, Berners-street, Oxford-street, W., 8 p.m.
Royal Horticultural, South Kensington, S.W., 1 p.m.
Royal College of Physicians, Pall-mall E., 5 p.m. (Croonian Lectures.) Dr. J. Braxton Hicks, "The Difference between the Sexes in Relation to the Aspect and Treatment of Diseases." (Lecture I.)

Thur. ...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Chemical Section.) Mr. W. Thompson, "The Sizing of Cotton Goods."
Royal, Burlington House, W., 8½ p.m.
Antiquaries, Burlington House, W., 8½ p.m.
Medical, 11, Chandos-street, W., 7 p.m. Anniversary.
London Institution, Finsbury-circus, E.C., 7 p.m. Mr. E. Pauer, "Handel and Bach."
Society for the Encouragement of the Fine Arts, 9, Conduit-street, W., 8 p.m. Mr. H. H. Statham, "The Principles of Architecture as Illustrated in the Greek and Gothic Styles."
Royal Institution, Albemarle-street, W., 3 p.m. Mr. William Pole. "Theory of Music." (Lecture IV.)
Inventors' Institute, 4, St. Martin's-place, W.C., 8 p.m.
Royal Historical, 11, Chandos-street, W., 8 p.m. 1. Dr. Gustavus G. Zerffi "The Historical Development of Idealism and Realism." 2. The Marquis de Campobianco, "The Methods for Ascertaining Historical Truth."
Mathematical, 22, Albemarle-street, W., 8 p.m.

Fri.......Royal College of Physicians, Pall-mall, E., 5 p.m. (Croonian Lectures.) Dr. J. Braxton Hicks, "The Difference between the Sexes in Relation to the Aspect and Treatment of Diseases." (Lecture II.)
Royal Institution, Albemarle-street, W., 8 p.m., Weekly Meeting; 9 p.m. Mr. Frederick J. Bramwell, "The Future of Steel."
Astronomical, Burlington House, W.C., 8 p.m.
Quekett Microscopical Club, University College, W.C., 8 p.m.
Clinical, 53, Berners-street, W., 8½ p.m.

Sat.......Trades' Guild of Learning and National Health Society (at the House of the Society of Arts), 8.30 p.m. Prof. W. H. Corfield, "The Laws of Health." Part II. (Lecture VII.)
Royal Botanic, Inner Circle, Regent's-park, N.W., 3¾ p.m.
Royal Institution, Albemarle-street, W., 3 p.m. Prof. Henry Morley, "Effects of the French Revolution upon English Literature." (Lecture III.)

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JOURNAL OF THE SOCIETY OF ARTS.

No. 1,268. Vol. XXV.

FRIDAY, MARCH 9, 1877.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

ALBERT MEDAL.

The Council will proceed to consider the award of the Albert Medal for 1877, early in May next. This medal was struck to reward "distinguished merit in promoting Arts, Manufactures, or Commerce," and has been awarded as follows :—

In 1864, to Sir Rowland Hill, K.C.B., "for his great service to Arts, Manufactures, and Commerce, in the creation of the penny postage, and for his other reforms in the postal system of this country, the benefits of which have, however, not been confined to this country, but have extended over the civilised world."

In 1865, to his Imperial Majesty, Napoleon III., "for distinguished merit in promoting, in many ways, by his personal exertions, the international progress of Arts, Manufactures, and Commerce, the proofs of which are afforded by his judicious patronage of Art, his enlightened commercial policy, and especially by the abolition of passports in favour of British subjects."

In 1866, to Professor Faraday, D.C.L., F.R.S., for "discoveries in electricity, magnetism, and chemistry, which, in their relation to the industries of the world, have so largely promoted Arts, Manufactures, and Commerce."

In 1867, to Mr. (now Sir) W. Fothergill Cooke and Professor (afterwards Sir) Charles Wheatstone, F.R.S., in "recognition of their joint labours in establishing the first electric telegraph."

In 1868, to Mr. (now Sir) Joseph Whitworth, F.R.S., L.L.D., "for the invention and manufacture of instruments of measurement and uniform standards, by which the production of machinery has been brought to a state of perfection hitherto unapproached, to the great advancement of Arts, Manufactures, and Commerce."

In 1869, to Baron Justus von Liebig, Associate of the Institute of France, Foreign Member of the Royal Society, Chevalier of the Legion of Honour, &c., "for his numerous valuable researches and writings, which have contributed most importantly to the development of food economy and agriculture, to the advancement of chemical science, and to the benefits derived from that science by Arts, Manufactures, and Commerce."

In 1870, to M. Ferdinand de Lesseps, "for services rendered to Arts, Manufactures, and Commerce, by the realisation of the Suez Canal."

In 1871, to Mr. (now Sir) Henry Cole, C B., "for his important services in promoting Arts, Manufactures, and Commerce, especially in aiding the establishment and development of International Exhibitions, the development of Science and Art, and the South Kensington Museum."

In 1872, to Mr. Henry Bessemer, "for the eminent services rendered by him to Arts, Manufactures, and Commerce, in developing the manufacture of steel."

In 1873, to M. Michel Eugène Chevreul, "for his chemical researches, especially in reference to saponification, dyeing, agriculture, and natural history, which for more then half a century have exercised a wide influence on the industrial arts of the world."

In 1874, to Mr. C. W. Siemens, D.C.L., F.R.S., for his researches in connection with the laws of heat, and the practical applications of them to furnaces used in the Arts; and for his improvements in the manufacture of iron; and generally for the services rendered by him in connection with economisation of fuel in its various applications to the Manufactures and the Arts."

In 1875, to Mons. Michel Chevalier, the distinguished French statesman, "who, by his writings and persistent exertions, extending over many years, has rendered essential service in promoting Arts, Manufactures, and Commerce."

In 1876, to Sir George B. Airy, K.C.B., the Astronomer Royal, for "eminent services rendered to Commerce by his researches in nautical astronomy, and in magnetism, and by his improvements in the application of the mariner's compass to the navigation of iron ships."

The Council invite members of the Society to forward to the Secretary, on or before the 14th of April, the names of such men of high distinction as they may think worthy of this honour.

AFRICAN COMMITTEE.

A meeting of this committee was held on the 2nd inst.; present, Vice-Admiral Erasmus Ommanney, C.B., F.R.S. (in the chair); Sir Samuel Baker, F.R.S., Lieut-Col. Grant, C.B., and Edward Hutchinson, with Dr. Mann, Secretary of the African Section.

FOOD COMMITTEE.

A meeting of this Committee was held on the 2nd inst.; present, Benjamin Shaw (in the chair), Sir Antonio Brady, Lord Alfred S. Churchill, W. H. Michael, and James A. Youl, with P. Le Neve Foster, Secretary. The Committee had before them some specimens of fresh American meat, and some specimens of meat preserved by sulphurous acid gas, also some extract of coffee, shown by Mr. W. P. Branson, and some specimens of preserved milk food, shown by Mr. Lobb.

HEALTH AND SEWAGE OF TOWNS.

The Annual Conference on Health and Sewage of Towns will be held on the 3rd May next, the Right Hon. James Stansfeld, M.P., in the chair.

INDIAN SECTION.

Friday, March 2nd, 1877; Sir Rutherford Alcock, K.C.B. in the chair.

The paper read was :—

THE PROGRESS OF TRADE WITH CENTRAL ASIA.

By Sir Douglas Forsyth, C.B., K.C.S.I.

The annexation to Russia of vast regions in Central Asia, taken together with the prospect of further annexations, gives rise to considerations of practical importance, not merely in a political view, but as affecting our relations with that part of the world. There is no subject, perhaps, on which more divergent and erroneous opinions have been held by both Russians and Englishmen than on the trade with Central Asia.

Of the diversity of opinion amongst the Russians, a very favourable specimen may be taken from the writings of Colonel Glukhowski, who thus expresses himself:

"Up to very recently, our diplomatists have thought that our interest rested on strong foundations, and that nature herself protected our commercial interests, and that therefore it was not necessary in any special manner to patronise Russian traders in Central Asia. They affirmed that, first, the Central Asiatic Khanats were so dependent on our trade that it was sufficient for us to announce its suspension in order to make them comply with all our demands; second, that the Hindu-Knsh and the petty tribes inhabiting the country of the head waters of the Amu Darya and Afghanistan obstructed the Central Asiatic trade of the English so effectually, that we had nothing to fear from England, and that our supremacy in the markets of Central Asia was consequently guaranteed.

"How far these suppositions of our diplomatists were groundless, may be judged from the military operations of 1864, '65, '66, '67 and '68; these clearly proved, 1st, that the Central Asian Khanats can dispense with our trade; 2nd, that they are not at all dependent on it, and do not consequently fulfil even the most international obligations; 3rd, that the trade is more important to us than to the Central Asian Khanats, which, taking large quantities of our manufactures, possess such articles as cotton and silk, which are essential to us, and which will always be of value in every European market; 4th, that English merchandise always penetrated into Central Asia through Hindu-Kush, and that latterly such quantities of tea and cotton goods were brought to Bokhara from India that the tea trade in Taskhend was suspended, and the sale of our manufactures fell off very considerably."

Opinions of an equally opposite character might be quoted from English authorities, and if too favourable a prospect was put before us by Burnes, Atkinson, and others, who having travelled in those parts, formed a correct estimate of the position held, at the time of their travels, by Russia and England respectively in the Central Asian market, certainly in more recent times much too gloomy a view is apt to be taken by us of our chances of competing with Russia in these markets.

It would be interesting, if time and space permitted, to review the whole subject of commerce in Asia from the earliest times, a subject on which ancient histories throw a broad and valuable light. But it will suffice for the present to confine our inquiries to dealings with Russia and Anglo-India, and if Monsieur Gregorieff, who is a great authority, be correct, the first advances towards trade with Europe were made, not by the Russians, but by the Asiatic traders. According to him, the natural productions of Russia being much demanded by Asia, had from old brought Asiatic traders thither. When Kazyan and Astrakhan fell, through which the Russian trade had been carried on, ambassadors came to Ivan the Terrible from Samarcand, Bokhara, and other places, asking for a "free road for guests." The commercial relations with Central Asia were profitable to Russia, and therefore the road for guests was willingly opened; but the Russians, even then, understood that it would be still more advantageous if they could provide themselves with the Asiatic wares they needed by buying them at the place of production by means of their own merchants. For that reason Moscow Czars showed the greatest favour to those of their subjects who were bold enough to penetrate into the Central Asiatic markets through the hostile steppes full of marauders which separated them from Russia. The effort to obtain for the Russian merchants who went to Central Asia the same rights and conveniences which Central Asian traders had in Russia was the chief reason which in the seventeenth century called out an embassy from Russia to the Central Asian sovereigns.

It is said by M. Gregorieff that Peter the Great, in all his designs with regard to Central Asia, had no aspiration to conquer it, but was attracted by two great ideas. First, to give to Russian trade a way through the steppe to the treasures of India, which he knew had given wealth to his friends, the Dutch. Second, to bring to Russia the gold which, as report had told him, was to be found in masses in a river near the city of Yarkund. Taking advantage of an embassy from Khiva in the beginning of the eighteenth century, which came with a proposal to swear allegiance to Russia, he despatched a force nominally to give support to Khiva and Bokhara, but really to open the road to India and Yarkund, and to send thither a Russian commercial caravan. The utter failure of this expedition under Prince Bekovitch Tcherkanski is well known.

Nothing further was done in his reign; but the rule of Empress Anne was remarkable for the voluntary submission of the numerous horde of Kirghiz in 1734; but owing to singular mismanagement, the relations between the Russian Government and its newly-acquired subjects were for a long time of the worst description. The disobedience and the marauding propensities of the Kirghiz were especially galling to a nation whose constant dream was the development of trade with India, and who rejoiced at the submission of the Kirghiz chiefly because it portended, as they thought, the attainment of their commercial aspirations, The Khans constantly promised to convey commercial caravans to Central Asia and from thence to Russia in perfect security, but their subjects as constantly took from these caravans a heavy contribution or completely pillaged them. Under such circumstances the commercial relations of Russia with Central Asia could not flourish, and frequently were stopped for a long time.

Besides this, they were carried on from the Orenburg line almost exclusively with Khiva and and Bokhara. In order to keep up and strengthen those relations, they coquetted even with Mohammedanism. It is well known that one of the best colleges in Bokhara was built at the instigation of the Empress Catherine, who gave 40,000 roubles* for it. With Khiva they carried on trade with Afghanistan by way of the Caspian Sea and the Turkoman steppe, but the Caspian Turkomans did not fall behind the Kirghiz in their marauding disposition, and the Khivans, remembering the destruction of Bekovitch, avoided coming into close relations with the Russians on that side where they were most open to attack. At the end of Catherine's reign the ineffectual nature of their policy was apparent to the Russian Government, and in 1794 Russian officials were sent from Siberia, who brought back some very curious information about Bokhara and Tashkend. Still less important was the trade carried on with the settled populations of Central Asia from Semapalatinsk and Petropaulovsk on the Irtysh line, where merchants sometimes arrived from Tashkend, Khokand, and the cities of Eastern Turkestan. But with the Kirghiz a barter traffic sprang up, which was very profitable to Russia.

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* About seven roubles—£1 sterling.

The next attempts at close relationship with Khiva and Bokhara were made by despatching embassies to those countries in 1819-20, but the only fruit was the enrichment of Russian and European literature by the works of Muravieff, Meyendorff, and Eversmann. In order to keep up the trade with Bokhara, which suffered from the Kirghiz marauders as well as from Khivan robber-bands, the idea was conceived of sending caravans under military convoy. The first attempt of this kind was made in 1824, but was a signal failure, as the caravan was robbed.

The mission of Wozoroff to Khokand in 1814 was fruitless, and then, says M. Gregorieff, the policy of Russia with regard to Central Asia during the first quarter of the present century was in aims, methods, and results, as unsuccessful as it had been in the eighteenth century. Without aims of aggrandisement or schemes of conquest, their case was limited to the modest object of securing equality in commercial relations with the petty tribes of Central Asia, yet without effect. While Bokharan, Khivan, or Khokandi traders travelled all over Russia and traded, not merely without molestation, but with immense profit to themselves, Russian traders could scarce show their faces in Bokhara and live, and on account of the exertions and perils they had to undergo they were compelled to give up their journeyings.

A slight improvement was indeed made in 1810, when the Emperor Alexander I. advanced into the Kirghiz steppes and colonised the Iletsk district with Russians, and abolished the title of Khan over the Kirghiz in the Siberian, and then in the Orenburg steppes. During the reign of Nicholas I. measures for strengthening the union of the Kirghiz steppes with Russia brought a great part of its inhabitants into complete submission. In 1834 a fort was built on the north-east of the Caspian Sea, and in 1835 a military line was established between the rivers Ural and Ui, and all the region which was in this way cut off from the Trans-Ural steppes were united to the territory of the Orenburg Cossack army. An attempt to recover their independence by the Kirghiz ended in further subjugation, and about 1847 the Russians erected fortifications on the eastern part of the Trans-Ural steppes on the rivers Jungar and Irghiz, and placed a fort at the mouth of Syr Darya. Meanwhile, in a parallel way from the side of Siberia, there was an onward move, and the great, or old Kirghiz horde found it to their advantage, in 1845-57, to submit to Russia, and forts were immediately erected at Kopal and Vernoye. Having now become the masters of these great Kirghiz hordes, the Russians found it to be their duty to protect their newly-acquired subjects from the marauding bands of Khokand and Khiva, and for this purpose all the Khokandian forts along the valley of the Syr Darya, including the strongest, Ak Masjid, were attacked, and by 1853 had fallen into Russian hands.

The attempt to chastise Khiva was not so successful for a time, and the destruction of Perofski's ill-fated expedition in 1839 is a well-known matter of history.

During the Crimean War, tranquility prevailed in the Central Asian steppes, and active hostilities of any importance did not recommence till 1860, when the forts of Tomak and Pishpek were seized and destroyed. In 1863-64, the towns of Aulicta, Turkestan, and Chumkund were occupied. At this juncture the celebrated despatch of Prince Gortchakoff was given to the world, from which I take the following passage, as explanatory of the reasons put forth by Russia for her advance:—

> "It is unnecessary for me to call attention to the evident interest that Russia has in not extending her territory. Of late years people have been pleased to assign to Russia the mission of civilising the countries which are her neighbours in the continent of Asia. The advancement of civilisation has no agent more efficient than commercial relations. These last, to become developed, require order and stability, but in Asia this necessitates a complete change of customs. Asiatics must be made to understand that it is more to their interest to favour and insure the trade of caravans than to pillage them. These elementary notions can only penetrate the public conscience when there is an organised society, and a government to direct and represent it. We accomplish the first part of this task in advancing our frontiers to the limit where these indispensable conditions are to be found. We accomplish the second by endeavouring henceforward to prove to the neighbouring States by a firm system, so far as the suppression of their ill-dealings is concerned, but at the same time in moderation and justice in the employment of force, and by respecting their independence, that Russia is not their enemy, that she entertains towards them no ideas of conquest, and that peaceful and commercial relations will be more profitable than disorder, pillage, reprisals, and permanent warfare.
>
> "In consecrating itself to this task, the Imperial Cabinet is inspired by Russian interest. It believes that at the same time it serves the interests of civilisation and humanity, it has the right to count on an equitable and loyal appreciation of the steps which it pursues, and of the principles by which it is guided."

It is unnecessary to go into any detailed account of the manner in which the desire to live at peace with their neighbours, and a due regard for the interests of civilisation and humanity, have yet compelled the Russians to make further advances, taking the town of Tashkend, Samarcand, and spreading out their aims east and west, till now, in 1877, the Russian boundary line includes a large portion of Khiva, Bokhara, and the whole of Khokand, and there are clear indications of a desire to extend still further eastward.

The commercial policy of Russia, as is well known, is to maintain a system of the strictest protection, and to exclude as far as possible all competition with her home manufactures. But on the European side it is impossible thus to shut out foreign goods, and we find from the returns of trade that, taking an average of five years, between 1869 and 1873, a total of ten millions' worth of goods was yearly imported into Russia from England alone. We know that, owing to the high customs tariff, smuggling is carried on to a very large extent, so that the imports to Russia from England might really be put at a much higher figure. In Asia, however, the Russians prohibit altogether the import of English goods, with the exception of indigo, and unless we take account of the smuggling which is inevitable, we may assume that wherever Russia fixes her boundaries in Asia, all trade between England and the countries now Russianised must be considered as put an end to.

This being the case, we may confine our attention at present to the trade of those countries lying between India and Russia, or, to take them as they appear on the map, the countries of Khiva, Bokhara, Afghanistan, Kashgar, and Thibet. In truth, we may almost exclude Khiva from our calculations, because, though the Khan of that country is allowed a semblance of that independence, the power of Russia has cast a fatal shadow over the land, and ere long will completely extinguish all trace of any other than Russian supremacy. It is very difficult to get at the truth regarding trade anywhere in Asia, and even in the Punjab, where a census of trade has been taken with all due care year after year, a discovery has just been made which causes a complete *bouleversement* of all former calculations. How much more difficult then must it be to arrive at the correct estimate of Central Asian trade from the Russian side, where, as Mr. Schuyler tells us, in the Orenburg-Siberian frontier the customs line has been abolished since 1868, and the collection of statistics has consequently been abolished. Another difficulty, too, is to arrive at anything like a correct estimate of population—the most widely divergent opinions being expressed. To take the instance of Eastern Turkestan, or Kashgaria, it has been asserted in a Russian paper that the population is under estimated at 20,000,000 and 30,000,000, or even more have been assigned. On the other hand, Father Hyacinth, drawing from Chinese sources, puts it at 1,000,000, and M. Valikhanoff, who visited Kashgar, reduces this 1,000,000 to 580,000. The compilers of the Russian Military Statistical Census for 1868 put the entire population of Eastern Turkestan at 3,000,000.

Wells Williams, in his "Middle Kingdom," gives the populations of the chief towns of Eastern Turkestan as follows:—

Yarkund	200,000
Kashgar	80,000
Sairam	31,000
Aksu	20,000

I am not sure whether these figures are meant to represent the population inside the four walls and the immediate suburbs of each town, or whether they include the whole district, or to use an English word, a county of that name. During the visit of the embassy from India to Kashgar in 1873, great pains were taken to form some correct estimate, and I give the following extracts from the report of the mission:—

"The city itself having a circuit of four miles outside the walls, may be considered as covering an area of 3,097,600 square yards. If we deduct one-fifth for fortifications, streets, courts, bazaars, and tanks, of which last the number is said to be 120, we shall have 4,478,080 square yards left for the houses. And this, if we take 25 by 20 yards as the average measurement, will give the number at 4,956, or about 5,000 houses, which, at seven persons per house, represents a population of 35,000 souls. The calculation is certainly fully up to the mark, and I believe much above the actual fact, for, compared with Peshawur, which has a population of something under 600,000 souls, Yarkund is an insignificant city. I don't think its population exceeds 20,000 souls at the present time."

From the data furnished in the preceding description, the population of the Kashgar State may be tabulated and summed thus:—

	Houses.	Souls.
Khutan	18,500	129,500
Yarkund	32,000	224,000
Yangi Hissar	8,000	56,000
Kashgar	16,000	112,000
Ush Turfan	2,000	14,000
Aksu	12,000	84,000
Kuchá	6,000	42,000
Kurlá	2,000	14,000
Karashaher	8,000	56,000
Turfán	18,000	126,000
Lob	10,000	70,000
Marálbáshi	5,000	35,000
Sárigh Kúl	2,500	17,500
Kirghiz	3,000	21,000
Pakhpúlúk	2,000	14,000
Total	145,000	1,015,000

"Such are the results of a careful inquiry into the population of the several divisions of the country, and the numbers given are mostly those represented to be revenue reckonings of the Chinese rulers. My personal observation, however, leads me to the belief that this 1,015,000 is very considerably above the actual numbers which a proper census would disclose as the true population of the country in the possession of the Amir, as defined in the preceeding pages, and I have been enabled to form this estimate for the whole country from experience of its western divisions.

"Two circumstances conspire to mislead the mere traveller in his calculations. One is the sudden transition from a region of solitude and desolation to another of society and habitation; and the other is the striking contrast between the desert wastes around, and the flourishing settlements that spread far and wide between them. Thus the traveller approaching the country from the south has to cross a vast uninhabited region utterly devoid of trees and verdure, and after ten or twelve days of such desolation, he suddenly plunges into a flourishing settlement extending over as many miles along a river-course, and thickly planted with trees in all its extent. His first impression is one of dense population and plenty, but a closer investigrtion shows him that abundance of trees does not necessarily prove population, and he discovers that the houses are widely scattered, either as single homesteads, or in clusters of two or three together; and if he counts them, he will find that within a radius of a couple of miles all round hardly fifty tenements visible. He quits this settlement on his onward journey, and, whichever way he goes, he traverses a wide waste of blank desert to the next, which, may be, is a market-town, and entered on market-day. He here finds a closely-packed and busy crowd blocking the streets with their numbers; and extricating himself from their midst he goes his way, impressed with the density and activity of the population. But if he halt here, he will find the illusion dispelled. The morrow, instead of a struggling jostling crowd, will show him lonesome streets, with long rows of silent forges, empty cook-shops, deserted grocers' stalls, and the tenantless sheds of the shoemaker, hatter, and draper, and if he inquires, he will learn that the multitude of yesterday is dispersed far and wide, over this and the adjoining settlements, till next week's market-day brings them together again."

The Russians seem to have come to the conclusion that the population of Central Asia within their boundary line, as it extends at the present day, may be put at 2½ millions, and I think we shall not be very far from the mark if we assume that from 2,500,000 to 3,000,000 represent the number of inhabitants of the other independent States in Central Asia, exclusive of Afghanistan, the population of which is variously estimated at from four to five millions.

We will now consider the state of Bokhara.

During the nineteenth century and up to 1870, four missions had been sent to Bokhara, the first in 1819-20, under Negri and Meyendorf, the second in 1841, under Butenef, Lehmann, and Khanikoff, the third in 1859, under Ignatieff, and the fourth in 1865-66, under Struvé and Glukhowski. All these missions were more or less unsuccessful. But a more successful one was sent in 1870, under Captain Kostenko, and from him we gain much valuable information. According to him, the city of Bokhara has a radius of about seven miles, and is about two miles in cross section. It is surrounded by a clay wall 24½ feet in height, crenellated as usual, and flanked with bastions. There are eleven gates. While enjoying the reputation of being the capital of all Central Asia, and the centre of Mohammedanism, Bokhara is not remarkable for either splendour or cleanliness. Similar to all Central Asiatic towns, it is filthy and ugly; like in all others, the streets are tortuous and narrow, lined with large cobble stones, the blind sombre-coloured houses added to the gloomy effect by being disposed in no kind of order whatever. Bokhara differs in only one respect from the Central Asiatic towns, and that is in the form of construction of the habitations, a great many of which in the city have two stories. Moreover, these are not so far apart, and there are in Bokhara very few of those gardens which constitute the only pleasurable, or, so to say, charming features in other cities of Central Asia, such as Tashkend, Khojand, and Samarcand.

There are, it is said, 15,000 houses in Bokhara, which, multiplied by five as an average number of residents in each house, gives a result of 75,000 as the population of the city. This is said to be the population also of Tashkend.

There are said to be 365 musjids, and 140 schools or madrassahs. These latter are filled with students, flocking not only from all parts of Asia, Persia, Afghanistan, India, but also from the Volga, pioneers of Russia. Having absorbed all the Mohammedan learning that is to be acquired—and it is to be obtained from study and interpretation of the Koran alone—these scholars return to their places of residence and become mollahs. In this manner Bokhara fills among Mohammedans the *rôle* of Rome in the Catholic world.

Numerous as the spiritual class is in Bokhara, that of the trading community is larger still. Bokharians are essentially traders.

Occupying a position from which diverge all the caravan roads connecting the eastern and southern parts of Asia with Europe, Bokhara has long constituted herself the emporium of trade, and her merchants penetrate much further than her mollahs. Indeed, the Bokhara traders must in every respect be allowed the precedence of the men of learning. The latter spread about the deadening principles of the formularies of Islam, of perverseness, and fanaticism; whereas the latter, exchanging the products of the various countries, are sure to promote the union of different races; and to give them their due, they perform their part with great ability.

Bokhara is famous for its bazaars, which are, in some parts, of a solid stone wall, but the shops in these bazaars are of miniature dimensions. These are occupied by retail dealers, who obtain their merchandise on credit from the wholesale merchants whose warehouses are in the fifty caravanserais said to be in Bokhara. Each nationality has its own caravanserai. Their Russian merchants deposit their goods in the Alam Serai, which can hold 1,500 camels. Russian Tartars (clerks or agents) are housed in the Usgar Serai, arranged for the accommodation of 2,000 camels. The Afghans have a separate serai, and so forth. A retail sale is carried on in these serais, and there is a duty levied of two and a half per cent. from Mussulmans, and five per cent. from non-Mussulmans. Innumerable taxes are exacted from the people. They pay in Khiraj one-third of the product of their lands, whereas, according to the Sheryat, or law, they are required to pay only one-fifth. Besides this, new taxes, unheard of before, have been laid on.

Bokhara is said, by Captain Kostenko, to incline towards Russia in matters of economy and trade. In the bazaars Russian merchandise may be seen at every step. In the tea house, Russian samovars, teapots, trays, cups, &c., are to be found in use; in every true believer's house will be observed many of the articles of primary necessity in a household, which have been brought from Russia, such as crockery, wooden boxes, locks, doors, hinges. Every Mussulman of the most slender means is robed in a khilat made of Russian cotton chintz, and his feet are cased in boots of Russian leather. The agriculturist ploughs his land with Russian iron, and the soldier is armed with a flint gun of Tula manufacture. Captain Kostenko says that so great is Bokhara's dependence on Russia, notwithstanding the great distance which separates it from Moscow and Nijni-Novgorod, that her people could hardly continue their existence for a year if all their relations with the empire ceased for so long a period. These relations, existing from of old, have taken root so deeply, and Moscow has to so great an extent adapted herself to her distant neighbour, that Russian merchandise fetches a lower price in Bokhara markets than in Moscow itself. For instance, sugar sells in Bokhara at 8 rupees per pood; stearine candles at 11 rupees per pood; cotton prints at from 4 rupees to 9 rupees the piece of 40 and 50 arshines.* This is owing to the quality of the goods and to the nature of the trade.

Russian goods destined for Bokhara are prepared in a special manner; the manufacturer studying the tastes and requirements of the Asiatic. For this reason, the sugar exported to

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* A pood is 36 lbs. One arshine = 28 inches.

Asia is generally unrefined, and invariably in small heads weighing about 5 lbs., the fact being borne in mind that the Asiatics are fond of giving presents. The cotton prints are of glaring colours and of bright patterns; the boxes are necessarily painted and bound with iron, and provided with sounding or musical locks. The trade with Bokhara is, moreover, a barter trade; the Bokharians bring to Russia their raw produce, such as cotton, silk, madder, zedoary seed, rhubarb, &c.; these they exchange for Russian manufactures, which they take back with them to Bokhara, where they endeavour to convert them into money. Asiatic traders do not aim at large profits, as the Russians do, because they are satisfied in the possession of the strictest necessaries, having no idea of the comforts, and still less of the luxuries of life.

Agriculture in Bokhara is in entire dependence on Samarcand, because the upper course of the Zarafshan, which supplies the fields and gardens of Bokhara with irrigation, passes through the Russian dominions. In the spring-time, when there is very little water in the Zarafshan, it is most wanted for irrigation purposes, and all that comes down at that period is intercepted and turned into the aryks in the Samarcand and Katty-Kurgan districts. Bokhara receives a supply only on application from the Government of the Khanat, when the Russian authorities order the inhabitants of the Russian districts to close their aryks, so as to allow the water to flow into the Bokhara territories. Bokhara thus owes her bread to the good-will of the Russian Government. Of all the agricultural products of Bokhara, cotton constitutes at one and the same time the wealth and pride of the Khanat.

Captain Kostenko says that:—

"Bokhara cotton is decidedly superior to that of Khokand and Tashkend, and it is even preferred to the Khiva cotton, being finer and whiter, although its staple is not of the length of that of the Khiva cotton.

"Year by year there is more cotton grown in Bokhara to meet the increasing demand for it in Russia. Silk is another item of importance to Bokhara.

"Although this branch of industry has not been so widely developed as the cultivation of cotton, we may safely predict a brilliant prospect for the occupation of rearing silkworms. The manufacturing industry of Bokhara may be said to be still in its infancy, and yet it is in a somewhat more advanced state than that of the neighbouring independent Khanats.

"Industrial pursuits in Bokhara do not progress, on account of the want of technical knowledge, the acquisition of which is discouraged by the law, for it is held that all knowledge is sinful but that which is to be derived from the Koran."

Although Captain Kostenko exults in the thought that, notwithstanding all the efforts of the English to push their manufactures into Bokhara, and, as he says, to suppress the Russian trade, Russian goods are yet disposed of there in far greater quantities, still he is a very important witness on the side of the English, as the following extract from his report shows:—

"The principal articles of English manufacture brought to Bokhara:

"1. Muslin, which, being of a better quality and cheaper than Russian muslin, puts the latter completely out of the market.

"2. Tea of various sorts from the Northern Provinces of India.

"3. Calico, which, though somewhat dearer, is of a quality superior to the Russian.

"4. Stamped muslin, with a flower pattern. In this article the English have not suited the Asiastic taste, so that the muslin does not find a good sale.

"5. Fustian, something like Russian fustian.

"6. Brocaded cloth, used for khilats, turbans, sashes, and state dresses. This is an article of the greatest luxury."

The fact is, however, that whatever efforts may have been made to open the market in the direction of Kashgar, no such efforts, till most recently, have been made to push the trade through Afghanistan, simply because the Amir Sher Ali has been either unable or unwilling to listen to the advice given him by the late Lord Mayo, and succeeding Viceroys.

To a certain extent there has been a slight improvement in the matter of safety to caravans from open plundering, but in the way of petty exactions and vexatious interference, the merchants are not much better off than they were years ago. So that any increase that can be shown in the trade with Afghanistan, and through that country with the States beyond it, will be all the more satisfactory, and will show what might be realised if proper trading principles could be recognised and enforced by the ruler in Kabul.

To make this paper anything like complete, we ought to investigate the state of the trade between the Mediterranean and Central Asia; but I have failed to get any reliable data. When I was at Constantinople in 1869, our ambassador regretted, in conversation with me, the supineness of the Turks to their own interests in allowing the trade from the Black Sea eastward to fall into Russian hands. I learn from Mr. Long that "the trade of England through Trebizond and Erzeroum to Persia is now taking the Tiflis route, as the Turks refused to make a good road between Trebizond and Erzeroum, while the Russians afford every facility and protection on the Tiflis line. Tabriz is on the line of projected railway, a most important place, giving access to a populous country. Manchester goods and clothes, to the value of one million sterling, are imported into it, and are exported from thence to Central Persia, Khorassan, the shores of the Caspian, and even to Khiva."

The publication of Mr. Schuyler's valuable work on Turkestan at the present time fortunately enables us to draw a very correct comparison between the trade carried on by Russia, and that by India, with Central Asia.

According to Schuyler, the trade between Russia and the the Syr Darya district, and that between Khiva and the Caspian Sea, as well as that between Kashgar and Vernoe, amounted in 1872 to a total of about £2,000,000, or 15,000,000 roubles; but in 1867 the total trade amounted to 19,000,000 roubles, or £2,650,000.

I give the following extract verbatim:—

"It would seem that the trade with Central Asia has diminished rather than increased since the year 1867, unless the figures for that year were exaggerated. The trade of Bokhara, through Kazala, was, in the year from September, 1868, to September, 1869, 4,193,000 roubles imports, and 1,793,000 roubles exports; and through Tashkend, in 1872, 8,643 roubles imports, and 14,000 roubles exports. The trade of 1869 was, therefore, much larger than usual, as can be seen from the amount of zekat received, which, in 1869, was 114,000 roubles;

in 1870, 36,000 roubles; in 1871, 33,000 roubles; in 1872, 24,000 roubles. The probable trade with Kazala, therefore, in 1872, was not more than one-third of what it was in 1869; but counting it at one-half, we would have the total trade with Bokhara in 1872, inclusive of both exports and imports, as not more than 3,000,000 roubles. In 1869, the total trade with Bokhara was more than 11,000,000 roubles. We cannot ascribe this falling off in the trade to the separation of the Zarafshan district from Bokhara, for we find that the whole trade of the Zarafshan district, as represented at Samarcand for 1872, was only 2,000,000 roubles. It is, of course, possible that the data from which these statistics are made are not full, and it is possible that the disturbance in the Kirghiz steppes, and the crisis in the cotton trade, had considerable influence on the commerce with Bokhara, but in any event, the result is not favourable.

"For the trade of Khokand the statistics are tolerably full, and we find that in 1872, the imports from that country amounted to 2,189,836 roubles, and the exports to 1,273,520 roubles. The chief articles of import from Khokand are cotton and silk, and in much smaller quantities fresh and dried fruit, coarse native half-silk and half-cotton materials, and native clothes. The exports are chiefly Russian prints, cotton yarn, cloth, and Russian shawls and handkerchiefs, which are used as girdles.

"The chief statistics for the present trade with Khiva are those taken in Kazala. From September, 1868, to September, 1869, the exports from Russia to Khiva were 112,045 roubles, and the imports from Khiva 294,887 roubles. The exports to Khiva that year were entirely confined to the winter months from January to April. Most of the Khivan trade passed through Kazala, although a small portion of it goes through the Caspian steppes. As to the special articles of import, those of the greatest importance are cotton and silk; cotton having been imported across the Orenburg and Siberian customs line, in 1863, to the amount of 2,933,248 roubles; and in 1864, to the amount of 6,583,229 roubles; in 1865, 3,394,267 roubles; in 1866, 4,326,145 roubles; in 1867, 5,513,422 roubles; all of course coming from Tashkend, Khokand, Bokkara, and Khiva. In 1872 there was imported from Khokand, in transit through Tashkend, cotton to the amount of 208,568 roubles. From Tashkend there was sent to other parts of Russia, as well as to other towns of the Turkestan district, 1,953,860 roubles' worth. In 1872, from Tashkend, the district of Kurama, and from Samarcand there was only 785,089 roubles' worth exported. In 1869 the cotton imported from Kazala amounted to 1,943,860 roubles, and from Khiva 60,002 roubles. If we take the highest figures of the export from Tashkend, the total amount of cotton imported in Russia during 1872 would come to only 3,606,356 roubles (£500,000), a considerable falling off from former years.

"The silk trade, which began to increase after the occupation of the country by the Russians, makes rather a better show. In 1867 it amounted to 75,643 roubles; 1869 to 1,181,967 roubles. In 1872 there was exported in transit through Tashkend, silk to the amount of 200,360 roubles. In 1871 there was transported from Tashkend to Russia, 471,188 roubles' worth. In 1872 from Tashkend, Hodjent, and Kazala, it amounted to 762,468 roubles. The import of silk from Kazala in 186 came to 1,095,667 roubles; from Khiva 86,300 roubles. Should we take the highest figure, which would be unfair, as the import of silk from Bokhara in 1872 was by no means equal to that in 1869, we should have the total of the silk trade, 2,134,795 roubles (£300,000).

"Fully one-half of the silk sent to Russia comes from Bokhara, and nearly all the other half from Khokand, but a very slight quantity coming from the Russian provinces. Thus in 1871, there was brought to Tashkend from Khokand, 929,537 roubles' worth; from the cities of the Syr Darya, a province, only 70,523 roubles' worth. The trade in horsehair, which in 1872 amounted to only 10,131 roubles, could probably be easily increased.

"The chief articles sent from Russia to Central Asia are prints and cotton goods. Of these there were sent in 1869, from Russia to Tashkend, 3,857,207 roubles' worth; to Bokhara, 2,810,060 roubles' worth; and to Khiva, 284,522 roubles' worth; the total amounting to 6,951,789 roubles (£952,000). Of such goods there were sent to Tashkend in 1872, 4,470,723 roubles' worth; to Bokhara, 1872, 1,054,717 roubles' worth, to Khokand in 1869, 240,630 roubles' worth; to Khiva, 1869, 55,829 roubles' worth; the total being 5,821,902 roubles (£800,000). These figures will also show a falling off in the Central Asiatic trade although the market is reserved almost exclusively to the Russians, very few English goods getting further than Bokhara. Tea is also sent in large quantities, the amount imported into Turkestan in 1872 being 1,048,508 roubles, of which but a very small quantity (about 100,000 roubles) came from China, through Siberia, the rest being sent from Moscow. During the last half of 1868, the whole of 1869, and the first half of 1870, there were 635,273 lbs. of tea imported. Of this 174,772 lbs. were sent to Khokand, while 18,533 lbs. were brought back from that country, not being saleable. In 1871, 141,597 lbs. were sent to Khokand, and in 1872, only 21,970 roubles' worth. In general the tea trade with the Khanats is not flourishing, as green tea in very large quantities is imported from India by way of Bokhara. Its passage through Turkestan is prohibited, but nevertheless most of that used in Khokand passes through Russian territory, close to Samarcand, by what is called the 'robber's road.' Much also is smuggled for sale in the country. For instance, in the Zarafshan district, no one buys Russian tea except the Russians, and in 1872 but 11,900 lbs. of tea were imported from Bokhara through the Custom House (the prohibition not being then applied to its region), which for over 200,000 inhabitants, is less than half a pound a year each. Now tea is universally drunk, and the consumption of each man is much nearer half a pound a month. Fully 500,000 lbs. of tea must have been smuggled. The import of sugar in 1872 was only 171,700 roubles."

From Mr. Schuyler's report to the American Government, written in 1874, I take the following outspoken opinion:—

"Russian trade in Turkestan is falling off rather than increasing during the last eight years. The population of Central Asia is not large, its wants are few; very little can be exported there with advantage except prints, cotton goods, clothes, and tea. The only goods imported from Central Asia are cotton very bad in quality, silk, and a few sheepskins. The communications are so bad as to render trading very difficult. For industry and commerce, the Russian administration has done comparatively little. Commercial treaties have been made, but slight pains have as yet been taken to ensure the enforcements of their stipulations. Foreign commerce has not greatly increased. Various projects have been proposed for starting factories for cotton spinning and the fabrication of silk, and the Government in some cases has lent material assistance to these and other projects, but with the exception of a silk spinning establishment at Khodjend belonging to a Moscow company, nothing now exists. The bazaar of Bokhara is the trade centre of the whole of Central Asia, and unless Russian commerce is subject to few restrictions and make greater efforts, it will be entirely crowded out of Bokhara by the English, for even now large quantities of English wares are imported there by way of Afghanistan."

This is a very important piece of evidence, and will be dwelt on hereafter, but, meanwhile, I wish to pass on to the trade with Kashgar.

According to Russian authorities, this country was open to Russian traders up to the year 1755; but when its conquest was effected by the Chinese, it was closed to them on the ground that they had permission to trade with China at Kiachkta and Tsuru Khatai. Notwithstanding this exclusion of the Russians from the then Chinese province, Russian merchandise continued to find its way into it through the Khanats of Central Asia, and more especially through Khokand, whose political relations with the Chinese offered opportunites for the introduction of Russian goods into this country. Those relations originated with the expulsion of the Khojas from the Province, and from the fact that they had sought refuge in Khokand. The Chinese Government paid the Khan of Khokand an annual subsidy, under an arrangement that the exiled Khojas should not be allowed to pass into Kashgar. Hence frequent missions were sent back by the Chinese Viceroy to Khokand and *vice versá*, where Russian merchandise found easy admittance. But it was not till 1868, or four years after the outbreak of the Mohammedan rebellion, and the expulsion of the Chinese from Eastern Turkestan, that Russian merchants ventured to send caravans to Kashgar, and from that time till 1875 the returns were as follows:—

1868-69	£37,628
1870	30,618
1871	82,837
1872	150,685
1874	97,000
1875	80,000

Let us now see how trade between Kashgar and India has prospered.

Up to the time of the expulsion of the Chinese from Eastern Turkostan, the markets of Yarkund and other towns across the Himalayas had been hermetically scaled to Indian traders, only a few more daring spirits, tempted by enormous profits, risked their property and lives to smuggle opium into the country. The trade was kept in the hands of a few officials or favoured merchants at Leh, in Ladakh, and outside adventurers were fleeced and ruined by the exactions of the Kashmir officials. The consequence was that the total trade returns of Ladakh did not show more than £10,000 in a year.

It is unnecessary now to detail all the efforts made to open out the trade with Kashgar. It is sufficient to note that the Maharajah of Kashmir has abolished all tolls, exactions, and hindrances of any kind to trade in transit, and that by a commercial treaty, concluded with the Amir of Kashgar, goods are admitted into the markets of his country, at an uniform *ad volorem* duty of 2½ per cent. There appears to have been some very material error in the method of compiling the statistics of the trade, but, from the reports published by the Lieutenant-Governor of the Punjab, I gather that, in 1873, the value of the trade through Leh was £95,000, and that in 1874 it was £125,000. In 1875 this is reduced to £45,000, though apparently, and for some reason which I cannot make out, a consignment of goods sent by an English trading company, and valued at from two to three lakhs of rupees, or say £20,000 in Yarkund, has been omitted from the calculations. I will quote the words of the official report:—"The increase in the value of the trade in 1874 over 1873 was great, amounting to four lakhs of rupees, of these four lakhs of rupees, however, 3.10.000 rupees represent the estimated value of the caravan of the Central Asian Company, conducted by Mr. Russell. Excluding the value of the caravan, which may be considered an abnormal addition to the ordinary traffic, the increase is reduced to less than a lakh of rupees, a satisfactory but by no means startling amount." In the report for 1875 the Financial Commissioner writes as follows:—

> "One of the events of the year has been the venture of the Central Asian Trading Company in a consignment of goods conveyed to Yarkund in charge of the manager, Mr. T. Russell, *viâ* Kuloo, Leh, and the Chang Chemno Valley. The consignment is valued at £8,714 in England, and about two lakhs of rupees in Yarkund. The journey was accomplished without any further misfortune than the loss of some of the baggage mules, and Mr. Russell displayed great courage and power of dealing with the native mule-drivers with whom he had to arrange for the carriage of goods, and the results of the undertaking are valuable as showing the extent to which the trade can be pushed, and the limits within which operations must be confined. Mr. Russell had intended selling the goods for cash only, but this could not be done, owing to the lack of capital and the custom of barter which prevails in Yarkund. The consignment was therefore largely exchanged for silk, pushm or shawl wool, and other saleable articles, which are said to have given a good return to the shareholders of the company. Mr. Russell notices the exaction at Yarkund of duty in excess of 2½ per cent., which under the terms of treaty with the Amir is leviable upon goods introduced from Hindostan. The general conclusion at which the Financial Commissioner arrived is, there is no opening for direct trade with Yarkund on the scale attempted in this expedition. The trade is in the hands of the Amir; the merchants appear to be creatures of his own, or so entirely under his influence, that unless he allows them to buy and sell they cannot trade.
>
> "Of the various plans proposed by Mr. Russell for future operations the most feasible appears to be that of establishing a depôt at Leh, but the demand for English goods is evidently small, and in fact, payment having to be received by barter, limits the transactions considerably."

The plain truth is just what I pointed out in 1874, before the Central Asian Trading Company made their venture, the country lately opened to trade is not sufficiently populated, and the habits of the people are too simple to support a very large commerce, and the danger to guard against is, overloading the market with imported goods. Just at present there appears to be a glut in the market, and I take this opportunity of reiterating an opinion I have frequently expressed that there is not room in Eastern Turkestan for English merchants who are accustomed to do business on an enormous scale. For the petty traders of India who invest £5,000 or £6,000 at a time in a venture, the prospects of trade with Yarkund are likely to be very good. The character of these investments is a matter for careful consideration, and the habits and wants of the people should be attentively studied. I can scarcely repress a smile when I read, in the official report published in the Indian Government *Gazette*, that the Central Asian Trading Company sent a consignment of silk stockings to the Yarkund market? It is quite true that good Balbriggan hose may be disposed of there, for I have seen most excellent coloured woollen stockings manufactured in Yarkund. But silk stockings, however much adapted to the taste of the Japanese, who have taken to wearing evening suits of clothes *à l'Anglaise* in the daytime, would be somewhat incongruous with an Oosbeg's garments. Another instance of ill-judged investment was a consignment of imitation furs at £20 apiece. As the officer who mentions this in his report says:—

> "Considering that an embroidered portion of a Russian fur (genuine of course) can be bought for this sum in Yarkund, the merchant will be very fortunate if he succeeds in persuading anybody to take his imitation robes at that price."

From an Indian newspaper received by this week's mail, I take the following extract from a Lahore correspondent, who, after commenting on the fact that the trade with Yarkund last year had risen to £120,000, says:—

> "Mr. Russell, of the Central Asian Trading Company, is here with some four hundred horse-loads of produce—haschish, wool from Turfan, silk from Kashgar, Astrakhan lambskins, silk fabrics from Andijan, Khoten, and Bokhara, and carpets from Khoten. The carpets are made in the old-fashioned domestic way—the only way in which anything worth having of colour and texture can be produced, and are infinitely better than most Kidderminster productions. The ordinary Persian pattern jail carpets look faded and washed out by the side of these solid and richly-coloured fabrics, which are yet exceedingly quiet in tone, perfectly flat and conventional in treatment, and untouched by aniline dyes. They are not so elaborate and rich as some Persian and Turkish carpets, and there are decidedly Chinese details here and there. Our bright British carpets make most Indian furniture look seedy and dingy. These new Khoten carpets produce the opposite effect. It is plain that in Eastern Turkestan and the countries to which the Company trades, there are several things very well worth having."

For illustrations of the primitive wants of the people in Central Asia I may refer to the collections at the India Museum. I may also mention that there is in that museum a collection of textiles purchased in the bazaar at Shikarpore before the annexation of Sindh, proving that in those days textiles of Russian manufacture penetrated as far as India. If we but had an Indian Museum, like the one the erection of which on the Victoria embankment, at the joint expense of England and of India, is now being so warmly advocated by the Chambers of Commerce in this country, such collections, it might be hoped, would receive the attention they deserve, and would be turned to good account in supplying useful hints to our manufacturers and exporters.

Now let us see how trade between India and Central Asia generally has fared during the last ten years.

In a report on the trade and resources of the countries on the north-western boundary of British India, compiled in 1864, Sir H. (then Mr.) Davies gave the estimates in the next column of the value of the trade between India and the countries beyond the mountain frontier of the Punjab.

At the same time Mr. Davies gave the following statistics of the trade with Kurrachee. Between the years 1855-56 and 1859-60, the imports increased in value from £629,813 to £1,712,751, and the exports from £604,440 to £947,938; the customs duties from £8,908 to £52,492. The returns for 1861-62 showed an increase in exports to £1,361,724, whilst the imports decreased.

—		Imports into British India.	Exports from British India.	Total.
		£	£	£
From Afghanistan and the countries beyond.	By the Tater and Abkhana Passes.	516,513	120,643	277,157
	By the Ghawailra and Golera Pass	130,000	164,000	294,000
	By the Bolan Pass.	31,870	18,892	50,762
Jamu and Kashmir		199,950	184,900	384,850
Ladak and Yarkund		9,170	14,434	23,604
Total		527,503	502,869	1,030,372

Among the exports the following were brought down chiefly through the Belooch and Afghan mountains:—

	Value.
Madder	£12,228
Assafœtida	2,296
Raw silk	17,975
Sheep's wool	315,104
Horses	92,651
Fruit	14,914

Taking the Punjab trade report for 1874-75, or ten years after, we get the following figures of trades between the Punjab and foreign countries:—Imports to India, £1,157,446; exports from India, £1,001,510. Total, £2,158,956.

That is to say, in one decade the trade with Asia from India, or rather from the Punjab, has just doubled in amount. Of this trade, that with Kabul has risen from £621,818 to £1,211,535; whilst that with Kashmir, and the countries beyond, has increased from £408,454 to £947,417.

I have great difficulty in getting at statistics of the Kurrachee trade in a form suitable for comparison with former years. But, from various official documents, I glean the following facts:

The total imports to Kurrachee in 1873-74 were £1,481,765, against £1,712,751 in 1859-60; and total exports were £2,025,919, against £947,334; or, a total of £3,507,684, against £2,660,086.

Amongst the articles imported from Kandahar and Kelat, *viâ* Kelat and Bela, wool has increased slightly, but in every other item there appears to have been a great falling off. This, I imagine, must be owing to the disturbed state of affairs across the border till lately; but, now that we have come to terms with the Khan of Kelat, and have secured both sides of the Bolan Pass, there is every reason to expect a great impetus to trade. In the Shikarpore returns, I find imports from Bokhara put down for 1873 at £10,000, and for 1874 at £8,000. As you are probably aware, the Shikarpore merchants are renowned for their enterprise; they are to be found in the bazaars of Bokhara, Tashkend, and some have penetrated as far as Moscow and St. Petersburg.

The statistics of trade between the Sindh frontier and Central Asia are not to be found in any detail sufficient for our purposes; but, in estimating the progress of the trade generally of late years, and the prospects for the future, the recent arrangements entered into between the Viceroy of India and the Khan of Khelat, whereby the passage of the famous Bolan Pass is to be rendered secure from robber raids, are matter for consideration, and also for congratulation. I will not attempt to pourtray the difficulties of the trade in former times, but would refer you to the highly graphic account given in the statement exhibiting the moral and material progress of India for the years 1872-1873. You will there read how the Povindahs, the great carrying merchants between India and Central Asia, have for ages struggled manfully, and on the whole successfully, to maintain a profitable commerce, in spite of the exorbitant demands of the governments, the exactions of the officials and petty chiefs at every stage of the road, the internecine feuds between their own tribes, and the black mail of the various tribes through which they had to pass. Writing in 1873, the able compiler of the statement to which I now refer remarked that if the route were made safe, and the duties in Afghanistan were fixed at a moderate *ad valorem* rate, the Povindah merchants might make four trips in the year instead of one, because they could proceed independently instead of being obliged to proceed in strong caravans, and the value of the trade would assume much larger proportions. In 1872-73 their trade by the Gomul Pass was estimated at £60,000, and in 1874-75, it was reported that the trade between Khorassan and British territory, *viâ* the Saughur, Sori, and Sakhi Surwar Passes, had risen during the past few years from nothing to £35,000. The Punjab Trade Report for 1875-76 gives more accurate details of the trade with Sewestan, and we may reasonably look for a considerable increase in future years, as the pacific and protective influence of the British Government begins to be felt on both sides of the Bolan Pass. Kerman wool is one of the most important imports by the routes across the Suleiman range. A good deal of this goes to Umritsar, and is worked up into shawls, which of course cannot compete with the Kashmir article in fineness of texture, but being cheaper is more in demand. The export from India of wool is steadily increasing, and chiefly from Sindh and Bombay, a large proportion coming from across the frontier. According to the latest returns, wool to the value of £959,901 was exported last year, as against £465,238 in 1869-70. The bulk of this goes to the United Kingdom, which took 21,365,326 lbs. France took 178,854 lbs., and the Mediterranean ports took 46,592 lbs.

Taking the trade with Kabul, we have the following figures:—

Imports to India.	Value.
Churrus	£35,770
Other drugs	14,387
Dyes other than indigo	46,353
Fruits	83,848
Silk	185,511
Furs	18,275
Wood	56,943
Sundries, making a total of	£525,362

Exports from India.	Value.
Cotton cloths, Indian	£210,762
Ditto, European	98,077
Tea	146,353
Indigo	63,609
Leather	20,517
Salt	11,797
Other sundries, making a total of	£610,879

Taking the trade with Kashmir and the countries beyond, we have the following chief imports and exports:—

Imports.	Value.
Silk (Kashmir)	£21,607
,, (Yarkund)	834
Churrus (Yarkund)	1,912
Fruits (Kashmir)	11,898
Pashmena	233,021
Pashm (Yarkund)	1,225
,, (Thibet)	2,570
Woollen goods	37,328

Exports.	Value.
Cotton cloths, Indian, to Kashmir	£20,850
Ditto, ditto, to Yarkund	29
Cotton cloths, European, to Kashmir	80,662
Ditto, ditto, to Ladakh	9,982
Ditto, ditto, to Yarkund	1,886
Salt, to Kashmir	50,717
Tea, ,,	14,323
Ditto, Ladakh	944
Ditto, Yarkund	3,756
Sugar, refined, to Kashmir	17,967
,, ,, to Ladakh	248
,, ,, to Yarkund	215

The classification just above given of goods destined for Kashmir, or Ladakh, or Yarkund separately, is somewhat deceptive, as a large portion of the exports to Ladakh, and a good deal of those to Kashmir, found their way on to Yarkund.

Taking different items in detail we are informed by the last Punjab report that the import of churrus* into India is on the decline, both from Yarkund and Kabul. Wool is principally imported from Kabul and other countries on the west frontier. Raw silk is also on the decrease, and the Deputy Commissioner of Umritsur states that no silk was imported from Bokhara into that city last year. Tea to the value of £146,353 was exported to Kabul, and the great bulk of this, of course, finds its way to Bokhara. This is an article which fluctuates greatly according to the temper of the Russian authorities at Tashkend. In 1873 there was a tendency to throw as much green tea as could be made in the Kangra and Dehra Doon Valleys into the Central Asian market. But next year a prohibitory order was passed, and the losses of the Punjab traders were very heavy. The trade has taken another start it appears, but as at any moment the Russian authorities at Tashkend may issue their prohibition, in spite of all professions and promises to the contrary, this branch of commerce cannot be looked upon as yielding a steady and satisfactory increase.

In the export of European cotton cloth there has evidently been a large increase, for whereas in 1872-73, when the largest imports yet recorded were made, the total was 65,587 maunds, during the last year 341,474 maunds were imported, of which 61,711 maunds were re-exported, and of these again 20,000 maunds,† valued at £190,000, went to Kabul, Kashmir, and the countries beyond.

In estimating the prospects of trade with Central Asia, we have to take into consideration the probable increase of population, cost of transit, and facilitates of transport, and last, but not least, the political relations of Russia. Hitherto, and till within a very recent period, the heart of Asia has been for centuries the scene of rapine, war, and devastation, and not only were men's minds too occupied with the struggle for existence to devote their time or thoughts to amassing wealth by peaceful pursuits, but their lives were perpetually jeopardised, and frequently sacrificed in the internecine quarrels and party feuds which destroyed the humblest houses as well as the most powerful dynasties. In the turmoil of insurrection, and in the long and bloody wars which have been waged throughout the Khanats of Asia for centuries, there was little opportunity for families to increase and multiply. In this respect, if in no other, the advance of Russia on one side, and England on the other, must have a beneficial effect by establishing a more peaceful state of things. When we were travelling through the territory of the Amir of Kashgar we remarked on the very large number of young children. Peace has reigned throughout his dominions—except on the extreme Chinese frontier —for some years, and the speedy result of this is observable in the growing homes of the peasantry. As peace spreads through the land we shall see cultivation extend, habitations spring up, and communities flourish. The ruins of ancient cities and towns, which were seen on the march of the Seistan Boundary Commissioners, attest the fact of former civilisation, and throughout Central Asia there are traces of life and activity which may yet be restored under the blessings of good government.

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* Churrus is the juice of the hemp, more familiarly known as hashish.

† One maund=80lb.

It is a fact worthy of note and consideration, that the whole trade between Russia on one side and India on the other with Central Asia, which reaches a total of four millions sterling yearly, is transported on the backs of camels or ponies, and there are difficulties to be met with, such as broad deserts and high mountains, which must necessarily act as a severe check to a steady flow of commerce, and the heavy cost of carriage acts as a further drag on the increase of trade. According to Schuyler, the chief trade route to Bokhara is from Orenburg through Kazala, either directly across the steppe or by way of Orsk, from 1,060 miles to 1,160 miles in length, requiring about 47 days. According to him the freight costs about 21 roubles, or £3 per camel, and a camel's load may be assumed to be 432 lb., making the total cost of 36 lb., or pood of goods, from Moscow to Bokhara 7s. 1d., or 2⅓ per lb.

From Bokhara to Balkh, by way of Karshi, is a distance of 300 miles, or 13 days. To Kabul is 350 miles more, needing another 13, or I should say more, days, as the Bamian Pass has to be crossed. The direct route through Khulm is shorter, being 20 days from Bokhara to Kabul. From Kabul to Peshawur the journey is performed in 12 days, and a camel's load costs from 30s. to 40s. carriage. From Bokhara to Peshawur a camel's load costs £4 14s. 7d. in carriage alone, which is the same as from Moscow to Bokhara.

This is Mr. Schuyler's calculation, and he tells us that freights have risen of late years. But M. Glukhowski, who is a great Russian authority on Central Asian trade matters, gives much higher rates. He made the cost in 1869 of transport from Moscow to Bokhara from 3½ roubles to 5 roubles per pood, or very nearly double the rate given by Schuyler. What the cost may be between Shikarpore and Bokhara, I have been unable to find out, but it must be borne in mind that all trade which passes through any part of Afghanistan is subjected to very heavy tolls and unauthorised exactions, and it is a fact well worthy of note, that in spite of all the obstacles, and they are formidable, and as yet have not been attempted to be removed by our Government, with the exception of very recent arrangements for securing the Bolan Pass, trade between India and the countries west of Kashgar has doubled within the last ten years, whereas with all the professedly strenuous efforts of the Russians, trade from that side has actually declined.

In the direction of Kashmir and Kashgar, without question, the efforts of Government have been exerted, and, as I shall be able to show, with markedly favourable results. Mr. Davies' report dwelt largely on the hindrances to trade through the Kashmir territory. He then pointed out that the insecurity of the road between Ladakh and Yarkund was the principal cause of the decline to zero of the trade between those two countries, but a scarcely less potent cause was the outrageous exactions of the Maharajah's officials in Le. Even the ordinary custom dues at Le were far too heavy, and, as Mr. Davies remarked, the Kashmir import duties levied on the confines of the Punjab were so excessive as to be almost prohibitory, the duty on English longcloth and broadcloth being 30 per cent., and sugar 85 to 150 per cent.

Since this report was written great changes have taken place. Not only have all illegal exactions been swept away, but all transit duties through Kashmir have been abolished, and import duties have been reduced to a minimum. The cost of carriage, as well as the difficulty of procuring it, interfered greatly with trade. But in this respect the strenuous exertions of the officials both of the British and of the Maharajah's Government have had most beneficial results. The physical difficulties of a road which traverses eleven passes varying from 11,000 ft. to 19,000 ft. high, must always remain great; but so far as human ingenuity and a liberal expenditure of money can effect improvement, a steady progress is made year by year by the officials of the Kashmir Government, and as is well known a comparatively easy and smooth road to Yarkund can be opened through Gilghit and over the Pamir so soon as certain political difficulties, on which I need not enlarge now, are smoothed over.

The Russians have not been backward in their endeavours to improve the communication from their side, and various plans have been suggested. The navigation of the Syr Darya was attempted, but was found to be impracticable. In the Khivan trade an effort was made to run steamers through the Aral Sea and up the Amu Darya, and in 1874 a steamer did with the greatest difficulty, and by a roundabout route, get as far as Nukus. Mr. Schuyler tells us that explorations have been made of the old bed of the Oxus, partly with a purely scientific aim, and partly to investigate the possibility of turning the waters of the river once more into its old channels. It has been found that a well-defined bed exists in what is called the Uzboi, debouching in the Caspian near Kradsnovodsk, and it is believed that if the dams on the Laudan were removed, the water would flow along the old beds for some distance, at least as far as Sary Kamysh; but there seems to be this difficulty in all the schemes for the improvement of navigation in Central Asia, that the amount of water in the rivers is not so great as formerly, owing no doubt to the destruction of forests on the mountains on their upper course. In order to have sufficient water for navigation it would seem necessary to destroy the irrigation system, a suicidal policy, as Mr. Schuyler points out.

Mr. Schuyler tells us a good deal about the scheme for a grand Central Asiatic railway, which was brought out by M. de Lesseps. This railway it is proposed to make from Orenburg to Tashkend, and from Tashkend to Khokand and Kashgar, and thence over the Karakorum to Ladakh, and so down to the Punjab. I may mention that, on my return from Kashgar in 1874, I met M. Ferdinand Lesseps at Srinugger in Kashmir, and had the benefit of hearing his views on the subject. When I suggested that before committing himself to an opinion, it would be advisable for him to see something of the country, and the formidable obstacles he would have to encounter, he replied that it was beyond the scope of his journey to go so far, and he treated all the obstacles of enormous elevations, vast deserts, and total want of fuel and population as purely frivolous objections. Certainly, after travelling over the Pacific Railway from San Francisco to New York, I am little disposed to say that anything is impossible, but I venture to think that the very last line that ought to be attempted, and certainly the least tempting either for passengers or traffic, is the line so boldly put forward by the successful projector of that wonder of the present age, the Suez Canal.

In looking through the reports and articles which have appeared in Russian papers or translated into English, it is evident that the great problem for Russia to solve is the shortest and safest route between Russia and Western China. According to Glukhowski in 1859, the trade with China through Kiakhta or by the Amur River, which Russia conducted in remote ages, has not only failed to increase during the last ten years, but has fallen off, and is visibly declining, and it has been the aim of the Russians for many years past to endeavour to open out other and more direct and lucrative lines. Such a line is that which passes by Barkoul and Hami, from Western China to Urumtsi, whence two roads branch off, one to Kuldja, 628 versts (418 miles) and thence to the other to Chuguchuk, 416 miles, thence to Nor-Zaisan, 140 miles, or to the Irtysh, and so to Orenburg.

The importance of Kuldja and Chuguchuk have long been known to the Russians, and the first protocol of Chuguchuk with the Chinese in 1851, under which Russian factories were established in Chuguchuk, opened up to the Russians the whole of the province of Ili. The treaty of Peking contained provisions for the formation of trade in that direction, and the second protocol of Chuguchuk contained more explicit stipulations with reference to that trade. The factory which was established in Chuguchuk under the first protocol was demolished in 1855, by the Tungani rebels. Though the Russians have occupied Kuldja and Ili, which they profess to hold in trust for the Chinese, it is impossible to open out trade until the question of mastery over the route has been decided. Colonel Sosnofski, who was sent in 1874 on an exploring expedition from the Zaisan Pass to examine the roads leading thence towards Western China, with a view to the re-establishment of the Russian Chinese trade which ceased on the capture of the Kuldja and Chuguchuk by the rebels in 1864-65, has reported on the feasibility of opening commercial relations with China in that direction, and proposes to establish consular agents at Urumtsi Khamul or Hami, and Guchen. M. Shishmaref, the Russian consul at Urga, proposes another route, crossing the Altai from Biisk and proceeding in the direction of the Orkhou River, and skirting presumably the track followed by Mr. Ney Elias.

The caravan route from Khukhu-Khoto through Uliasatai to Khobdo, would come to the Valley of Buktarma (south of Biisk, Eastern Siberia), and bring tea to Kuldja, Chuguchuk, and Kashgar.

It would seem that at one time the Russians had an idea that the shortest and easiest route to China would be through Kashgar, and it was probably with this in view that General Ignatieff, taking advantage of his influential position as mediator between the Chinese and the Anglo-French armies in 1859-60, obtained from the Court at Peking a treaty giving permission for the Russians to erect factories in the vicinity of the town of Kashgar. As a similar permission for them to establish agencies in Goomah, and in the vicinity of Khoten, it may be presumed that the idea was to reach the heart of China by the direct route skirting the northern slopes of the Kuen Luen and great northern Khoten ranges arriving at the Kansuh provinces of China.

But subsequent experience has shown the impracticability of such a route, or rather the vast inferiority of it to others. Unquestionably the most lucrative, and by far the most easiest route from Kashgar to China, is through the fertile submontane tracts in which the towns of Asku, Ush, Sairam, Kuchar, Karashar, are situated, and from whence the onward route would strike the great trade line from Kuldja through Manass, Urumtsi, Hamil, or Khamil, to the province of Kansuh.

It has been ascertained that coal abounds in the range of mountains along this line, and Baron Richtofen has made very valuable explorations on the Kokonor side of the route, and from his report, as well as from other sources, should the idea of a railway to China from Russia ever assume the shape of practical enterprise, it will be found that the direct line between Kuldja and Kansuh will afford the greatest advantages.

Mr. Glukhowski, in a very valuable paper on trade, writes:

> "It cannot be expected that the teas from Kiahkta to Western China will ever be conveyed to Russia through Tashkend down to Syr Darya, and thence to Orenburg. From Kiahkta there is a direct route to Russia through Siberia, and from Western China there is also a direct route which is more convenient and cheaper. From Urumsti, the centre of trade in Western China, the road to Russia is either by way of Kuldja, or still more direct by Chuguchuk, leading to the Orenburg Siberian line on to Lake Nor-Zaisan, or to the Irtysh."

Now, after taking this brief survey of the past, the practical question may be asked—Is this trade with Central Asia worth striving for? To this I reply emphatically, Yes, it is. We have seen that with all the drawbacks arising from deficient means of transport, heavy rates of carriage, and undue exactions in Afghanistan, commerce through that country has doubled within the last ten years, and there is now a total yearly trade with the countries between India and Russia proper of about four millions sterling, of which Manchester goods to the value of about a quarter of a million cross the frontier from Kurrachee and the Punjab, and wool to the extent of one million is exported from India, the bulk of which comes from across the frontier.

As population increases, so the demand for goods must increase likewise. And the population must increase. I look upon it as a positive certainty that the lawless state of things which has existed for so many centuries throughout Central Asia, and has operated as a check on everything like civilisation, must gradually be brought to an end. It is the inevitable consequence of the advance of Russia on one side, and the spread of English influence from the other side. A time must come sooner or later when all the restless, fiery spirits of the desert countries on both sides the Oxus will find no further scope for their marauding propensities, and they will have to turn their energies into some other channel. If Afghanistan is not looked upon as the birthplace of valour and the cradle of worth, still it maintains the reputation for martial ardour which was for so long the characteristic of our northern neighbours. Like the Scotch, the Afghans have been and still are famed for their clannish spirit and clansmen's feuds. But there are causes at work which, in course of time, will gradually extinguish such internecine quarrels, and the progress of civilisation and the healthy influence of commerce will produce manifest results. The energy and canny disposition of the Scotch, when no longer able to find an outlet in the battle fields, soon caused our north countrymen to take the lead in the fields of commerce. No less marked or successful has been the conversion of the martial ardour of the Sikhs and Punjabees into a spirit of commercial and industrial enterprise. Even at the present time, famous as the Afghan is as a bold and skilled warrior, I venture to affirm that no keener hand at a commercial bargain can be found than the long-haired Kabulee, who is to be seen in the bazaars of Yarkund, or Tashkend, or in the streets of Calcutta, or any other large towns of India during the winter season. It is clearly to our interest, not merely for the commercial advantages of our country, but in the interests of civilisation, to bind these frontier tribes to us by ties of personal profit. On the political value of subsidies granted to the ruler of the country, I will not now venture an opinion, but it should be clearly understood that with a people like the Afghans, who have a keen eye for personal profit, it is a mistake to suppose that by subsidising the chief we conciliate the people. It should be our aim to let each man individually feel that he has a direct interest in maintaining friendship with us, and this can be done by creating or fostering a taste for luxuries, small though they be, which they will be loth to forego when once indulged in. I know I shall be met with the argument that Afghanistan is a poor country; and that Dost Mohammed once replied to the Chief Commissioner of the Punjab, when asked to encourage trade, that his country produced nothing but stones. Then, too, there is all the talk about the danger of advancing across the Indus, and of the chance of embroiling ourselves politically wherever we find access commercially. I am well acquainted with all the arguments in favour of masterly inactivity, but I do not think they apply to commercial questions.

The laws of commercial progress are irresistible. As wars cease and populations thrive, so commerce must increase. Viewing the question from this standpoint, and setting aside all political consideration, the advance of Russia must unquestionably be looked upon as a great gain to civilisation, and if Russia adopted principles of free trade, or were content with only a moderate degree of protection for her own manufactures, I should—always speaking in a commercial spirit—welcome her advance. But, unfortunately, we know too well what her policy of jealous seclusion is, and, as matters now stand, those who would rejoice to see Russia extend her frontier to our Indian borders, must be prepared to temper their exultation with the humiliating knowledge that Russia's gain will be a loss to our trade. The evil effects of Russia's policy have been forcibly pourtrayed very lately by Prince Bismarck's master-hand, and it will be well for all, and especially for Russia, if she awake to a sense of her position, and withdraw from the suicidal course she seems bent on following, to the complete breakdown of her commercial fabric. The peculiar views of the Russians on the subject of trade, and their jealousy of England, have been well pourtrayed by Mr. Wallace in his interesting work on Russia, and by a Russian writer, M. Terentieff.

> "Great Britain, by her *politique d'exploitation*, is looked upon as the bloodsucker of less advanced nations. Having no cause to fear competition, she advocates the insidious principles of free trade, and deluges foreign countries with her manufactures to such an extent that native industries are inevitably overwhelmed. But the Russians think that the fallacies of free trade have been exposed, and the nations have found in the beneficent powers of protective tariffs a means of escape from British thraldom."

Carrying out these views into practice, a rigid blockade is maintained against the entry into Russia of foreign manufactures. "Thus," says Mr. Wallace, "they protect their newly-adopted subjects from the heartless exploitation of Manchester and Birmingham, and consign them to the tender mercies of the manufactures of Moscow and St. Petersburg. The economic influence of Moscow, which sells dear, is somehow infinitely less baneful and burdensome for the native populations than that of Manchester, which sells cheap."

It is, therefore, to our interest commercially to enter into such treaties as were made with the Amir of Kashgar, because, unless we establish some such footing as we have got there in those countries, we shall not be able to remonstrate successfully with Russia if, or when, she annexes these territories to her empire. But, if we can show that we have had trading relations with them, and have entered into treaties with the rulers of the land, there will be good ground of remonstrance against anything like a complete stoppage of trade.

The question has, doubtless, been well considered with reference to the possible or probable absorption of Constantinople and European Turkey into the Russian Empire. In the absence of any remonstrance from the other powers, Russia would doubtless wish to exclude all foreign trade, and England would be a direct loser to the extent of 12 millions a year. But it is not to be supposed that the whole of the European powers who have an interest in the question, would tamely submit to see themselves expelled from the Turkish market, and some rules and regulations would certainly be arrived at, and would be respected by all parties. But not so in Asia. Probably, if the question were put to the Government of St. Petersburg with regard to Central Asia, we should get some kind of assurance that no such sweeping orders for exclusion would be given. But we know too well, from practical experience, that orders issued at St. Petersburg are carried out in a very different sense at Tashkend. In 1869, when I went to St. Petersburg, partly to discuss this very question of the injury done to our trade by the prohibitory orders issued by the Government of Tashkend, I was solemnly assured that no such orders had been given. But since then we know, from native evidence, and it is openly stated by Mr. Schuyler, that this prohibition has been strictly enforced.

It may appear a vain thing to draw comparisons between trade in Europe and trade in Asia, where the conditions are so entirely different. Yet it may not be uninteresting just to glance at the fluctuations of commerce in different countries. In the three northern countries of Europe—Norway and Sweden, Denmark, and Holland—where tariffs are most liberal, our trade has increased 300 per cent. since 1859. In France, Germany, Austria, and Italy, where the trade is less liberal, our trade has increased 100 per cent. Our trade with the Channel Islands, which is perfectly free, amounts to £20 per head of the population; our trade with Belgium, under a liberal tariff, to £6 10s. per head. Our trade with France amounts only to £2 per head. These figures are for countries where, beyond the ordinary tariff fixed by law, no exactions or impediments are allowed to hamper trade. In the East things are very different. Tolls, exactions, robberies, and accidents render the transit of merchandise difficult and dangerous. Yet we find that our trade with Central Asia has increased 100 per cent. within the last twelve years, and gives an average of something less than 10s. per head of the population.

These facts are encouraging, and permit us to indulge the hope that, as peace is spread over the land, as population increases, and more enlightened views as regards commerce are adopted, trade will take great strides in advance of its present limits.

In the Report on the Trade of India for 1876, it is said that India is not well situated geographically for becoming a re-exporting country, and the trade with the countries on the north-west, north, and north-east has been considered to be insignificant. At the same time, it is acknowledged that hitherto very little effort has been put forth by the Government to ascertain what that trade is, and, with the exception of the Punjab, there are no returns as yet which can be accepted as an adequate representation of the state of the export trade over any but a few chief routes.

Yet, when we come to inquire more carefully into the matter, we shall find that on all sides there are rivulets and streams of traffic, which, joined together, help considerably to swell the returns of trade for the whole of India.

It is boldly asserted by many acquainted with that part of the world, and competent to form a correct estimate, that trade with Thibet, and the countries to the north of the plains of Hindostan, equals in value and importance that which is carried on between India and the countries on the north-west. The Thibetans are said to be eminently a commercial people, and every person in authority, including the chief Lamas of the monasteries, keeps an agent, and carries on trade on his own account. Besides this a large number of Mussulman traders from Kashmir are located in the capital. Bullion is a great article of export, gold and silver being produced in large quantities. The commerce of Thibet with China are imports of tea, cotton fabrics, thread, porcelain, and Yunnan ponies, and exports of silver, salt, blankets, and other woollen goods, furs, drugs, and musk. From calculations carefully made, it is said that our Darjeeling planters could supply Lhassa with tea at prices that would undersell the Chinese. In the statement of moral and material progress of India, from which I am largely quoting, it is said that English woollen cloths are much sought after in Thibet, but they have apparently to contend with importations from Russia. A M. Desgodins saw numerous packets on their way to the salt works, wrapped up in wax cloths bearing the name of a Halifax maker; they appeared to be made expressly for Thibet, where they sell well, though the quality is but mediocre. Flowered calicoes, too, are much in demand, as well as indigo, corals, turquoises, and pearls.

The great and inexhaustible staple of Thibet is its wool, which can be produced on its vast plains and mountain slopes in any quantity and of the finest quality. The trade in this article might be increased very considerably, as Mr. Clements Markham so conclusively shows in his valuable edition of "Bogle's Travels in Thibet," if all the passes to India could be freely opened to commerce, if the obstructions to trade on the part of Chinese agents could be removed, and if the danger of aggression from Nepal, which is ever present to the minds of the peaceful Thibetans, could be removed.

To remove the obstruction of the Chinese it is proposed to follow the example of the Russians, and obtain from the Government at Peking permission to establish consular agents at the Court of the Teshu Lamas, just as the Russians are allowed to place their agents at Urga, near the Court of the Taranath Lama.

Hitherto no organised attempt has been made to register the amount of traffic between Bengal and Nepal, but Sir R. Temple notes that the traffic at certain seasons is considerable, and with his accustomed energy he has organised a complete system of registration. In the report of the North-West Provinces the subject of trade with Thibet is wholly omitted.

The question of improving communication with Thibet, which originated with Mr. Brian Hodgson, so far back as 1831, and was revived in a practical form by Sir G. Campbell, has been taken up by Sir R. Temple, who is decidedly of opinion that the best and shortest route is that over the Jeylup Pass. This pass is open all the year round, and is the lowest in the Chola range, which again is one of the lowest sections of the Himalayas. It leads into the Thibetan territory of Choombee, and the journey from the pass to Lhassa is said to be from 250 to 300 miles over a not very difficult country. The distance to Jhansu Jong, the principal mart of Eastern Thibet, is only 150 miles, and to Tashilumbo, on the great Narichoo River, where one of the best tracts of Thibet is situated, it is 200 miles.

From Darjeeling to Teedong, 37 miles, the road is tolerably good, except where it crosses the Teesta, where a cane bridge has been provided for foot passengers, and a raft for the passage of laden animals, which, however, is useless in the rains.

From Teedong to Jeylup, 56 miles, the trade is carried on the backs of men. The road is evidently capable of great improvement, and will be so improved when funds are available.

The total value of the ascertained exports from Darjeeling and Sikkim to Thibet, is £17,130, and of imports £7,505, leaving a balance of £9,625 due by Thibet, which is paid in British rupees, which the Thibetans obtain by selling their cattle, salt, and other produce in Assam and Nepal. Other items of merchandise on this trade route bring up the total to about £43,000.

I cannot leave this part of the subject without drawing attention to a letter which appeared some time ago in the *British Trade Journal*, and was written by Dr. Campbell, late superintendent of Darjeeling. His remarks as regards Sikkim need not be quoted, as, happily, the energetic action of the Lieutenant-Governors of Bengal for the last three or four years has begun to have effect, and many of the reforms proposed or hinted at by Dr. Campbell, have been carried out.

As regards Nepal, Dr. Campbell's remarks deserve attention. He says:—

> "Although we have been in what is called friendly alliance with Nepal for fifty years, our trade with that country, which has an open frontier with our Indian territories extending about 500 miles, is subjected to the most vexatious obstructions and exactions, at the same time that her trade into our territories is free and unobstructed.
>
> "While we freely admit and welcome into our territories every subject of Nepal, and they have free and unquestioned liberty of travelling over the whole of India for purposes of trade, pilgrimage, or amusement, no Englishman is allowed on any pretext to enter Nepal without the express sanction of the Government, formally applied for through the Resident.' '

Altogether, Dr. Campbell well points out that free trade with Nepal is, in existing circumstances, an impossibility; and, as Mr. Markham justly observes, a policy of worse than Chinese exclusiveness and obstruction is maintained.

One of the leading journals has pointed out that the English commercial interests at stake in the Eastern question in its broadest sense, and not merely confined to Turkey, are as far as possible from insignificant. The great peculiarity in English manufacturing industry is that it depends so largely for the sale of its products on countries which are forcibly kept from establishing protective tariffs, or which have not yet reached that half civilisation which produces a belief in the virtues of protectionism. India, China, the interior of Asia and Africa, and the Ottoman dominions, are the true markets which preserve us from the commercial distress or ruin with which we are constantly threatened by the economical policy of the Continental and North American States. The states of the European Continent do indeed show a slightly increasing tendency to become our customers, but there is one country which has never for a moment relaxed its commercial hostility, and this is Russia. Every portion of the Ottoman dominions, or any other part of the world absorbed by Russia, is absolutely lost to English trade, and the pretended civilising mission of Russia is everywhere an errand of obstruction to our manufactures.

If this be true, then, the whole of our trade with countries across the border, along the whole line of territory extending from Kurrachee round by Kabul, Thibet to Lhassa, which has doubled within the last ten years, and already exceeds two millions sterling, is in danger of being lost to us, if the wishes of those who desire to see the Russian boundary in Asia march with ours are ever fulfilled, or if we do not take steps to induce Russia to relax her protective policy, which is, in fact, prohibitive; and encourage, by every means in our power, the introduction of British manufactures into the markets of Central Asia.

DISCUSSION.

Sir George Campbell, K.S.I., in opening the discussion, said he could do but little more than express the very great satisfaction he had felt at hearing the exhaustive and invaluable paper which had been read. In fact, Sir Douglas Forsyth had so exhausted the subject, that very little was left for any one to add, especially those whose knowledge must necessarily be so inferior to his. He concurred in every respect with the views so ably expressed by Sir Douglas Forsyth; but, if there was one point in which he should venture to differ, it was with regard to the means of promoting commerce with Afghanistan. Commerce, in reality, was one of those plants which thrive best under what he might call negative cultivation. That is, leave it alone, and simply remove all obstruction. It thrives best in a state of nature, and artificial stimulants rarely succeed. He agreed with Sir Douglas that the Afghanistans were eminently a commercial people, and that it was not by subsidising the ruler, but by making the people feel they were benefited by intercourse with ourselves, that success was to be looked for. Political jealousy must be put aside, and our territory opened to commerce to the very utmost extent, and if we enabled them to trade with us, there must also be a return trade through them to the countries of Central Asia. With respect to the trade with Central Asia, he thought Sir Douglas Forsyth might give some information which would be extremely valuable, as regards the prospect of direct communication between the Caspian and Bokhara, and the other trade marts of Central Asia. He was very much struck with some observations made by General Tchernaieff in conversation with himself, in which he expressed the belief that Russia must take possession of Bokhara, because he thought the communication between Russia and Central Asia must be through Bokhara, for the route between Bokhara and Orenburg was a difficult and expensive route. The General took, as was natural to him, a military view of the question.

Russia, he said, had very few forces (only two battalions) in Orenburg, whereas in the Caucasus they had a very large army. If they could only establish a route from the Caspian to this plain, they would have an infinitely preferable means of communication. In his opinion all that was wanting was a supply of water, and he thought that could be found from the Oxus, if it were true, as was supposed, that the Oxus flowed into the Caspian and the levels were not adverse. And if that were so, there would be no doubt that not only would they have greatly increased facilities for commercial purposes, but also for military purposes, and they would have that which General Tchernaieff pointed out, namely, immensely increased facilities between the army of the Caucasus and places in Central Asia, where they desired to consolidate their power. That was a very important view of the case, and would lead to a very great extension of Russian power. As regards the trade with Lhassa and that part of Thibet with which he (Sir G. Campbell) had had more to do than the other district of which he had spoken, the country about Lhassa was a cultivated country of considerable population, and the Thibetans were a very agreeable and good sort of people, with whom we should be very desirous of establishing friendly relations. The difficulties which stood in the way there were not physical, but political. As Sir Douglas Forsyth had pointed out, the route by way of Darjeeling was an easy route. The Himalayan range there was not very broad. He had tried to make a road to the Thibetan frontier, which he was happy to see his successor had carried on; the road was now, he believed, open, and so greatly improved, that travellers who had gone to the Thibetan frontier said the road was easy, and you could almost drive a coach and four. That being so, the political difficulties alone had to be removed to establish a good and profitable trade. Darjeeling was excluded from Thibet by some kind of monopoly, and the Thibetans had hitherto favoured trade by way of Nepaul, not by Darjeeling. If by negociations with Thibet this difficulty should be removed, he felt sure that there would be a very easy intercourse between us and Thibet, of which the capital was Lhassa, and a very considerable trade would be established.

Sir Charles Trevelyan remarked that his experience was so old that he feared it was not worth having, but it might be interesting in the way of establishing a point of comparison between the present time and his earlier days. In the year 1832 or 1833, he happened to pay a morning call on a friend in the place where he was then residing in Persia, and sitting in the room was a very handsome-looking gentleman, with a black moustache and long flowing beard, in the Persian dress. He salaamed to him, and entered into conversation in English with his friend, when, to his great astonishment, the supposed Persian joined in the conversation in excellent English. He said to him, "Dear me, who are you?" to which he replied he was Lieutenant Connolly—Arthur Connolly—and had just arrived by the overland route from the Bokhara Pass. He invited him to his house, and having been previously much interested in the subject of our trade with the north-west, on the arrival of such a guest, who was also much interested in the question, he arranged with Lieutenant Connolly that they should prepare a joint memoir on the subject, Lieutenant Connolly taking the military part, and he the commercial part of the question, and for some two or three months he went into the matter in very great detail, and obtained all the information possible, and in due course presented their memoir to Lord William Bentinck, who was very much interested in it, and said he would like to hear it read, but before it had been read a quarter of an hour his Lordship went to sleep. He had no doubt the document was in the records of the India-office, and it would certainly be interesting to compare it with the present state of affairs. Runjeet Sing was then reigning in the Punjab. Communication with England was carried on only by a four or five and even six months' voyage round the Cape of Good Hope. His scheme then was to establish an entrepôt at Bukkur, an island in the Indus, capable of being fortified; but see what the state of things was now. The Punjaub belongs to us, Scinde belongs to us, everything up to the Kyber and Bolan Passes is ours. We have established a first-rate harbour at Kurrachee, where ships, even of large burden, are able to enter, and there are lines of railway from Lahore to Calcutta on the one side, and to Bombay on the other, and the railway not merely facilitated travelling, but in a measure annihilated distance, and the Afghan merchants who used to come all the way to Delhi with a long string of camels, now go on to Calcutta to make their investments. He asked them why they went so far, and they said they found things better and cheaper there. Then, as regarded communication with England, the overland route by the Suez Canal was open, which, perhaps, was the most important change of all. He remembered the most important point, as he considered, of his memoir was the statement that the Afghans were not merely a warlike people but a commercial people, and it had been asserted that they were descended from the Jews. They had the commercial spirit in a very high degree, and traded to the fullest extent of their opportunities, and they were the carriers of their country. They were in possession of the whole of the carrying trade between India and the countries beyond. Russophobia had begun even in those days, as was shown by the paper written at that time by Sir John McNeil and supported by Lord Palmerston, then in the ascendant; and they were even at that time thinking of barring out Russia. He did not remember what Lieut. Connolly's plan was, but his own was to bind the people of the intermediate countries to us, and especially the Afghans, by making their interests identical with ours, by enabling them to become the principal agents of a growing trade between India and the countries beyond; and, at a distance of nearly half a century, he still maintained that doctrine, and the more so as we were now under far more favourable circumstances for carrying out that policy. With the help of the overland route and railways, and greatly increased political influence, we could now carry it out to much greater advantage. As regarded any invasion of India by Russia, he considered it mere delusion, a mere bugbear. Russia was our favourite *bête noir;* and he hoped when the generation which so regarded it had passed away, that the younger generation would take a different and more common-sense view of things. He considered that Russia must be regarded from two points of view in respect to the question under discussion—the trade between India and Central Asia, and our relations with intermediate countries. In one point of view she was a highly beneficent power. If people had heard and seen as much as he had of the countries of Central Asia, Turkestan, Khiva, and the others, they would rejoice at their occupation by Russia. If there were any countries which were the habitation of the grossest cruelty and intensest barbarism, it was those. His poor friend Connolly had met his fate at Bokhara, and both he and his friend Colonel Stoddart had been tortured and terribly ill-treated before their execution. He might horrify them with the details of such things, even beyond the Bulgarian atrocities. Wholesale executions and wholesale tortures had taken place. Five hundred people at a time had had their eyes gouged out, and then been left to wander about and starve. But Russia would put down that, and whatever objections there might be to Russia in comparison with England, she had caused great improvement in those Mohammedan countries. In that respect she had been a beneficent power, and anybody who had read Mr. Schuyler's book would see that, in spite of deficient experience and deficient morality and other drawbacks, those countries were already improving. And, as had been observed by Sir

Douglas Forsyth, the presence of the moral influence of Russia on the one side and of England on the other, could not fail to exercise a most beneficial effect in forming settled habits and gradually civilising the people. There was, however, one war which we ought undoubtedly to carry on with Russia, and that was a competition in trade, for which we had such far greater advantages than Russia. Manchester and Birmingham would beat Moscow and Toolah out and out, and our conveyance was so much cheaper. The greater part of our trades was by sea and afterwards by rail. He had spoken of the good side of Russia, but it also had its bad side, and that was its protective policy. He felt, however, they must not be blamed too severely for that, for other nations professing to be more advanced (even our American cousins) still held to that. No doubt it was a great evil. But Russia could not stand competition with English free trade. She cannot remain entirely isolated from the rest of the civilised world. Even the occupation of the neutral country between India and the Russian possessions will very severely try her. He was delighted in reading Mr. Schuyler's work to learn that our Indian tea, and Manchester piece goods, and muslins, had penetrated to Bokhara, and were found in abundance there, and our best policy was in every possible way to facilitate that trade. He said by all means let us take our railroad as far as we can with any safety, or with the acquiescence of the intermediate people up the Bolan Pass. In conclusion, he said they were all deeply indebted to Sir Douglas Forsyth for his invaluable and exhaustive paper.

Mr. Brian Hodgson most cordially and thoroughly concurred in what had been said by Sir Douglas Forsyth, and also with the remarks of Sir George Campbell, and said he was confident a large and increasing trade might be carried on with Thibet. The spirit of the population was thoroughly commercial and friendly. What was wanted was that the existing difficulties, which were met with along the line of frontier, should be removed by the Chinese Government, and he was confident that if a firm representation were made by us to that Government, they would be. He felt it was quite ludicrous to suppose Russia could eventually compete with us, or that any influence could for ever bar the way through Nepal.

Mr. Ward was very glad that Sir Douglas Forsyth had alluded to the efforts of Dr. Campbell with Thibet. If Dr. Campbell were present, they would have a tower of strength to advocate the necessity of a railway from Calcutta to Darjeeling. If Thibet could be brought close to Calcutta, it would be a very great advantage. Its great want was communication with Calcutta, and if the railway were completed it would bring Lhassa close to communications. The question of making the railway was entirely in our own hands; it was only a question of funds. It ought to be warmly taken up here. The importation of Darjeeling tea into Thibet was a very important matter, and ought to be pressed forward, and every facility afforded to carry it on. Much new ground had been opened up for the cultivation of Indian tea, and Thibet would be a most important market the moment communications were opened.

Mr. A. Cassels said he was acquainted with the country of which Sir Douglas Forsyth had spoken only from books and dispatches, but one part of the paper had struck him as new, and that was the statement that Russian trade had fallen off while ours had increased. He had long felt that the trade of Russia did indirectly benefit this country. He recollected, when at Bombay, some patterns of Russian manufactures which had found their way into the markets of Afghanistan and Turkestan being sent to the merchants to see if they could be imitated. They were submitted to the Chamber of Commerce, and they were all found to have been manufactured in Glasgow. As to railways, Mr. Ward had said the only thing that was wanted to construct the one he advocated was funds. That was the one great difficulty now, and he felt that till brighter and happier days came they could only do these things very slowly.

Mr. Hyde Clarke said the restrictions on our intercourse with Thibet had very often been agitated in the Society, and many representations had been made from the Society to the Government with the view of obtaining some action by the Chinese Government to remove them; he sincerely hoped they would continue to be made until they were successful. If, as Sir George Campbell had said, trade prospered from non-interference, it was surely on the other hand the duty of Government to see that all obstructions to its progress were removed, and that every opportunity was afforded for free intercourse. It was too late at that hour of the evening to refer to many of the subjects which had been touched on, but he must say that he felt that the progress of some of the countries which had been spoken of was due far more to the civilising influence of intercourse with England, than to Russian trade and Russian influence. Many Mussulman pilgrims came down from Central Asia to Kurrachee and Bombay, and in conversation with them it was invariably found they were impressed by what they had seen of English rule in India. Many of them were sharp, intelligent men, engaged in trade, and understanding their business well, they were very much affected by what they saw of English power and English government, and they were in a position to and did compare it with what they had seen of Russian government, because these pilgrimages were made not simply for religious, but for other purposes; they were frequently extended to the capital of Islam, Constantinople, and back through Russian territory, sometimes even *vice versa*.

Mr. Trelawney Saunders observed that the subjects on which they had been addressed were chiefly as to the power of Russia on the one side and of England on the other, Russia being represented by an enormous area which he pointed out on the map, and England by a comparatively small area. Much of this vast area we had hitherto had nothing to do with, and some parts of it had never been entered by Europeans till Sir Douglas Forsyth's march there. He believed we had a far greater interest in regard to those countries than the mere importation of manufactures, although against that he had nothing whatever to say. Carry our manufactures into Asia as much as possible, but we were not going the right way to work. The whole of that vast region was in the occupation of China, except some small portion which was under the dominion of the Atalik Ghazee, because although there had been several rebellions not a single man save him had been found capable of maintaining his position, and he feared that, in the event of anything happening to him, it would either again be subject to Chinese occupation, unless we were disposed to favour some change in Russian policy, and allow Russia—who was perfectly ready—to seize it. He contended it was utterly useless to expect any change in Russian commercial policy, which was bent upon sustaining Russian manufacturing interests—built up with so much care, and supported with all the power of the State, that they were not allowed to drop for one moment—and yet it was out of the question that those interests could be sustained one day without protection, and it was equally out of the question to expect that for centuries she would be able to compete with us in Central Asia, except by establishing territorial influence; and if Russia were to succeed in establishing her position in these parts, she would have a nursery for her army which would enable her even to become the empire of the world. This country was also remarkable as being the oldest and largest wool-field in the world, and yet we did not get from there a bale of wool; and he thought that our efforts ought to be concentrated to avail ourselves of this invaluable staple, so necessary to our manufactures.

If proper relations were established, we might have such an export of wool as would tend greatly to the development of the woollen manufactures of this country, and also with that country for the manufactured article. He had risen, in the first place, to urge that it was of essential importance to maintain the territory in this district in the hands of China, as against Russia, though he did not wish to exclude Russia, but only to see England admitted; and, in the second place, to advocate the importance of cultivating the export of wool as a staple article, so as to enable us to command the import of our manufactured articles into that vast territory.

Sir Charles Trevelyan, observing that the discussion had turned very much upon the increase of trade across the Himalaya, hoped he might make a practical suggestion to Mr. Cassels. In his reading of the old records, it was apparent that a very considerable trade was carried on through Nepal with Thibet. The ruling race of Nepal had been there less than 100 years, and trade then was so important, and considered at that time so capable of increase, that Warren Hastings sent one, if not two, embassies to establish relations. Now, any investigation with a view to opening trade, ought to go back at least 100 years, and to take their starting point when, undoubtedly, the trade was open, and when our predecessors thought a great deal of it, and believed it might be much more improved.

The Chairman, in closing the discussion, said they had listened to a very interesting and most valuable paper, by Sir Douglas Forsyth, on the progress of trade, and it had suggested immediately to many minds, as it did to his, that it was not only a question of trade, but of the capacities of that trade; for they could really form scarcely any estimate of what its importance and value was by what at present existed, but must cast their eyes forward into the future and see what the materials were for an extension and enlargement of the trade hitherto enjoyed. There were two great obstacles to this—one was the obstacle of physical geography, which was very great — enormous in fact, because whichever way you attempted to move, either through Cashmere, or by the Darjeeling route (which, in his opinion, was the best), there were enormous physical difficulties to overcome, and of course that meant not only obstruction as regards the carriage of goods, but also limited their quantity, especially if they were of a bulky nature, and made any extension of that kind of trade very limited. Another obstacle of a still more important nature, was the political difficulties which they had to deal with. All who had any knowledge of Central Asia were perfectly aware that there were two great enemies to any advance from India of trade in which we were interested. The one was, no doubt, Russia, though he would not cast any undue blame upon them, for they were acting according to their lights, and doing what many nations (even that which claimed to be the most advanced) were doing at this day. They believed, in order to preserve the trade, which to them was quite as important as it was to us—the trade of all those regions stretching into China—that they must have protection. They know that they cannot compete with Manchester or Birmingham, and it was all-important that they should know and feel that they cannot compete. But still, so long as they have political power of stopping all access into these countries, it is all in vain to say that Manchester, and Birmingham, and Bradford can shut out all Russia's trade if they have opportunity. They cannot get their goods passed the Custom-house, or passed the barriers. They had had their attention very much directed to the question of how far that difficulty might be overcome by influencing China on the subject. But China herself was as protective as Russia. It was true she admitted a very fair tariff in respect to her trade with us, and we had no reason to complain. But it must be remembered that had been done under compulsion, not under conviction. If they had power to-morrow, they would shut out our goods by a protective tariff, but they are not able to do so, because they are not strong enough. But when you come to their land boundary and to their tributary States, which are more or less under their control, no doubt if China were disposed she could remove the difficulties at once, and if we could pass through those countries, then undoubtedly, unless Russia was in possession of the whole of those States, she would have to bear our competition. A great and important move had been made in that direction by Sir Thomas Wade when making his late convention, that trade facilities should be established across the Burmese frontier into Assam, and more than that, he had obtained a promise that India should now have the power of transit and communication from China through Thibet. That, in his opinion, was the first ward in the lock, and Sir Thomas had obtained nothing more important in the late negociations than in tapping and breaking down the wards of the lock in those two directions. And he conceived it was only to carry out the same principle in other directions, and this was all to be done by diplomacy. They have allowed Russia to trade with China and their great frontier, and cannot with any consistency deny us what they have given to Russia. The only argument they can reply to us is, Russia is strong, and you are not, but that can be met in various ways. One thing which is very striking was that it was not Europe pushing on to the East, but that the Asiatics were pushing on to Europe. They were heart and soul commercial. The Chinese, Nepalese, Afghans, and Thibeteans, were all commercial, and they only wanted to be allowed to push their way. If the barriers were removed they would come to us, and we need not go to them. All that was required was to remove away all physical obstacles, and after that they had only to remove the political obstacles, and then they would get abundance of trade into Central Asia. It only showed the great necessity there was that every effort should be brought to bear, to remove, not so much the obstacles that prevent us reaching them as that prevent them reaching us. Free trade and competition will always have to fight the same battle. So far as Russia is concerned, her interest as a commercial State, her whole hope of carrying on trade, is protection, because she considers anything like fair competition impossible to her. And she would stay as she was until she was clearly over-matched. It was in China and the great field of Africa which was now open to us—it was in Turkey and those States that were not yet under Russian influence, that we must look for the prosperity of our manufactures, and the increase of our trade, and it was, therefore, most important that we should not allow ourselves to be shut out from communications. It would not, however, be done without very much effort, and they were deeply indebted to Sir Douglas Forsyth for drawing their attention to these subjects. In conclusion he moved a most cordial vote of thanks to Sir Douglas for his paper.

Sir Douglas Forsyth, in returning thanks, said that when he undertook, two months ago, to prepare the paper, he was of the same opinion as Mr. Cassels, that Russia was beating us out of the field, but he was very glad to find it was otherwise. His chief authority for that was Mr. Schuyler's work, and he had been at much trouble and pains to ascertain whether it was a trustworthy source. He had consulted Mr. Wallace on the matter, who was of opinion that it was entirely trustworthy, and this was the opinion of several others whom he had spoken to. He had also to acknowledge his indebtedness to Mr. Cassels for his kindness and courtesy in placing at his disposal the valuable sources of information at the India-office. He had also consulted some Russian reports and works, and was exceedingly glad to find that our trade had really increased to the extent mentioned. He had not so much drawn attention to the removing of obstacles as to giving facilities, and it was most satisfactory to find that, in spite of all the difficulties, the trade had about doubled in ten years, and that, though we had not taken any pains to push our trade in those parts, the people found it to their advantage to come for our goods again. All we wanted was peace, and not to have ourselves entirely pushed out of the market by Russia. Sir Charles Trevelyan had entertained the hope that Russia would be driven out of the market; so had Prince Bismarck. If, however, she should drive us out, we should get in again with difficulty. Sir George Campbell had spoken as to the best route, and he confessed it was the weak part of his paper, for he had not been able to get information as to that line. The old historical route between China and Constantinople, which was to run through Cashmere, was the line which would eventually be the most paying one. In a work called "Railways in Asia," published in Germany, a line of railway had been drawn, which would be the best one for us to take, if it were ever made; but the man who drew it on paper had not taken into account the difficulties he would meet with in the shape of mountains and other physical obstacles. In conclusion, Sir Douglas acknowledged the vote of thanks which they had given him.

A vote of thanks to the Chairman for presiding concluded the proceedings.

SPECIAL MEETING.

Tuesday, March 6th, 1877; Major BEAUMONT in the chair.

The Chairman, in commencing the proceedings, said he attached a great deal of importance to the legislation which was now before Parliament with reference to patents. There was great difference of opinion with regard to the clauses of the Bill, and, therefore, the more discussion which could take place upon them the better. At the same time he would remind the meeting that the principle of patents had received the attention of the public, of a Royal Commission, and of Parliament, and its desirability had been generally accepted. He should, therefore, ask the gentlemen who might favour the meeting with their views, to confine themselves as closely as possible to the resolutions which might be proposed and seconded, and not to speak upon that which, he was happy to say, was rendered a foregone conclusion. The resolutions had been framed, not in any sense with the desire of forcing them upon the meeting, but simply that persons coming into the room might know the object of the meeting. His opinion was that the Bill ought, on the whole, to be received with satisfaction, on the assumption that in passing through the House of Commons it received certain modifications; and he was not without hope that if a sufficiently strong expression of opinion from those most interested was shown, the Bill, with those modifications which would be alluded to, would become the law of the land. No arrangements had been made for any particular person to propose or second the resolutions, but it would be open to any gentleman in the meeting to do so. With these few remarks he would call upon Mr. Wood to introduce the subject by the reading of his paper.

The paper read was—

THE PATENTS FOR INVENTIONS BILL, 1877.

By H. Trueman Wood, B.A.

(Assistant-Secretary of the Society).

The Council of this Society have honoured me with their instructions to prepare a paper which might serve to introduce the subject for this evening's discussion. In doing this, it has seemed to me that I could best use the very brief time I could allow myself by directing your attention to the two or three most striking features of the Bill rather than by attempting any criticism on all the points which might suggest themselves for consideration.

Before doing so, however, I must ask to be allowed to state most distinctly, that the remarks I have to make are to be taken simply on their own merits, and not in any sense as expressing the opinions of the Council. To do this I have no pretensions whatever, and I feel it my duty to let this be clearly understood.

The first point that suggests itself for consideration is the appointment of unpaid Commissioners. The Society of Arts, through its Council, and by the collected action of its members, has for some years earnestly recommended the appointment of additional paid Commissioners of Patents. The necessity for this is sufficiently obvious. At present the office is ruled by a body of important Government officials, whose time is fully occupied, and who cannot possibly study the details of departmental administration. The consequence is that they either delegate their duties to a subordinate, and, therefore, irresponsible official, or they discharge them in a hasty and perfunctory manner, in the intervals of their other more important occupations.

The effects of such a method of administration have recently been well illustrated. Last session, it is well known, an investigation into the affairs of the Department was held by the Master of the Rolls and some officials from the Treasury. It would probably have been difficult to have found gentlemen more eminent or more capable of such an investigation. The result, however, of this sudden activity on the part of the nominal, but inexperienced heads of the office, was that a number of minor alterations were made in the existing system. These alterations have caused great irritation amongst those whose business is connected with the office, but have, as far as can be judged, effected none of the many-required improvements in the old system of administration.

Were it not that the proposal for unpaid Commisioners is supported by persons whose opinions deserve respect, it would be difficult to believe that it is put forward seriously. Some eight years ago, the then Master of the Rolls, the late Lord Romilly, applied to the different learned societies to nominate gentlemen eminent in various branches of science, who might act as unpaid Commissioners. The answers he received were such as might be expected, the Council of the Royal Society, as was stated in this room by a late eminent member of that body, receiving the proposal with derision, and flatly refusing to have anything to do with it. An alteration in the Bill, which would turn these amateur functionaries into paid responsible officials, should be strongly pressed upon the House, and then a long-needed reform would be effected. The *ex-officio* members might well be retained to lend weight to the Commission; but the real work of the office ought to be performed by men whose special duty it is to attend to it.

I pass to the consideration of the next main feature of the Bill—that of preliminary examination. On this point there is, it must be allowed, some diversity of opinion. There are two strong parties in favour of it; first, those who look on it as a means of killing off obstructive patents; second, those who wish for it because it would increase the value of those patents that were granted. The result expected by the former would, I think, be on the whole, undesirable, while the expectations of the latter are not likely to be realised. It seems so plausible a notion that the inventor should receive, in return for the large fees exacted from him, something better than "a mere permission to go to law," that it is small wonder if many of the less opulent class of inventors demand that, at least, their patent shall be *prima-facie* evidence of novelty. May I be forgiven if I suggest that it is just those who have the least practical acquaintance with the subject to whom this idea is most fascinating. They forget the minute points upon which questions of validity and infringement of patents frequently turn. They overlook, first, the difficulty of collecting the facts; and, secondly, the difficulty of arriving at a just conclusion from those facts. Those who have to get up patent cases know the trouble involved in the first; the reports of those cases are sufficient evidence of the second.

It is true we cannot tell how the new Act would work in this respect. Very possibly it might produce no difference in the existing practice; but, on the other hand, it might easily be so worked as to introduce the Prussian system into this country. Considering the Bill is brought in by a Ministry some members of which are avowedly hostile to patents, and that it is expected by the Attorney-General to stop half the patents now granted, I think we are justified in suspecting it. I take it that, if the Bill passes, we shall have a rather strict examination, an examination with the object, if possible, of stopping the patent, and for the moment I assume that the examination can be properly carried out. Now, time will not permit me to go very deeply into the results even of a carefully considered examination, and indeed there is the less need for anyone to do so, inasmuch as only two years ago Mr. Bramwell—far more forcibly and ably than I could hope to do—set before a meeting of this Society the results which might come from such an examination. I will, however, ask you to look at the diagrams on the wall, and judge for yourselves whether in the case of any one of these well-known inventions, an examiner who did his duty would not have been compelled to refuse protection, and whether such a refusal would not have involved a distinct loss to the country. Understand me, that I do not wish to put forward any of these examples of prior inventions as invalidating a later patent. Most of these patents have been litigated and well established; others have never been attacked. I only ask you to consider how an examiner would act with two such descriptions — the old invention and the new invention—before him, and no means of ascertaining the relative practical value of either one or the other, Dr. Siemens was actually refused a patent in Prussia because of the ancient heating apparatus at Marienburg. Can we say that the Prussian officials were not logically justified in their refusal? Bessemer might certainly have been refused a patent by an examiner who had before him the specification of Martin. Nasmyth's steam-hammer (1842) was described in so many words by Deverell in 1806, and Watt in 1784 went very near it. Cunningham's self-reefing topsails (1850 and 1855) are extensively used in the merchant service, yet he was anticipated by Winspear (1843) and by Bywater (1806). Martin's anchors (1859 and 1864) and Porter's or Trotman's anchors (1838 and 1852) are well-known; the former was preceded by Hawkins (1821), the latter by Piper (1822). Perkins' hot-water oven (1851, improved in 1864), is only another form of that described by Don (1833), and by Robinson and Lee (1849). Captain Warren's cooking pot (1865) had its predecessors in 1769 (Scott's), afterwards, in 1827 (Vazie's), 1849 (Masters'), 1851 (Norman's). Muntz's metal (1832) was invented by Keir in 1779, and by Collins in 1800. Weston's well-known differential pulley block (1859) was described in a book published in 1847. The description of Betts' capsules (1849) cannot be distinguished from that given in Dobbs' specification (1804). Field's boiler differs so little on paper from that of Perkins, that it would have stood a poor chance of a patent; yet Perkins' boiler is useless, and Field's is used in every fire-engine made by Messrs, Merryweather. Botfield patented a hot blast before Neilson, though this was not sufficient to invalidate Neilson's patent at the celebrated trial, Neilson *v.* Baird. Norton's tube wells, Gale's method of protecting gunpowder (which the inventor sold for a considerable sum), have been described more or less closely in previous publications. The difference between Smith's watch-chain swivel and the ordinary swivel might easily escape notice, yet the invention was worth a lawsuit, the costs of which were some £4,000. To take one more instance, there is given in the "Philsophical Magazine" for 1834, an absolutely exact description of the ingenious toy called the Zoetrope, which was patented in 1860, and was popular enough to have brought to its second inventor a very good return. This list might be extended to considerable length. The few brought before you are merely the result of a very short search during the few days available for the preparation of this paper. Some of them were described three years ago in an interesting series of articles in *Engineering*, and all of them are more or less well known and successful inventions.

But what reason have we to suppose the examination will be properly conducted? We are to have at most six examiners and assistant-examiners. These are to deal with 5,000 applications annually. The inadequacy of the staff proposed by this as by former Bills is so obvious, that I am really ashamed to refer to it before an audience familiar with the subject, but is a point in the Bill to which it is necessary to allude. To examine properly all the applications would take a staff of at least six times the number mentioned in the Bill, and then they would have more than enough to do. As to abridging and indexing, that would take as many more. The Patent-office have been at work on their classified abridgments alone for nearly twenty-five years, and they are more than ten years behind still.

In the American Patent-office there were 95 examiners to 21,425 applications, and the reduction of the staff to 88 has thrown the work into arrear. It may safely be estimated that our 5,069 specifications would give as much work as the 21,425 in America, considering the relative character of English and American specifications.

One word as to the system to be adopted. The examiner is to report on the provisional specification that it comes within the Statute of Monopolies, *i.e.*, that it is "a new manufacture within this realm." He is also to say whether, "having regard to former specifications and other documents in the Patent-office, and to publications known to him, that the invention is open to objection on the ground of want of novelty." What can be more ambiguous than this? Is each examiner to have a different standard according to the contents of his private library and the extent of his general information? Then again, is the acceptance of the specification as sufficient to bar all future proceedings on the ground of vague and insufficient description?

What would really be useful, what is really required, is that an inspection should be made to see that the specification is properly drawn and intelligible. This might be done under the present law, but it is not. The least that can be asked from the man who receives a monopoly is that he should accurately define what his monopoly is. Besides, it is part of the bargain between the inventor and the public that, in return for his protection during a certain number of years, he should give such a description as should enable the public to make use of the invention at the end of that time.

Beyond this I do not believe examination can usefully go. Either it is a nullity, and, therefore, a nuisance, or it is a restriction on the freedom of trade and manufacture. In the latter case it is contrary to all our received procedure. The Courts have always upheld a patent when it was possible to do so. The abridged description of Plimpton's skate, published by the United States Patent-office, was held not sufficient to enable any one to construct the skate, and therefore it was not publication sufficient to invalidate the English patent. Dobbs never could have made his compound metal, therefore Betts' patent was good. It was recently held that an abandoned provisional specification can contain only worthless matter, and therefore should not invalidate a subsequent patent. Over and over again the difference between success and failure is too slight to be perceived, except by an expert—not always by him. How is the examiner to obtain the necessary minute knowledge of so many branches of science and manufacture? Imagine any examiner having before him all those inventions now before you. He must be a sailor, a cook, an engineer, a chemist, a watchmaker, and to-morrow he may require to be a musician, a bookbinder, a farmer, a weaver, and an optician, or at least he must possess more familiarity with the knowledge required in these various occupations than the average of those employed in such pursuits. Without such knowledge he can never do his work properly, and the more accomplished he becomes, the worse it will fare with the unlucky inventor.

We are, however, told that we are to have preliminary examination; that a large number of the public desire it, and that the Government intend to carry the Bill enforcing it. The former statement I believe to be incorrect; the latter, unluckily, has all the appearance of truth. Whether with the object of eventually destroying patents or not, it seems likely that we are to have the system thrust upon us, and it only remains to be seen whether the new department will be more successful than the unlucky Trade-mark office, which has certainly not succeeded, even in the simple work of examining into the novelty of a trade-mark. It may be that those are wisest who accept the examination system, and then try to take the sting out of it. To do this many suggestions are put forward. Indeed, there are almost as many different systems as there are advocates of preliminary examination, all of whom, when pressed to define their views, seem to differ. First of all, we get the through-going people, who look on patents as obstructive nuisances, and examination as a means of getting rid of them. Most opposed to these are the set who would make the examiner a sort of Government patent agent, to confer in a friendly manner with the inventor, and give him advice gratis. Another party would endorse an adverse report on the specification—a sort of notice to the public. "N.B.—This patent is open to infringement." Yet another proposal, and perhaps the most practical of all, is that advocated by Mr. Lloyd Wise. It is to refer the specification back to the inventor, and require him to insert a reference to prior inventions, and a statement of his claim notwithstanding such inventions.

To pass on to another point. The obligation to grant licenses is surely of rather doubtful policy. There are indeed cases where such a provision would be of value. Inventions, like bullocks, are sometimes bought to be killed, not to be worked; but there are many cases where an inventor might be undersold and ruined by an unscrupulous licensee. The obligation to put the invention in use might always be colourably evaded, as it is in France, but this would probably only be done when the patentee was not yet ready to work his invention, and this provision is therefore harmless, though not perhaps very valuable.

The reduction in fees does not seem to be received as gratefully as might have been expected by the advocates of cheap patents, and there is a well-grounded fear that the increased cost of procedure may more than swallow up the amount gained by the reduction. The charges involved in an appeal like that to the Lord Chancellor provided by the Bill are shown by such a case as that tried a few days ago in Vice-Chancellor Malins' Court (Barrows *v.* the Registrar of Trade Marks), when it cost £250 to appeal against a wrong decision given by the Registrar of Trade Marks. Costs, it must be remembered, are not allowed against the Crown.

Many other points, of greater or less importance, must be passed over, but there is one more which deserves notice, and that is that greatly increased powers are granted to the Commissioners. In the Act of 1852 much is set out in detail which is by the present Bill left to the Commissioners. It is not even required, as it is by the existing law, that any rules and regulations made by the Commissioners shall be laid on the table of the House; they are merely to be included in the annual report of the Commissioners, which is presented to Parliament at the close of the session. If the Commission was a real working body, this might be a wise step enough, but as it is composed at present, it is rather dangerous to trust it with much administrative power. The existing Commissioners are too much occupied with other matters, and they must of necessity delegate their functions to a subordinate, who, whether efficient or not, is, at all events, irresponsible to the public.

In conclusion, I cannot but express regret that the Government—if they felt compelled to bring in a Bill for the amendment of the Patent-law—did not introduce reform where reform was really needed. It is not difficult to imagine a measure which would have received the adhesion of all the classes interested. Such a measure would have placed a real working Board at the head of the Department. It would have done away with the use of the Great Seal and the huge tin of wax considered necessary to receive the impression thereof. Perhaps it would even have exploded the ancient theory that a patent is a special direct grant from the Crown of certain valuable privileges, and that it is only by her Majesty's most gracious favour that these privileges are granted at all. The theory is that a grant of Letters Patent under the Great Seal of England is a peculiar act of royal bounty. In practice, it can be obtained by the first crotchet-monger who thinks he has discovered the perpetual motion, and is willing to spend £25 for the privilege of saying so. There is plenty of room for reform at the Patent-office; but the reform required is administrative, not legislative. At all events, whatever changes are wanted are changes in the direction of simplification of procedure, not of multiplication of formalities.

DISCUSSION.

The **Chairman**, in moving a vote of thanks to Mr. Wood, recommended the meeting to confine their attention to the provisions of the Bill now before Parliament, rather than discuss the question whether legislation was required or not.

Mr. E. A. Cowper moved the first resolution, as follows:—"That this meeting is gratified to perceive that the necessity for additional Commissioners of Patents is recognised, but at the same time it desires most strongly to express the opinion that such Commissioners should be paid, the meeting being of the opinion that unsalaried officials cannot be expected properly to perform the important duties required of them." It was of very little use to make a law unless machinery were provided for carrying it into effect. The Patent Law Amendment Act of 1852 had not been enforced. It said that the law officers of the Crown, together with such other person or persons as her Majesty should choose to appoint, should be the Commissioners of Patents. Now, her Majesty had never appointed that other person or persons. There never had been a number of Commissioners competent to do the work of the office. There had been law officers, who had no time to give to the matter, sometimes not meeting for six months together—on one occasion, not for nine months—even for the purpose of considering what was required in the office. It was no secret that Mr. Woodcroft's name had been put down, in black and white, to be appointed Commissioner of Patents; but, from some other influence, his name was erased, and he was made simply clerk to the Commissioners. If he had been appointed Commissioner, they would have been able to see what he would have done; and no doubt he had made many suggestions, but he found the greatest difficulty in getting any improvement carried out, and was thwarted in almost every way at head-quarters. The Act of 1852, then, had never been put into force; there had been no head to the office, and no Commissioner to consult from time to time as to what was necessary. As had been said by Mr. Wood, the abridgments of patents were not kept up to the present day, and, not only that, but they were being destroyed. They were sent to the mill to be worked up, together with all old specifications, except five copies, up to within fourteen years of the present time. Only the other day, a person who wanted some copies of a specification, for the purpose of a patent suit, was told he could only have one, there being only five in the office; but he could have copies printed at his own expense. This would have involved a great expenditure in preparing the drawings, &c., and the copies would not have been ready until the suit was over. The Patent-office was therefore being very much damaged for the purpose of inventors. If there were real working Commissioners appointed, they would no doubt consult the reports of the Royal Commission and the various Parliamentary Committees which had considered this subject, and see what could be done with the £90,000 surplus which had now accrued. One of the most important things they could do at present, therefore, was to recommend the appointment of paid Commissioners in sufficient number. He trusted that when this was done, the specifications would be printed and not destroyed, proper indexes made of all the patents and specifications, and the abridgments brought up as nearly as possible to the present time. Hardly anything would do more to advance manufactures and commerce than full and complete knowledge of what had been done before; and he would recommend that some of this surplus should be devoted to indexing and cataloguing inventions from abroad. Very often the best description of an English invention was to be found in some foreign book, because in this country it was not thought worth while to collect the knowledge of what had been done in any given trade or manufacture.

Mr. Murdoch seconded the resolution, and was about going into matters not strictly connected with it, when the Chairman suggested that those observations should be deferred till the proposition of later resolutions, which would cover them.

Admiral Selwyn, while cordially supporting the resolution, took exception to the word "additional" In his opinion, it would be great folly to get in by the side of paid Commissioners the great unpaid, who could know nothing at all about the matters brought before them. His view was that it was expedient that a properly paid staff should be appointed, who should confine themselves to that work alone.

The **Chairman** put it to the meeting whether it desired to strike out the word "additional," not understanding that Admiral Selwyn intended to move an amendment.

Admiral Selwyn replied he did not.

No one rising to speak,

The **Chairman** was about to speak, when

Mr. Hale objected to its being put so hastily, without further discussion.

Mr. Varley suggested it would be better, rather than abridge discussion on the subject, to let there be the fullest discussion, and, if necessary, adjourn the meeting, even for two or three evenings,

Mr. Hale said there could not be two opinions on the question proposed. The arrangements of the law of 1852 were not carried out, and therefore it was absolutely necessary that persons should be appointed who thoroughly understood the work.

The **Chairman** remarked he did not wish to press the motion; but no one rising to speak, and having in view the large amount of work before them, he thought he ought to put it.

The resolution was carried unanimously.

Mr. Campin rose to order. The Chairman had said they were to be at liberty to touch upon other questions, but if there was no discussion he did not see how they could do so.

Mr. Hale asked whether the resolutions were supposed to come from the Society of Arts, or to emanate from the gentlemen proposing them.

The Chairman said the resolutions had been thoroughly discussed and decided upon, as being the best mode of obtaining the end the meeting had in view, and meeting the points which it was desirable to discuss. While it was not the intention of the Society to push the resolutions down the mouth of anybody, they still desired in some measure to suggest the course which a public meeting like this, which should be practical in its results, should take. He quite agreed that the subject was of very great importance, and the people of the country and members of the House of Commons were looking to this meeting for practical results.

Mr. Lloyd Wise proposed the second resolution, as follows:—"That no adverse report of an Examiner, even with a right of appeal, ought to preclude an applicant from obtaining a patent, at his own cost and risk. And further, that reports containing opinions of Patent-office authorities ought not to be made public, but that opportunity should be given to the applicant of amending his specification, by inserting reference to matters discovered by the authorities, with a definite statement of what he nevertheless claims." There could be no question that the Bill proposed was a great improvement upon the Bills of the last two years. At the same time, it contained hidden within it that which meant not only disaster to the inventor, but to the country. He did not wish to be understood as referring exclusively to those who were called poor inventors; there was a vast army of inventors who would not come strictly under that denomination—professional men, and men of skill, many of whom devoted themselves to the production and working out of inventions, men of an income of say £500 or a £1,000 a year, who would, nevertheless, hesitate before incurring the risk which the Bill would impose on them in obtaining a patent. He then referred to the provisions of the Bill, which afforded provisional protection to the inventor for twelve months. It was not clear what the practice was to be in relation to the provisional specification, whether it would be open to the authorities to refuse that protection on any objection the examiner made or not. Reading the Bill as it stood, he was inclined to think that the provisional protection would follow as a matter of course in the manner it now did, when a complete specification was filed, instead of a provisional at first. The application was to be referred to an examiner, who was to report whether the invention was a proper subject for patent within the statute of monopolies. In his view that included the whole question, in fact, all the issues that could possibly be tried in a court of law, whether the invention was new or not, and whether it was sufficiently useful to support a patent. He was sorry to see this matter hidden in an obscure clause. The points in question had been included in other Bills in definite language, but such was the objection raised to them that they were struck out from the present Bill, and yet the essence of them appeared to be hidden in the Bill still. Three months before the end of the term of the provisional protection the applicant might file a complete specification; when he did so, his provisional and complete specifications, and the report containing the opinion which the examiner should have formed on all those points, were to be made public, thus inviting opposition and affording the means to unscrupulous persons of greatly damaging the inventor's interests. Then the application was to be again referred with the complete specification to an examiner, who was to report to the Commissioners his opinion, whether it was in conformity with the provisional, and if it appeared to him, having regard to former specifications and other documents in the Patent-office, and to other publications known to him, that the invention was open to the objection on the ground of want of novelty, the Commissioners were then to refer the application to the law officer, who was to report to the Commissioners. All this was to be made public. They had, therefore, three reports, all of which were to be made public. If procedure of this kind were to be allowed, very few inventions would come forth without a damaging report being attached to them. To take the instance of a poor inventor; he could not possibly stand against them; and, as an illustration of the effect of such a course, he was of opinion that if Field's boiler—which he personally knew was the result of very considerable time, care, energy, and study—had come before the examiner, with the two patents of Perkins and Barran before it, he believed that the examiner must have given a very damaging report. It was true, you could appeal to the Lord Chancellor, or you could bring in Mr. So-and-So, a very eminent expert, to say that, in his judgment, the examiner's report was not correct; but that would involve an expenditure of probably £500, which would too often deter further proceedings. He then quoted the opinion of the Glasgow Philosophical Society, under the presidency of Sir Wm. Thompson, that the expense of appearing by counsel and agents in four such contests would be ruinous to the majority of inventors, and would go far to render patents the luxury of the great capitalist. He thought it a great mistake to make everything public. Examiners could never be infallible, and, however careful they were, they might overlook what had gone before. An eminent member of his profession had told him that he liked one thing in the new Bill, that the patentee would go forth with something he could depend on as a sound patent; but he thought this was an entire delusion. It would give a false colour to many worthless patents, where the examiners had inadvertently overlooked prior things, as they often would, while on the other hand good ones would be crushed. The course proposed in the resolution was a medium course, and after many years study of the subject, he thought it the only one which could hope to be successful. Where a patent was similar to a previous one the inventor should be required to mention the prior one, and to point out the difference clearly in his specification for the information of the public. The resolution would prevent deception, and ensure clearly-defined specifications.

Mr. Lewis Olrick seconded the resolution. He considered this question of preliminary examination was one of the greatest importance. He had looked into the kind of examinations proposed at the Vienna Congress on International Patent Law, but such general terms were used that he thought they would apply to the examinations in almost every country. In Prussia the examination was so strict that it was almost impossible to get a patent, Giffard's injector and Dr. Siemen's regenerative furnace both being rejected. In the United States the examination was more liberal, but it was a mistake to suppose that it secured the validity of a patent, because from 1872 to 1874 there had been 212 patent suits, 53 of which were lost for want of novelty in the invention. It was said that we must be more strict in granting patents than they were in America, but it must be remembered that one English patent would often cover as much as ten or fifteen American ones. It was evident, therefore, that two examiners and four assistants would be quite insufficient for the performance of the duty required, which would therefore be done in an unsatisfactory manner. The publication of the result of the examinations would be very much against the patentee, and the appeal to the Lord Chancellor would be a mere farce, because he had quite as much to attend to as he could manage, besides which lawyers were not the best fitted to decide on questions of engineering and chemistry. It was not at all likely that anyone would go before the Lord Chancellor with three adverse reports against him; it would be like a cabman asking for a renewal of his license with the magistrate's endorsement upon it. The idea was that the examinations should be made harmless, and every application should undergo an examination limited to the question whether the specification was clear and distinct, and whether the invention was open to objection as being contrary to public morality or wanting in novelty, regard being had to the publications in the Patent-office. If the examinations were adverse to the inventor, and he still insisted on having a patent, he should be compelled to insert an acknowledgment of the existence of the prior matters pointed out by the officials, with a clear statement of what he, nevertheless, claimed. Such a mode of procedure could do no harm to an inventor, and the patent would only be refused in case of fraud, or where the invention was contrary to public morality. Other points could be settled in the law courts, but there should be no publication of reports. The result would be that inventors who had been anticipated would be saved a great expenditure of time and money, and, on the other hand, the public would be amply protected. Even if trivial things were patented, nobody would be injured. Inventions were the backbone of the country, and every means should be taken to encourage them.

Mr. Campin supported the resolution. Having taken a great deal of interest in the amendment of the Patent-law, even before the Act of 1852, he had often considered this question of examinations, and he must say that the generality of inventors were in favour of examiners, though he himself had always felt there were great difficulties. He had often thought that if they had good Commissioners, and good indexes, and especially good abridgments, which could be put into the hands of an inventor, he could conduct the examination for himself. But the evil of the examination, it seemed to him, might be removed by this idea, which he believed was the invention of Mr. Lloyd Wise, and which seemed the *via media* which would make the examinations not only harmless, but useful, because it would be of an advisory character. To show the evil effects of refusing patents, he might mention that the late Dr. Normandy, who introduced a method for rendering sea water drinkable, applied for a patent in Prussia, but was refused on the ground that it was not novel, because some bakers had used something which was considered similar in the 13th or 14th century. But by-and-bye, when they began to raise a navy, they found that this apparatus would be very useful, and had to send over to Dr. Normandy in order to obtain it.

Mr. Carl Pieper, who had been secretary to the Vienna Congress, controverted the statement of Mr. Olrick, that the principle adopted there was so vague that it could be accepted by anyone; it was exactly in accordance with the principles laid down by Mr. Lloyd Wise. What was wanted was some security to the public and to the inventor by having an examination as to novelty. The search which took place should be especially in the interest of the inventor, and that would protect the public also. The American plan was a very good one, because the claim was so worded that the examiner could judge whether the invention were new or not, but in England the claims were so vague that this could not be effectively done. Reference had been made to the Prussian law, which was not quite correctly stated. Prussia never had a Patent-law, but a kind of king's order had been issued in 1815, and since then certain officials had exercised the power of granting patents. For many years the principle acted upon had been that things which would be of great benefit to the public should not be patented, from the idea that it would be a hindrance to industry, but now a sounder opinion prevailed, and it was seen that to protect invention was to benefit the public. There was now a law before the German Parliament very similar to the English, and in some points superior to it, and he believed improvement would be made in it which would suit English ideas as well as German.

Mr. Theodore Aston, Q.C., said he was unable to concur in the resolution, for the following reasons, though he had no doubt he should be in a minority. In the first place, the opening clause was contrary to the resolution of the Committee of the House of Commons, which, after considering this matter very carefully, and hearing the evidence of the best authorities, came to the conclusion that it was advisable to put some check on the applications for patents in the interest both of inventors and the public. But here it was proposed that inventors should be entitled to protection, although they were told by the examiners that they ought not have it, and he desired to warn inventors that by insisting on this they might be doing themselves an injury. This opinion was based on a long and intimate experience of the working of the present system. If they were allowed still to proceed at their own risk, after being warned by the protest of the examiners, useless expenditure would be, in many cases, entailed, and he feared discredit brought on the whole system. At the present moment they were met by the Legislature with something which patentees and those who had been speaking in their interest for many years had been advocating, and examiners had been provided for, not quite satisfactorily he admitted, but in a spirit of conciliation, while previous Bills had provided for examinations which would have been to some extent hostile. But now the examiners were to report, first as to whether the specification was in proper form, and secondly, whether it was a good subject-matter for a patent. The proposer of the resolution, he feared, had not sufficiently applied his mind to this question. The question was whether, on the face of it, the invention was a thing for which a patent ought to be granted, having regard to prior knowledge. No doubt there were difficulties in ascertaining that, but the great difficulty of those who had to enforce the rights of patentees, was the doubt which was often expressed by judges, whether a thing was proper subject for a patent or not. When a patentee went into court, he often received the information for the first time that a thing which all practical men believed was a very great improvement, was, in point of fact, no proper subject at all. If the judge on the bench were to find that an application was endorsed by competent men to the effect that it was a proper subject, he did not say that they would be bound by it in law, but they would certainly pay great deference to it, and to go into court under such circumstances would be a very great advantage. As a lawyer, with some experience in these matters, he thought that would be a very great boon, and if they attempted to thwart the operation of the Bill to that extent, he feared they would be jeopardising their true interests. Amongst the features in the Bill of great importance, was the extension to twenty-one years instead of fourteen, and in return for this boon, patentees ought to be prepared to yield some of their favourite projects. Again, the provisional protection which in the Bills of last year and the year before was done away with, was now proposed to be granted for nine months at least, and it might be twelve, instead of six, and this was another great advantage. Again, they had now, —and for this they had been struggling—a helping hand held out to the inventor, by the office undertaking to examine the complete specification. One of the greatest difficulties that patentees had to encounter was to be left to their own devices, or to incompetent advisers, in drawing the document which should define their legal title, and they never found out whether it was right or wrong until they got into court. Here for the first time was introduced the element of supervision, and it would depend entirely on the regulations of the Commissioners whether this supervision should be friendly or hostile to patentees. If it were a friendly one, it would be an immense boon, equal, if not superior, to the extension of the term to 21 years, because for the first time legal advisers would feel confidence when they took the title deeds of a patent into a court of law. Without going into other points, he would say that there was so great an improvement in the present Bill, compared with anything that had preceded it, that he hoped they would to a considerable extent mould their opinions with a view to obtaining what they might reasonably hope to secure, rather than endanger the passing of a Bill which he believed would be greatly to their advantage.

Mr. F. J. Bramwell, F.R.S., was sorry to hear Mr. Aston say he could not agree with the resolution. He appeared to put his argument on this footing—that if they did not take care they would not get the Bill at all, and it was so good that it had better be secured, rather than run the risk of its being rejected. But he had no reason to suppose that there was any antagonism between the law officers of the Crown and the gentlemen met there that evening, who thought they had experience in the conduct of patents. On the contrary, he believed that there was a desire on the part of the promoters of the Bill to improve it in those particulars in which it might be improved? He knew, at any rate, that this was the view of the Attorney-General. That being so, while hailing the extension of the term, was it not possible that other provisions which they considered objectionable might be modified? Mr. Aston said the Parliamentary Committee recommended a preliminary examination; and, no doubt, as they had on former occasions appealed to these recommendations, it did not appear to come with a very good grace now to object to them. But it was now about ten years since there was a meeting of the Society for the Amendment of the Law to consider the question of patents, and this question of preliminary examination; and that meeting came to the conclusion that it would be desirable not to refuse any applicant his patent, in spite, even, of an adverse report. They did so on the ground that you could not have infallible examiners, and from the opinion that, if an applicant persisted, much harm could not ensue. Probably, in nine cases out of ten, the intending patentee would accept the decision with thanks, and perhaps nine out of ten of those who persisted would be wrong in doing so; but he did not think it would be so, but rather that a man would persist because he knew he was right in doing so. But even such cases they proposed to hedge about with precautions, as, for instance, that the objections should be endorsed on the specification, and that if any one brought an action on such a patent he should give security for costs, and in the event of failing upon the grounds so endorsed, should be liable for all costs as between solicitor and client. They proposed this in order that patents should not be rejected by fallible examiners. Mr. Aston limited the benefits of examinations to two things: first, to seeing that the specification was a proper and a clear one, and further, a decision whether the invention was the subject matter of a patent. But he had not alluded to the far more difficult question of novelty. By clause 12 it appeared that this was one of the things to be examined into, and it was with regard to this point that he felt the greatest misgivings, and although in obedience to Parliament, it might be well to submit to an examination, he did think the inventor should be at liberty to have his patent, though accompanied by some such precautions as he had mentioned. He might perhaps throw out as a suggestion that the examination should be optional; that one man might be allowed to say, "I want my patent without examination," and another might say, "I desire examination," and let this man abide by the chance of the examination. The result would be there would be two classes of patents—those that had been examined and those that had not. Whether an examination had or had not been made would be stated on the first of the specifications, and the two kinds of patents would have very different values. He believed that this would be found not to be an impracticable suggestion.

Admiral Selwyn fully approved the object of the resolution, which amounted to nothing more nor less than an endorsement of the American practice, in which an examination took place of an advisory character, entirely for the benefit of the inventor. He could not speak on any part of this question without bringing forward the fact most strongly, that the interest of the inventor was much more the interest of the manufacturer, and still more that of the nation, which benefited by every facility offered to invention. It was as much a fallacy to tax invention as to levy a duty on seed corn. It would be useless for England to endeavour to compete in the markets of the world if they were not to give every encouragement to inventors. The natural result of any difficulty thrown in the way of obtaining patents would be a state of things destructive of all our best interests. He declined, therefore, to discuss the question from the standpoint of the inventor, the patent agent, or the lawyer. He based it on the great ground of the benefit to the nation. An examination of an advisory character did this. It took the inventor by the hand, led him through the maze and difficulties of specifications, with which he could not be acquainted, and landed him with a perfect specification on which he possessed his right to charge the public the royalty. If he got that, instead of going to law with a number of opponents at an enormous cost, he actually enjoyed it as the result of what the nation afforded him. He made the royalty less in quantity, and the nation profited by it. The consumer was, therefore, benefited, as well as the inventor. It would be of the greatest value, therefore, to establish a Patent-office where it should not be impossible on the one hand for an inventor to obtain a patent, or on the other, if he did, that he had to charge the consumer an enormous sum, but an office that should be the friend of the inventor, and not his opponent. He ought to be able to go into a Patent-office here as he could to the American Patent-office—to find the man whose business it was from year's end to year's end to inquire into inventions such as those he wished patented, whether they were mechanical or chemical. He ought to receive full advice from him. He ought to be told the result of previous investigations, and wherein his specification transgressed previous inventions. Such a man would be a friend to him, and he would be sent away from the office, either with the full intention of dropping the matter, or seeing wherein his invention differed from others, and so able to proceed with it in such a way that he might obtain a perfect title. Much of the trouble and vexatious litigation would thus be avoided, It was quite true that there was, and always would be, even in America, litigation in regard to patents. But the cases were very few, and did not influence applicants for patents. As regarded the difference between American and English specifications, he differed from the remarks which had been made, to the effect that an American patent covered less than an English, and as to the difference of the two systems he instanced his own invention, which was the subject of an American patent as well as an English. When he applied at the American office they sent him two patents which seemed similar in their nature, but on his pointing out the difference they gave him the patent. And what was the result of this system? As Mr. Boynton had said at a recent meeting, the great superiority of America in mechanical invention and mechanical superiority was to be found in the aid given to patentees. Was there any reason why we should not go forward in the same line? He did not say imitate America in the points which were found to be objectionable, but he did say deal with the matter on a broad basis, and in a statesmanlike manner which should give satisfactory results to all. In his opinion the examination should be advisory in its character, and conducted by a competent number of examiners, no matter how many were required. The work they did would be paid for by the taxes received from the patentees. Therefore it was no real objection, whether made by the Treasury or by anybody else, to say that a great number would be required to carry on the system. He quite recognised the fact. But so there must be a large number of clerks in a merchant's office, where a great business was being done. The last argument which he had heard used against the proposal he must say was an extraordinary one, that an inventor required to be protected from himself. He had yet to learn that in other walks of life it was usual to protect men against themselves, who would be so unwise as to protect the gambler who goes to the board of green cloth, or who gambled and speculated on the turf or in other ways. And why should we protect the inventor? If the laws affecting property in that way were the same as in other matters, it would be right. But if you gave a man property with one hand, and then took it away with the other, he would not thank you, which would virtually be the result of what was proposed, if a clockmaker, say, were to decide on some great mechanical invention. Did they propose to do that, or would they follow the ordinary law, that the title to property is the inducement to wealth in every direction in which it could be produced at all in the nation. He said we ought to press forward in the recognition of great truths, and not simply remedy little matters which arose from the operation of bad laws. Mr. Aston had shown them their dangers and they were real, but they were such as existed under a very bad law, and as they had been told that the great officers of the State who had these matters in hand, were anxious to receive information on the subject, he thought it was the least that the Society of Arts could do, speaking, as its duty was the encouragement of Art, Science, and Manufactures, to give the longest time and the fullest opportunity for the most careful discussion of such an important subject.

Mr. Hinde Palmer, Q.C., was of opinion that the Bill was a very great improvement on the present state of the law, but it was quite clear, as Mr. Aston admitted, that it required amendment in some particulars. Mr. Aston had very properly said that the committee, of which the Chairman and he (Mr. Hinde Palmer) were members, reported in favour of a preliminary investigation; but that was not the first occasion upon which that had been advised, because a Royal Commission, of which the present Lord Derby (then Lord Stanley), Lord Cairns, Lord Hatherley, and other eminent men connected with the law; Mr. Forster, the member for Bradford, and Sir William Fairbairn and others, connected with manufactures and inventions, had made very similar recommendations. They all agreed in the report that a preliminary investigation was necessary. But they said distinctly that that examination should not extend to the merits or the utility of the invention, and, moreover, they restricted the nature of the examination which that Royal Commission proposed to a greater extent than what the Bill now proposed, that the examination should extend to novelty, as derived from existing publications in the Patent-office. But this Bill, as it stands, contained a dangerous extension of that inquiry, because it said it was not only to be novelty according to former specifications and other documents in the Patent-office, but it was to extend to publications known to the examiner himself. In his opinion that was an extension of the powers of the examiners, which was dangerous. He should propose that that clause should be omitted, even if the inquiry into the novelty of the invention were allowed to stand as regarded previous records contained in the Patent-office. But that was not all, because it had been said on several occasions that an examiner might take an erroneous view of the novelty of the invention. He might think it sailed so near the wind that, in his opinion, it had been anticipated in some degree by previous inventions; and yet, although it might be very nearly the same, it might not be quite. Yet he would, perhaps, refuse the application on the ground of want of novelty. There was great danger in that. Therefore he was inclined to support Mr. Lloyd Wise's proposition, although he was not sure that it was necessary, on the face of the Bill, that such an amendment should be made, because the inventor had twelve months wherein to perfect his specification. [A Voice—Nine.] Be it so. Therefore he did not see why, under the Bill as it at present stood, when he came to file his complete specification, he might not be able to do what Mr. Lloyd Wise proposed, by amending his specification by inserting a definite statement of what he claimed. He was aware that was open to the objection that the examiner might still adhere to his previous view and so report against it. But he did not see any objection to a clause of this kind:—"That no adverse report of an examiner as to novelty, even with a right of appeal, shall preclude the applicant from obtaining a patent at his own cost and risk, and that opportunity should be given to the applicant of amending his specification by inserting reference to matters discovered by the authorities with a definite statement of what he nevertheless claims." That would be a useful alteration in the law. But the difficulty on the face of it was said that we were sending an inventor forth to the world with a blot on his title.

Mr. Aston—It would.

Mr. Hinde Palmer—But, nevertheless, if he is willing to take his patent in that form, if it was to be done at his own risk, he did not see why it should not be allowed. And, after all, it would only come to this, that the recitals in the specification would contain reference to previous specifications on the same subject-matter, and it would make the specification clear, by showing what he claimed out of the whole thing as purely novel. If the propositions were framed in that way, he should be inclined to support it. He would, therefore, propose that amendment, which would be merely striking out some two or three words in reference to publication of reports, which he thought might come in in another place. If they were to have a preliminary examination at all, it must go for something, but nevertheless, in special cases of this description, which involved a great degree of nicety, he must say that there ought to be a degree of latitude allowed to an inventor, at his own cost and risk.

Mr Lloyd Wise said he could not accept the amendment. It would allow publication of reports containing opinions rendering a patent commercially valueless. His plan would equally protect the public, without importing mere opinions that might be erroneous.

Mr. Galloway seconded the amendment. He spoke as an inventor, and his desire was that the inventor and the Commissioners should come face to face, so that they might fully understand each other.

Mr. Coryton did not think the resolution was quite consistent with the practice of Englishmen. It was proposed by the Bill that competent men should be appointed to examine patents, but the resolution said that whatever decision they came to a man should still have his patent, and that was not the principle on which business was ordinarily transacted. You could not expect perfect justice in this life, but certain machinery was provided for endeavouring to obtain it. When a patentee went into a court of law, he had to submit to the decision of twelve men, who decided to the best of their ability under the direction of a judge, and if this Bill passed he hoped they would get competent men with competent knowledge to decide on the same questions, and he did not see why their examiners should go for nothing. He feared if the resolution were carried it would lead to a great deal of litigation, and be a great misfortune. The Bill was a great boon; it might be almost called a Bill to remind the Crown of its duties.

There was the coach of state to be driven, but they had no horses to do it; then horses were provided who would not work; next, when good horses were provided they were not allowed any oats; but now it was proposed that oats should be provided, and if this were fairly carried out, he did not see any necessity for the resolution.

Mr. McFarlane Gray supported the resolution, because it would protect the public against the intolerable nuisance of people with grievances, which would inevitably arise if patents were refused absolutely by the examiners.

Mr. Cowper thought the constant opposition to people obtaining patents, which would follow from these examinations, would have the effect of driving inventors away. It would be very unjust that an examiner should be called upon to pass a final opinion on an invention with regard to a matter on which he had no special knowledge.

Sir Francis Knowles, F.R.S., supported the amendment. It was proposed to have a committee, or commission, of five or six gentlemen, whose duties should be limited to the preliminary examination of the inventions proposed for patents; but these gentlemen would act in private, though they would have to discharge the duties now performed by a sworn jury under the eyes of the public, aided by experts giving evidence on oath. In fact, these preliminary examinations would only amount to a provisional verdict on the patent, and the patentee would, after all, be placed in no better position than at present. He would be equally exposed to infringement and to the costs of litigation. As an inventor, he should say, "Examine my invention as much as you like, but then let it go forth under the protection of the Government." He might repeat what he had said before—that they should allow no further speculative infringements, and that could be attained by cheapening the remedy by *scire facias*, and by permitting no issue to be raised in a patent action except that of infringement and the quantum of damages.

Mr. Mundella, M.P., said he had derived great advantage from hearing Mr. Aston's speech, on the scope and character of the Bill. One thing at least he had proved, that the two Bills which had preceded the present one, and which had been successfully opposed, were hostile to inventors, and would have had for their object to limit, and, as far as possible, strangle patents. The present Bill was no doubt in many respects a better one, he did not say that a good Bill might not be made out of it, and he hoped they would address themselves to that object. Whenever anything was said against any part of it, it was urged that the Committee of the House of Commons had reported in favour of it, but he might remind them that "many things had happened since then." Opinion had changed a good deal about patents within the last few years, and it must be remembered that the committee was appointed on the motion of a member who wished to abolish patents altogether. There were also gentlemen on the committee, who were not so hostile as Mr. Macfie, but who still had the capitalist's objection to patents, and there were others who shared the prejudice that patents must be kept in check, and that they were on the whole rather prejudicial to the public. Now patents were either good or bad; if they were good you could not have too many of them, and if they were bad you ought to have none at all. He maintained that they were good, and very advantageous to the public. In the reduction made in the first cost, the present Bill was a great improvement on its predecessors; but after hearing the speech of the Attorney-General, he did not think it was conceived with the benevolent idea of fostering inventions, and that a good deal might be done to improve it. He was very anxious that whatever was done by that meeting should be done cordially and unanimously, so that one party might not be played off against the other. He believed patents were in the interest of the public, not merely of the inventor. What was England at the beginning of the century? There was a population of 9½ millions in England and Wales, a great many of them starving; now they outnumbered 25 millions, and at the present rate of increase they would be 50 millions in another 50 years. How were all the people to be fed? The land of the country was rapidly becoming a playground and kitchen garden, and the people must be fed by manufacturers. But they could only maintain their position as manufacturers by inventions, and in the future they would have to depend increasingly on the fertility of their brains. Their policy as the first industrial country in the world was to make England the depôt for inventions. Whenever a man had an invention of utility and novelty, this was the country where it ought to be his interest to bring it, but for some time past this had not been the case. Many men had been driven to America, because there patents could be obtained so much more cheaply. The American law was quite as stringent as that of the proposed Bill, but in practice they dealt liberally with inventors, though they had the power of rejecting flagrantly bad patents. The examination was in the interest of the inventor, to enable him to make a clear specification. In England the patent agent told him to make his claim as wide as possible, but in America the examiner narrowed it down to the actual invention. The American system consequently reduced enormously the cost of obtaining a patent, as he could say from experience, and though the patent agents' fees were much lower, he did not know that they were worse off, because they did more business. He agreed to some extent with Mr. Aston, but he objected to any examiner rejecting a patent for want of novelty, because some of the most useful inventions had been rejected by experts in the trade on the very same ground. It was always the reception of a good invention, "Oh! this is nothing new." He could mention the case of a man who had worried his brains for years and beggared himself in producing an invention which everybody laughed at—simply an ordinary knitting-hook, with a little flange to fall down over it—Townsend's needle—and it was some years before it was appreciated; but it had revolutionised the knitting trade of the whole world, and abolished three-fourths of the complicated knitting machinery. They knew also that Mr. Bessemer's process had been rejected in Prussia for want of novelty; but Krupp afterwards patented it, and this cost the Germans, in four or five years, some millions of thalers. The first thing wanted, in his opinion, was a reduction of fees. Some said that a poor man could not afford to take out patents; but he objected to that view altogether. The question was, had a man a right to get protection for his invention? If he had, the cost should not be so great that any man, however poor, could not get a patent. In Belgium the inventor paid ten francs originally, and then the fees increased every year. According to the proposed new law, in Germany, a man must pay 20 marks when he applied for his patent, and 30 more when it was granted, making £2 10s. when he got his patent, and then the fees went on increasing from year to year up to the end of the term. That, he thought, was a sound principle; because you gave a man his patent in the first instance at a very small cost. He had his invention sufficiently protected, and he could then go to a capitalist and deal with him on fair terms. If it became successful, he would be willing to pay more, and if it were not worth preserving it would drop. He objected to the principle of compulsory licenses; and it must be remembered that whatever was done in England would be done in other countries, and when an English inventor went to Germany or France he would find there he would have to grant compulsory licenses, if he did not do certain things which the State required. Were they prepared to let a German or French Commission decide the terms on which they could grant licenses? But that would be the effect of imposing such conditions in England, and he feared it would also drive away many useful patents. A man did not get a patent for the purpose of bottling it up, but to make it a marketable commodity. Mr. Aston informed him that he knew of only two cases of "dog in the manger" patents in his life, and, for his own part, he had never known of one. He believed that this Bill, with these amendments, would greatly improve the Patent-law.

The Chairman, in summing up the discussion on this resolution, said he had no doubt that it was one of the most important on the programme. It struck at the root of a principle which he believed was essential to the passing of the Bill. He believed the Government had made up their mind to pass the Bill, and that if they passed a resolution against it, they would rather damage than assist the cause they had at heart. The principle of preliminary examinations had been accepted by previous committees, and by a Royal Commission, and he was glad to see that both in the terms of the resolution and of the amendment that principle was accepted. He agreed with what Mr. Aston said, although he knew that view would not be shared by the bulk of the meeting. At the same time, so far as his opinion went, he did not attach quite so much importance as Mr. Aston did to the latter portion of this resolution. It meant that when a patentee had filed his specification, and an examiner reported against it, he was still free to go on. It seemed to him, under these circumstances, that if a patent were granted to him, it would be illogically granted, and he did not think it would be of very much use to the patentee. There was one other point in the Bill which no speaker had yet touched upon, which appeared to be an injustice, but which, no doubt, the Government would not be indisposed to remove, namely, that if a patentee filed his specification, and found afterwards that a patent was not granted, he was, by the terms of this Bill, obliged to disclose the nature of his invention. Thus he had disclosed what the invention was, and yet was not in a position to profit by it. But that appeared to be wrong in principle. Whether there was any practical importance in it he did not know; perhaps the inventor would not lose much, but it was essentially one of those points which were unjust in principle, and were readily capable of being remedied when the Bill came into committee.

The amendment was then put and lost, and the original resolution carried.

Sir Antonio Brady then moved the adjournment of the discussion until the following Friday, at seven o'clock, which was carried unanimously.

Mr. Lloyd Wise moved a vote of thanks to the Chairman, which concluded the proceedings.

Mr. Fleeming Jenkin, F.R.S., writes as follows:—

3, Great Stuart-street, Edinburgh.
March 1st, 1877.

Dear Sir,—I regret that I cannot be present on the 6th. The point in which I am most interested has reference to the preliminary examination by the Government referees. The Bill proposes to give an appeal to a court of law. This will either entail a great injustice to many inventors who may be unjustly condemned by the examiners to this abnormal and extremely expensive mode of obtaining a patent, or it will make the examiners unduly lenient. They may feel that practically their decision is final, and so give far too many patentees the benefit of the doubt, as is the case, I believe, in America. The former alternative is, I believe, the result of this provision in America.

Both dangers would be avoided if the examiners were merely a consultative body, giving mere opinion for the benefit of the public, and the patentee an opinion published with each patent. Of course in the great majority of cases the opinion of the examiners would be accepted by the patentee.

In any case a provision should be inserted, allowing the patentee to amend his specification, and send it up for consideration a second time for a smaller fee, than he would have to pay if he sent it up as a new patent.—Yours, &c., Fleeming Jenkin.

P. Le Neve Foster, Esq.

FOURTEENTH ORDINARY MEETING.

Wednesday, March 7th, F. Bramwell, F.R.S., in the chair.

The following candidates were proposed for election as members of the Society:—

Clark, Mrs., 24, Upper Woburn-place, Tavistock-square, W. C.
Farmer, John S., Kilburn-house, Kilburn, N.W.
Hall, Admiral Sir William, K.C.B., F.R.S., F.R.G.S., 48, Phillimore-gardens, W.
Hamilton, George, F.C.S., F.R.A.S., Queen's College, Liverpool.
Hart, James, 18 and 19, Fenchurch-street, E.C.
Isaacs, Lewis H., 3, Verulam-buildings, Gray's-inn, W.C.
McAlpin, Kenneth, Llanion-terrace, Pembroke Dock.
Mudie, John, Burton-on-Trent.
Niven, John, Gas Works, Clayton, near Bradford, Yorkshire.
Perrett, Edward, 23, Abingdon-street, Westminster, S.W.

The following candidates were balloted for, and duly elected members of the Society:—

Cohen, Mrs., 6, Holland-park, Notting-hill, W.
Copland, William Robertson, 83, West Regent-street, Glasgow.
Eve, Henry Weston, 37, Gordon-square, W.C.
Garnett, George, The Friars, Monkton-street, Ryde, Isle of Wight.
Hildebrandt, John Albert Rheinhold, A.I.C.E., M.I.M.E., Bow-chambers, 55, Cross street, Manchester.
Morris, Joseph, Stopford-road, Jersey.
Morton, Robert, 22, The Chase, Clapham-common, S.W.
Nathan, J., 38, Elgin-road, St. Peter's-park, W.
Peto, Henry, 10, Stafford-terrace, Kensington, W.
Steet, G. Carrick, Medical Department, General Post-office, E.C.
Strongitharm, Augustus Horace, Barrow-in-Furness.
Volckman, William, 43, Victoria-road, Kensington, W., and Buckingham Club, Waterloo-place, S.W.
Wigner, George William, F.C.S., 79, Great Tower-street, E.C.

A lecture was delivered on—

THE GROWTH AND PRESENT POSITION OF THE SCIENCE OF MACHINES.

By Professor A. B. W. Kennedy, C.E.

I have to-night to endeavour to give you a sketch of the development of a science, or branch of science, in which the members of the Society of Arts may be supposed to have some special interest—the science of machinery. Like other sciences, this one began to grow long before it existed. Anything like a complete scientific treatment of machines—their form and objects and dimensions—is of very recent date, and even the first faint traces of such a treatment do not date back more than a century and a half. Without going back to Hero or Archimedes, however—to say nothing of Aristotle—I must start at a somewhat earlier period than that I have named, if I am to give you, as I hope to be able to do, any connected account of the way in which machines have been viewed and treated by the men most capable of thinking about them, from the time when they began to put their ideas into writing—from the time, that is, at which their ideas first become known to us. We shall find that it is hardly possible to say exactly when these ideas first took anything like a scientific form, and it is not a question in which one can feel any great interest. It is more important and more instructive to notice that we can trace continuous, uninterrupted development, step by step, from Ramelli and Leising right on to Tredgold, Willis and Rankine, Monge and Hâchette, Redtenbacher and Leuner, and Reuleaux. It is the course of this development which I wish now to indicate to you.

At the outset, let me just remind you that it is not the growth of the machines themselves about which I have to speak, but the growth of their theory. Many names that are familiar in connection with the former have little place in regard to the latter, as you will find, and *vice versa.* Nor have I this evening to do directly with the growth of the science of mechanics, which I find had, by a little oversight, been announced as my subject. The general course of the connection between mechanics and machine science has been something like this:—At the very beginning mechanics was certainly identical with the science of machines, but although this was the case—although, that is, the science of mechanics contained all that was scientifically known about machines—yet we shall find that the two were in reality very far separated. The engineer made his machines with scarcely any knowledge of mechanics, the mathematician evolved his mechanics with very little reference to machines. In time, the nominal connection between them grew weaker, as the science of mechanics received higher and more general treatment, while, again, later still, we find certain portions of that science specially connected with engineering treated by themselves as "practical mechanics," the more general treatment of the subject for its own sake being called "theoretical mechanics." By this time, however, machine science, or some part of it, had begun to have separate existence, and stood beside, rather than coincided with, mechanics.

With this much of introduction, I may enter at once into my subject.

The literature of machinery dates from the latter part of the sixteenth century, and then it certainly makes an excellent start. Within a few years of each other appeared the "Mechanicorum Liber," of Guido Ubaldus (1577); the "Theatrum Instrumentorum," of Besson (1582); and the "Arteficiose Machine," of Ramelli (1588), each of them a substantial folio, such as a modern publisher would scarcely venture to bring out, and a modern public would hardly purchase very largely.

Let me indicate to you, as briefly as I can, the view of their subject taken by the writers I have named, and others of the same epoch. Its most noticeable characteristic is perhaps the absolute separation between mechanics and machinery which I have already mentioned. In the time of Archimedes, the mathematician was the engineer; the student of mechanics was the inventor of machines. During the centuries that had passed over the world since then, their relative position had altogether changed. The bulky "Mechanicorum Liber"—which consists of treatises on the balance, the lever, the pulley, the wheel and axle, the wedge and the screw—contains little that had not been given by Greek mathematicians centuries before. The problems are much the same, the point of view from which they are looked at is much the same, the solutions are much the same. Nominally, they have to do with physical data and phenomena; actually, they are no more than geometric exercises worked out in the study. But while the science of mechanics was thus in its infancy, gradually becoming a not unimportant branch of mathematics, the class of men to whom in time it was to be of the most direct value—the forerunners of our present engineers—had found themselves face to face with a very different set of problems. They had had to make pumps and water-wheels, mills, apparatus for land and water transport, hoisting apparatus, bridges and roads and viaducts, and so on. Everyone of these brought them into direct contact with nature. Their difficulties were not connected with lines and circles, and mathematics could help, as yet, very little in solving them. They had to deal with some of the most complex problems in physics—problems which, even now, we have not completely mastered; and physical science was as yet unborn. It must be admitted that the cut-and-dried lever and wedge and wheel of the mathematician, and his neat geometric figures cannot have appeared to the engineer, struggling mightily to utilise and control forces which he could not see and energies which he could not understand, to have much direct bearing on his work. We cannot wonder that, when at length he became articulate, his utterances took a form very different from those of the writers on mechanics.

The "Mechanicorum Liber," as I have said, is a collection of treatises on the mechanical powers; that unfortunate jumble of apparatus which has played the part of the "old man of the sea" to machine science, and which we have scarcely yet got altogether thrown from our shoulders. It is purely theoretic, and its theory is, in general, sound enough and useful, of course, now that we know how to apply it. At the time, it was no doubt regarded as a mathematical book, the "simple machines" only illustrating mathematical problems, and not as setting forth in any way the principles upon which machine design was based.

The "Diverse et Arteficiose Machine" of Ramelli, and the "Theatrum Instrumentorum" of Besson, are much more interesting to us. The authors were both men of distinction in their time, Captain Augustus Ramelli being an engineer in the service of the "most Christian" King of France, to whom he dedicates his book, and Besson, a doctor of mathematics.

Their books, therefore, which are very similar in form, will enable us to form some idea of the way in which the best engineers of that time looked at their work. Ramelli's, I may mention, is given, chapter by chapter, in both French and Italian; Besson's is in Latin, but a French translation of it was published in 1596. They consist solely and simply of descriptions of machines. There is absolutely no reference to general principles, not even to the mechanical powers. One plate (the engravings in the "Arteficiose Machine" are extremely beautiful) follows another, and for each there is a separate description. A connection is recognised between machines having the same general purpose, but this purposive connection seems to be the only relation distinctly realised by the authors. Ramelli, *e.g.*, begins his book with a hundred and thirteen machines for raising water. Each one has a plate and a description to itself, and each description begins in the same way: "C'este cy est un autre façon de machine par laquelle." . . . "Une autre façon de machine par laquelle." . . . "L'effet de ceste autre façon de machine est de faire . . . monter l'eau," and so forth, and goes on to detail the whole construction *de novo* from the suction-pipe to the discharge-nozzle. In this way, nearly every machine is described many times over; each one comes first worked by a water-wheel, and then by a man or an animal. Then the same machine reappears, with such minute alterations as the substitution of a figure of Neptune for the pipe through which the water is discharged, &c. But each time the whole description is repeated. Further on, come other machines, possible and impossible, treated in just the same way. A screw lifting-jack, for instance, is a machine for lifting a prison door off its hinges, and after being described separately once, is several times re-described in this particular application. A wrench is a machine for breaking the bars of a grating, and so on.

The authors of these early *theatri* view each machine, as a whole, only as one piece of apparatus, intended to do one particular piece of work. They recognise that, as a fact, it is made up of a number of different pieces; but, as soon as any one piece has become part of the machine, it seems to lose its identity; it no longer has any separate existence. An exactly similar piece in the next machine has to be again described, and so on in the next, and the next. Everything, moreover, as I have said, is looked at purposively in the most specialised fashion. The general ideas of, and of course the corresponding words for, pump, crane, hoist, wrench, and so on, are wanting. One is a machine to lift water from a well by means of a man; another to lift water from a river by means of a man; another to lift water from a well by means of a water-wheel; one to raise water for a fountain by means of a water-wheel; another by which a man can raise water for irrigation; and so on with the other classes of machines.

Then, further, there is no critical examination of the machines whatever; not even a statement that one is better than another, or simpler or more efficient. There is nothing but a statement of the machine's purpose, and a description of its construction. Ramelli's descriptions are very detailed, his plates being carefully lettered throughout. Besson's descriptions, on the other hand, are not nearly so minute, for the reason, among others, that his system of references is not a very convenient one. To avoid putting letters on his plates, he uses special names for top and bottom, right and left, calling them septentrionale, meridionale, orientale, and occidentale (these words being printed on every plate), and also special names for the corners, and then indicates, by the help of these, the portion of the plate in which any particular detail is to be found.

It must, of course, be remembered that the machines described in the *theatri* had no actual existence in many cases. Which did exist, and which did not, is, of course, now impossible to say, but certainly many of them are physical impossibilities (the lazy-tong bridge and the ship-lifting lever, for example). Ramelli's machines are drawn in such minute detail that I cannot help believing that he actually made models of them, from which his drawings were made. Besson, on the other hand, while far less minute in his details, contains fewer machines which are obviously mere inventions never practically executed.

The drawings in all the works of this time are, of course, in perspective, not arranged in plan and elevation—an improvement which was not long in coming.

I have endeavoured to give you some notion of the light in which the machine appeared to the very earliest authors who gave it a place in literature, at a time when as yet machine science did not exist. We have now to trace the growth of this special branch of literature and the development of the science to which it gave rise.

The attempt to connect mechanics with machinery was very soon made. In 1608, the first volume of Leising's "Theatrum" was published, in which the editor, mourning over the lamentable ignorance of practical men, incorporated a translation of a short Latin treatise, lately published, on "The Proper Foundation and Understanding of the Balance and Weight," by "that learned and honourable physician and mathematician, D. Eualterus Herminius Rivius," to which he added some general chapters on the meaning of the word machine, the scope of machine study, the origin of machines, the first inventors, and so on. But, as was to be expected, the introductory treatise, which is to give all readers full instruction for the understanding of all the machines, has, after all, very little to do with what follows. The author soon gets tired of his high horse, and descends to very perfunctory descriptions of his plates, which are to a great extent inferior reproductions of those given in the earlier and larger *theatri*.

The work is notable, chiefly on account of the distinct recognition in it, by an engineer, of the fact that his art had also a science. For, although many former works on mechanics had professedly treated of the science of machinery, it is obvious that, to the actual engineer—the veritable constructor of pumps and water-wheels, and other such "engines"—no such science existed. He worked away at his clumsy, but useful contrivances, without saying—or, at least, without writing—much about them; but the lever and the balance, in their mathematic form, were wonders to him, mysteries—things hard to be understood, but greatly to be respected. He did not recognise at first that they had much connection with his work, although he was continually making use of them. And this is not to be wondered at, for the theorists delighted chiefly in describing the enormous loads which could be raised by them, and the smallness of the effort required for that purpose; their levers would do anything—on paper. But he, poor fellow, found that the nearest approach he could make to the mechanician's lever was a ponderous, unwieldly wooden bar. It certainly gave him a very distinct "mechanical advantage;" but then, the effort required to move his load was something out of all comparison with the breath, or the touch of a straw, or pull of a thread, which ought, with a real lever, to do such wonders. And, worst of all, his lever required a very considerable effort to move itself, and that very few of the paper levers seemed to do. Thus, altogether, we cannot be astonished that he failed to discover at first any definite connection between his own machines, which were so hard to move, and these wonder-working contrivances, that did so much with so little trouble. They belonged to distinct *genera*. Herr Leising is not moved to astonishment over his pumps and bridges, and lifting-jacks; it is only of the "lever" that he tells us, very philosophically, that, "when we consider the matter, we shall find that those things which perform wonderful actions must spring from wonderful causes." "Is it not extraordinary," he says, "that an extremely heavy load can be easily raised by adding another weight to it?" and proceeds to discourse on the wonderful qualities of the circle, "the most beautiful, complete, and strong of all figures," and, following Aristotle, traces to these all the mechanical wonders of machines.

The timid attempt of Leising to combine mechanics and engineering was soon followed by bolder steps in the same direction. The work of Solomon de Caus, "Des Forces Mouvantes," was published in 1615. It differs from its predecessors in several points. There is a distinct recognition of the connection of machinery with physical science generally, and there is really some attempt to place machine problems on a scientific basis. The attempt breaks down altogether, as did most other such attempts for more than a century after the time of Caus; but it is not with its success, but with its existence that we have here to do.

His book commences with a series of physical definitions and theorems, and then, after examining the "mechanical powers," he goes on to "problems," which are, for the most part, such as require for their solution simply the description of a machine, old or new. Between the theorems and the problems there is no direct connection, but a stage had been reached at which it was recognised that engineering problems were based on physical and mathematical science; and that was a great deal. But the sciences had to advance much further before they could be actually applied to the complex problems of engineering, so that at present they could simply be put side by side. It was reserved for after generations to show the real nature of the connection between them.

Caus does, however, make two distinct and important steps forward. First of all, in his plates he shows the essential parts of a machine, sometimes apart from their ornamental surroundings. The head of Bacchus, through whose mouth water is pumped, is no longer as necessary to the pump as the piston itself. And secondly, he gives what may be called "working drawings" of their details, in the conventional representation now universally used, and called orthographic projection. He calls such a drawing an "orthographie." Previously all drawings of machines had been given in perspective. All engineers will recognise the importance of this change. In this book, then, which is before you, is perhaps the first published working drawing, or scale drawing, of any machine.

I am sorry to say, that our own country did not do much at this time towards the development of machine science, whatever may have been done here in improving machines themselves. The first work in our own language upon mechanics, and almost the first work on the subject published in England, bears on the title page the inscription, "Mathematicall Magick, or the Wonders that may be Performed by Mechanicall Geometry. In 2 Books. Concerning Mechanicall $\left\{\begin{array}{l}\text{powers.}\\ \text{motions.}\end{array}\right.$ Being one of the most easie, pleasant, usefull (and yet most neglected) part of Mathematicks, not before treated of in this language. By J. W., M.A." The author was no other than John Wilkins, afterwards Bishop of Chester, at that time chaplain to the Prince Elector Palatine. He has certainly succeeded in producing a very entertaining book, but it cannot be said that he did anything to advance the science of which he was so much enamoured. I fear, indeed, that his book had an opposite effect, if it had any effect at all. The Bishop seems to have been chiefly attracted by those parts of his subject which savoured of the marvellous, in this as in his other writings. He gives us a drawing, for instance, of a train of wheel-work and pulleys, by means of which a puff of breath, or a pull by a hair, or a push with a straw, could uproot an oak-tree, or, "a power, which is much less than the one-hundredth part of a pound will bee able to move the world;" and he gives us all his calculations to show it. But, as usual, the poor engineer fares but badly at his hands, for he goes on, "It were needlesse to set down any particular explication how such mechanicall strength may be applyed unto all kinds of local motion; since this, in itself, is so facill and obvious that every ordinary artificer doth sufficiently understand it." Wilkins was very credulous as to everlasting lamps, and subaqueous travelling, flying chariots, and so on. In speaking of flying, he tells us that "the wings of a bat are most easily imitable; perhaps nature did by them purposely intend some intimation to direct us in such experiments, that creature being not properly a bird, because not amongst the *ovipara*, to imply that other kind of creatures are capable of flying as well as birds, and if any should attempt it that would be the best pattern for imitation." One good service Wilkins certainly did, however. Although most amusingly anxious to discover and believe in a perpetual motion, he examines a number of proposed arrangements for that purpose, and points out that all of them are based on misconceptions, and that all have failed on trial.

After the time of Caus no very considerable progress seems to have been made until near the close of the century. The "Nouvelle Invention de lever l'eau," of Isaac de Caus, engineer and architect to Charles I., published in London (in French), in 1657, does not show much difference from the work of the elder Caus, from whose book most of his engravings are copied. During this period appeared also Moxon's "Mechanick Exercises; or, the Doctrine of Handyworks" (1677, and intended to be continued monthly). It is a detailed description of the construction of lathes, tools, locks, &c., and of technical processes and methods, and was thus entirely untheoretical. No doubt the book was a valuable one in its own range and period, although it does not concern us here.

Towards the end of the seventeenth century we can see distinct marks of progress, made, no doubt, slowly, but becoming visible to us more or less suddenly. Of these, the two most important are the use of geometrical construction in the solution of mechanical problems, and the consideration of the strength, or molecular resistance, of the materials from which the machines are formed. Of the first of these I shall have to speak further on. I shall only say here that the earliest work on mechanics in which I find constructions systematically used, in place of elementary algebraic proofs or arithmetic illustrations, is the "Traité de Mécanique" of the mathematician De La Hire (1695), which, on this account, marks certainly a notable epoch. It is worth noticing that De la Hire, in resolving forces, uses a triangle, and not a parallelogram. The overpowering influence of Newton, coming but a few years later, has made the use of the parallelogram almost universal, and it is only within the last few years that we have returned to the simpler figure. Even now, in books from whose authority one would not expect it, we find that conservative instincts have overmastered reason, and the student is told to draw five lines in order to see half the solution of a problem which can be perfectly solved by three.

De la Hire's work is also remarkable as being one of the earliest in which the resistance of materials to fracture was treated of. This subject, the "strength of material," which now forms the physical basis on which a large branch of machine science—namely, machine design—rests, was first worked in by Galileo, who published a theory of beams. Mariotte had, at this time, also written on the same subject. De la Hire introduces it as an essential part of mechanics, which meant, with him, the science of machines. In his chapter on the subject he adopts the theory of Galileo, which was an erroneous one, but which, nevertheless, in certain special cases, gave results identical in form with those now known to be true. In the absence of experiments to determine the value of constants, of course the theory, right or wrong, did not admit of any direct application in machine design. Another century had passed before we find traces of rational proportioning, by engineers, of the dimensions of the rods, or links, or beams of their machines to the loads or pressures they had to sustain.

Some practical work in machine design, however, De la Hire did, for he gave constructions for determining the forces of cams, and of the teeth of spur wheels, which might have been, and no doubt were, used in practice. If this were the case, we have here the first definite point of contact between the theoretical mechanics of the time, and the actual work of machine design or construction.

In passing, I may mention, that just at this time, viz., in 1696, the second English work on mechanics was published. Its title gives a good idea of its general drift, "Mechanick Powers: or the Mistery of Nature and Art Unvailed; showing what great things may be performed by Mechanick Engines in removing and raising vast weights with little strength or force; . . . . . a work pleasant and profitable for all sorts of men, from the highest to the lowest degree, and never treated of in English but once before, and that but briefly." Its authors were Venterus Mandey and James Moxon. While the work of these worthies was doubtless a useful one to many readers, it does not in itself do anything to advance machine science.

The chief article of faith of writers on machine-mechanics up to this time, and indeed for long afterwards, was, that certain contrivances called "mechanical powers," or "simple machines," were the elements from which all other machines, "compound engines," as they were called, were built up. There can be few things more remarkable in the history of science than the way in which this statement has been repeated and repeated, for centuries, without the least hint that it was not all right, by men who would have seen, if they had but honestly thought out the matter for themselves for five minutes, that it was not true. It is a somewhat striking commentary on the value of the historic argument for the truth of an opinion or hypothesis. The statement was first made by those who, with very limited knowledge and experience, really believed it to be true; it was repeated over and over again by others of greater knowledge and experience, simply because they would not take the trouble to think for themselves, to throw off the overpowering pressure of an ancient and venerable tradition.

The matter becomes in this case the more remarkable because no two writers agree as to which combinations are to be called the "mechanical powers," nor how they are related to each other, nor indeed of what each one essentially consists. Still less does anyone succeed in showing, either by analysis or synthesis, how the compound machines are built up from the simple ones. This very vagueness, no doubt, added greatly to the ease with which they might be dogmatised about. But no sham can exist without doing evil, and here the evil has been lasting and serious. Attempts to apply mechanics to machinery began naturally enough by applications of mechanics to the mechanical powers, the simple machines. But their beginning was their end. The connection between the simple and compound machines was so obvious that it went without proof, while at the same time it was so subtle that all attempts to get hold of it were failures. And so for two centuries we have over and over again the same story. The writer of a treatise on machine-mechanics gives us drawings of impossible levers, improbable screws, and unheard of wedges, and duly repeats, with more or less of variation, the received theory of these instruments, and here he stops. I fear the average engineer did not derive much benefit from his well-intentioned instructor. His lever was not a bent rod resting upon a triangle like the lever in the books, his screw never would do the wonders that it ought to have done, and his "compound engines" did not, in general, contain wedges or "funicular machines." We recognise that there may have been some good ground at one time for the now traditional distrust of "practical" men for what they call "theory!" Certainly at one time the theory may have been called unpractical in the fullest sense of the term.

From the beginning of the 18th century the interest in the "marvellous" characteristics and properties of machines diminishes, and they are treated much more as familiar things. A healthy spirit of scepticism, moreover, respecting the prodigies to be performed by the mechanical powers, began to spring up. Thus Sturm, in his "Mathesis Juvenilis" (of which a translation was published in London in 1708, and which was a very great advance on Mandey and Moxon), devotes a good deal of space to the demolishment of Archimedes and the world-moving lever with which tradition credits him. After elaborately estimating the probable weight of the earth, he calculates through how many thousand million miles Archimedes would have had to move his hand in order to move the earth the thousandth of an inch, assuming most exactly that the earth rested on his lever at one foot from the fulcrum, and that he could exact a pull of a hundred pounds, and calculates also how many hundred million years the operation would have occupied. From this very matter of fact point of view, he comes to the general conclusion that a great deal of the "tall talk" which had been indulged in as to the power of the lever and so on, was nothing more than talk, and was, therefore, much to be deprecated. He was one of the earliest to realise clearly a point that had been known well enough before, viz., that (to use his own words) "the immense force of the mechanical powers . . . . . would be infinite and altogether stupendous if it were not that the greater their force is the more slow their operations are." His services in this respect deserve special mention, for the matter was one which had led to the writing of much nonsense. The worthy Bishop Wilkins, for instance, although he knew the fact perfectly well, and even wrote a chapter about it, yet seemed to realise it so imperfectly, or else was so enamoured with anything savouring of the marvellous, that his knowledge of it does not for a moment prevent him from giving a detailed description of his tree-raising machine and others of the same sort, or from such statements as these:—"By these mechanicall contrivances, it were easie to have made one of Sampson's hairs that was shaved off, to have been of more strength than all of them when they were on."

Having mentioned Sturm (who was a professor at Altorf), I may further use his work as an illustration of the utter helplessness of the system of mechanics, based upon the "simple machines," in the presence of the more complex instruments of every-day life. In the "Mathesis Juvenilis" is a chapter headed, "Compound engines and their forces, which may immensely be increased." Here was certainly the place to say something about the important machines used in the arts, with at least the existence of which he must have been perfectly familiar. But it is obvious that he did not really believe these machines to be formed from his elements, for he can only mention two "compound engines," of which one was the lifting jack, and the other a machine like that "probably" used by Archimedes (the "Charistion") for drawing his enemies' ships out of the water. Engineers looking to the book for help in their work, had to content themselves with this, and the cheering intimation, than besides these two "compound engines," "there are innumerable ones daily invented, as also several that have been actually made and tried by experience!"

The well-known "Theatrum Machinarum," of Leupold (1724), marks an epoch in the literature of machinery. It is an immense work, extending to nine folio volumes, and containing descriptions of all the principal classes of machines used in the arts. In it we can mark most distinctly the transaction from the old to the new standpoint, from wonderment and criticism. (Two earlier works cited with favour by Leupold, Mögling, and Jungnickel, no doubt led up to him, but these I have not been able to find in London.) Leupold was a competent mathematician as well as a practical engineer, and his critical remarks are often sound and acute enough, taking into account the state of contemporary science and practice. The most notable feature about the work is one which the author does not remark or appear conscious of. To Leupold the machine is no longer a whole—as to Ramelli and Leising and most of the earlier writers—but a combination of parts, each of which may be isolated and examined separately. Leupold does not state this anywhere, in as may words, he simply takes it for granted—no doubt in this merely carrying on one step further a process which had been developing itself for a century past. After his definition of a machine, which runs:—"A machine or engine is an artifice by which some advantageous motion can be obtained, and something moved with a saving of time or force which would not otherwise be possible," comes the stereotyped "Machines are either simple or compound. The simple machines are the so-called mechanical powers," viz., . . . and so on. . . . . . "Compound machines consist of two or more similar or different simple ones." But like every other writer, he no sooner makes the statement than he throws it aside and uses it no more. He goes on to treat in separate chapters, and in similar ways, not only the mechanical powers but also cranks, fly-wheels, pendulums, cams (oval discs, he calls them), lazy-tongs, weights and springs. In these chapters, and throughout his book, it is evident that he looks at the machine essentially as a combination of mechanisms, the first great step in machine analysis. Leupold also treats systematically the external moving forces or agents, and the means employed for most conveniently utilising them; cranks and wheels for human and animal power, the sails of wind-mills and the wheels of water-mills. He has a chapter also on the "force of fire," but of this, perhaps, the less said the better, for at the time he published his theatrum, his idea of utilising the said force in a fire-wheel was not a very satisfactory one. He had not at the time invented his high-pressure engine.

It is evident from the plates in Leupold's volumes and those of his contemporaries, that a very great improvement had been gradually taking place in the accuracy of construction of machines, *i.e.*, the accuracy with which their different parts were made to move in the required paths. An engineer of Ramelli's time can scarcely have recognised that each of his rods and links should have some definite motion, for certainly (judging from his drawings) they must have had very indefinite motions indeed. The constraint of the motion had been obtained and its necessity tacitly recognised at the same time. The improvement in the construction of machines pointed out the direction for the development of their theory, and so far as Leupold's work was scientific, it was just this part of the science that he took up. His chapters on mechanics are very elementary, and contain scarcely anything that had not been given many times before, and his detailed work is mostly descriptive rather than scientific. He does, however, distinctly apply geometrical methods to the determination of the forms of different parts of machines, and to the investigation of their motions; and here we have the beginning of machine-kinematics, the first appearance of any science of machines separate from mechanics.

From this time the writers and books on machinery rapidly increase in number, and we can trace the development—or, if you like, the formation—of machine science along three distinct lines. Of these, one has the direction I have just indicated, and may be summed up, in one word, as the geometry of machinery. It connected itself with the motions—considered merely as changes of position—of the various bodies forming the machine. It included both the study of these motions in themselves and in their relations to one another, and the study of the geometric form of the bodies by which particular motions could be obtained. I think there can be no doubt that the increasingly great necessity for such investigations, and the necessity for carrying them on by grapho-geometric methods, in order to be of use to practical men for technical purposes, must have had an important influence in the bringing back of the study of pure geometry, which had for so long been neglected by mathematicians. In any case, the reaction in favour of geometry at the end of the last century soon had its effect on machine science. At the foundation of the Ecole Normale in Paris, in 1794, Monge introduced there his descriptive geometry, and his colleagues and successors—Hâchette, Lanz, Betancourt, Borgnis, and others — systematised machine-kinematics, and brought it into the form in which, essentially, it has until recently remained.

The application of geometry to machines formed formed one line of advance. A second was formed by the applications of physics, especially in connection with hydraulics, and, later on, with heat —it would hardly be correct to speak of thermodynamics at that date. These subjects were, of course, connected chiefly with the theory of prime movers, and the former was, comparatively speaking, of far greater importance then than now, for, at that time, water-wheels were the most important prime movers, and the raising of water was, perhaps, the most important application of machines. Among the names most closely connected with the progress of machine science in this direction are those of Belidor, Prony, and Langsdorf. Belidor's "Arch. Hydraulique" (1782) was for its time an extremely valuable work; it is a treatise, theoretical and descriptive, on every possible machine or structure which has anything to do with water. In Prony's "Nouvelle Architecture Hydraulique" there is far less description and more theory; and in Langsdorf's "Lehrbuch der Hydraulik" but little of the descriptive matter remains. His pages bristle with immense formulæ, and long explanations of the symbols used in them. Considering the great uncertainty of many of his data, and the want even now of trustworthy experiments on the subject of which he treats, I cannot imagine that his closely-printed volume was of much direct use to any engineers in their practical work. None the less, his labour was well spent in showing that the subject was one which could be treated scientifically, and in which results could be obtained by other than the mere "rough guess and divide by two" method, which had been till then almost universal.

I have mentioned Dela Hire's work in connection with the resistance of beams; it was merely theoretical, without numerical values of any constants, and interesting, therefore merely historical. Since his time several great mathematicians had written an the subject, and notably Bernouli had pointed out that Galileo's theory of beams was incorrect, ond that there existed in a beam a neutral axis, on the two sides of which the senses of the stresses was opposite. He had not continued to work at the subject, however, and so little practical interest was taken in it, that for many years no engineer seems to have even alluded to it, or thought it worth while to work at it. It is only towards the beginning of the present century that we find definite progress made in this direction in applying the laws of the strength of materials to the design of machinery.

Even in such works as those of Prony and Langsdorf, already cited, no mention is made of the possibility of proportioning the sizes of the pieces of a machine to the loads they have to bear, or the pressures they have to resist; the only exception I have found is a chapter by Langsdorf on the thickness of water-pipes. This can hardly have been owing to any inherent difficulty in the subject, for the author did not scruple to attack the much more complex problems of hydraulics unflinchingly. No doubt it was due chiefly to the lack of experimental data, for without any means of determining the values of constants, it must have seemed a somewhat useless task to write down formulæ. The earlier experiments of Müschenbröck and others had been conducted with woods of different kinds, and had given results so discrepant as to be of little practical value. Iron was now more and more superseding wood as a constructive material; but as yet estimations of its strength were little more than guesswork, and, indeed, for some time after determinations of the tenacity of iron had been made, you find it given in books only as so many times stronger than pine or oak as the case may be.

I have not mentioned our own country in speaking of the progress made during the last century, and for the good reason that our engineers had been busying themselves about other matters, and had aided the progress only indirectly. If my subject were machines themselves, and not their theory, I should, as you know, have much to say about the illustrious engineers of the eighteenth century and the splendid work which they did. But I must not turn aside to this tempting theme, —and it must be said that these men worked for the most part empirically, and that, although machine science is enormously indebted to them, their influence on it was almost altogether indirect.

It thus happens that the English engineering literature of the period in question scarcely calls for remark, in fact, it had scarcely any existence. The Registrar of the Society of Arts published, in 1772, a large volume of descriptions of machines and models, possessed and approved by this Society, and a second similar volume was issued in 1779, but these were purely descriptive, like the more extensive "Description des Arts et Metiers faites ou approuvées per Messieurs de l'Academie Royale des Sciences," which was published in Paris in 1761, in eleven folio volumes. Books treating engineering subjects scientifically, hardly ever appeared; probably the engineers themselves had neither the time nor the knowledge to write them, and certainly no one else had. The earliest record I can find of anything like systematic experiments on the strength of iron in this country, and one of the earliest anywhere, and the application of their results to machine design, is contained in a little book, published in 1803 by a Mr. John Banks, who styles himself "Lecturer on Philosophy." The author not only gives particulars of a number of experiments on a tolerably large scale, which he seems to have conducted personally, on beams of different forms, but indicates by numerous examples the application of his results to the designing of machine details. Banks adopts Galileo's erroneous theory as to the resistance of beams without question, but in most of the special cases of which he treats, the results are not much affected by it. He did not add anything to our knowledge of the theory, but his work, in rendering possible the application of theory, cannot be overlooked.

But Banks was certainly not the only one who was experimenting on the strength of iron at this time, any more than England was the only country in which such experiments were required. We find that the science of design—of proportioning form to stress—extended very rapidly everywhere, and was recognised as a promising field for further investigation. Olinthus Gregory, in his "Mechanics" (1806), devotes a good deal of space to it, though his adoption of Galileo's theory brings him into some queer mistakes; and Buchanan's "Essays on Practical Mechanics" (1808, and subsequent years), form early contributions to this part of the science. Both writers refer to Banks. Among the first, if not the very first, to state the theory of beams correctly, and at the same time in a manner accessible to others than mathematicians, was Prof. Eytelivein, of Berlin, in his "Statik festec Körper" (1808), who also pointed out that time was a most important element in all matters concerning the resistance of materials to load. In this country we owe a great deal to Tredgold in this connection. He was probably the first to give anything like systematic treatment of machine details in reference to their strength. This he did in his steam-engine, 1826.

I have now traced the development of machine science up to a time within the memory of living men. It remains that I should point out its more recent course, and indicate so far as I can its present condition. From a purely scientific point of view this is the most interesting part of the subject, and to treat it in a way corresponding to its scientific interest would require far more time even than I have already given to the more distinctly historical part. But although scientifically of so great interest, it could hardly be made interesting to a audience like the present, for anything like a full treatment of it would involve so many mathematical and technical details as to make it almost unintelligible to all but the initiated. I must, therefore, content myself here with a very brief review of the matter.

Looking first, then, at the mathematical side of the science, the first professors at the Ecole Polytechnique, to whom I have already alluded, made such enormous advance all at once that it was years before their contemporaries caught them up. Prof. Willis, in his "Principles of Mechanism" (1841), did yeoman's service, as every one knows, for his favourite subject, and his name is the most distinguished of those who have written upon it since the commencement of the century. He did not essentially alter its basis, and his system does not seem a satisfactory one, but his investigations in many directions were none the less extremely original and valuable. He has had innumerable followers both here and on the Continent, and among them Rankine is to be reckoned, whose original genius did good work here, as in other branches of machine science. Within the last few years, however, the orthodox faith in the old classification of mechanics has received a rude shock from the impetuous attack of Reuleaux, who maintains that they are, at the best, merely empirical, and who wishes not to modify, but entirely to subvert the former treatment of the subject. Reuleaux's leading idea is this:—The analysis of the machine may be carried further than the mechanism, which has hitherto been treated as an indivisible unit. The mechanism consists of certain elements arrayed in pairs—each pair constraining a particular motion (a pin and an eye, a screw and a nut, &c.)—these pairs are linked together by resistant bodies so as to form "kinematic chains," in which the relative motions of each link to every other are absolutely constrained, and the fixture of any one link of the chain constitutes it a mechanism. This method of analysis gives quite a new insight into the relations between one mechanism and another, and renders the treatment of the whole by one general method as easy as before it was difficult. Reuleaux has advanced the science of mechanism in other ways also, but this is his most important work, and one which, I believe, forms the most important step which has been made forward since the beginning of the century. It not only forms the basis of instruction in the principal German Polytechnic Schools, but forms also a foundation upon which already many men are doing valuable work.

The advancement of geometry told upon machine science. The growth of machine science has not been without its effect, direct and indirect, on geometry. Aranhold's "Kinematische Geometrie," a little pamphlet, contains an amount of original matter altogether disproportionate to the fewness of its pages—we owe, no doubt, to the suggestions of mechanisms—and still more recently the subject has been carried into higher branches in a most elegant manner by Burmester*. These general investigations will react again upon our special cases, and will no doubt be found, as has so often been the case with investigations which at first seem purely theoretical, to have important applications even in the limited region of machine science.

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* Schlömilch's Leitschrift für Mathematik, 1874-5.

I cannot leave this subject of the relations between geometry and machine science without some mention of graphical statics. I intended to have spoken about it at some length, but time absolutely forbids me this. I must say only that while graphic methods of calculation had for many years been used to a limited extent, it is only very recently that they have been systematised; and so far as concerns calculations in which lines represent forces, this has been done chiefly by Culman Zurich, who has called his subject "Graphische Statik." He has treated it throughout in connection with the methods of modern geometry; the two studies are, I hope, inseparably connected, and the graphical statics, which should form an essential part of an engineer's education, may be thus the means of introducing into this country some of those modern geometrical methods which ought to form, so far as I am able to form an opinion, a part of the education not of engineers only, but of everyone.

In its physical aspects, machine science has, during this century advanced alongside of physics. The most distinct progress which has been made here has been in the application of thermodynamics, and chiefly in the theory of the steam-engine. There probably was never a case in which the growth of a science and the growth of its children kept pace better. Rankine in this country, Clausius and Leuner in Germany, Hirn in France, as well as many others, whose interest in the subject was more purely physical, have worked so well that we have already a tolerably complete theory of heat engines, and are able to say in every case exactly what an engine ought to do, which by universal analogy must be the principle step towards making the engine do it.

The once popular study of hydraulics has become of secondary importance in connection with machinery, the steam-engine having to so enormous an extent superseded other prime movers. Redtenbacher's treatises on water-wheels and turbines, although published thirty years ago, remain the standard works on the subjects of which they treat. The more recent scientific research in this and allied subjects find its application chiefly in hydraulic engineering, with which we have not here to do.

And now, lastly, as to the progress of machine design, so far as it has been reduced to a science, and connected with the molecular resistance of materials. It was Redtenbacher who first fairly separated this study from mechanics, and systematised and extended it. Indeed it may be said that it was he who created machine design as a separate branch of science. His "Resultati für den Maschineu-bau" was published in 1848, and although much progress in details has been made since then, and his method of treatment may in many cases be greatly simplified, and must in some cases be entirely altered, this work and his published lectures ("Die Maschinen-bau"), remain classics. The direction of progress since his time has been in the more and more complete reduction, to a scientific basis, of the numerous determinations formerly made upon grounds of "experience" alone, that is empirically; and no year passes without some such gains to science at the expense of empiricism.

During the last thirty years a host of experimenters has been at work investigating the strength of iron and steel. As time has gone on, the experiments have been made more and more complete and accurate, and in some particular branches of the subject the experiments may be said to be complete, so far as concerns the constructive materials now most used. We have, for instance, thanks in great measure to Mr. Kirkcaldy, little left to learn as to the ultimate tenacity of many qualities of iron and steel, and as to their behaviour when near the breaking point. But, fortunately, many new fields for experiment are opening up. Engineers are not in the habit—intentionally, at least—of straining the members of their structures or machines to near the breaking point; and, as the behaviour of many materials, when exposed only to small stresses, differs greatly from their behaviour under larger ones, it is now recognised that our knowledge of the strength of a material is incomplete unless we know to what extent it is affected by such small loads as it usually receives in practice. New experiments, so far as they are to have scientific value, must now take this direction, and new apparatus is required for them, much more delicate in its operation than the former machines.

Modern experiments on the strength of materials have given us two conclusions, which have a specially important influence on machine design, and which I must not pass over without mention. The first of these is that the fracture of a material does not depend solely on the magnitude of the load resting on it, but also on the number of times which that load is applied. A bar of iron will be ultimately broken by many repetitions of a load of only about 60 per cent. of the load which will cause immediate fracture; and, as in most machines as well as structures the loads which do occur are repeated over and over again, it follows that the ultimate resistance of the parts of the machine to fracture is not much more than half what is indicated by the ordinary testing machine. The fact was established experimentally long ago by Fairbairn and others, and more lately very completely by the experiments of Wöhler on the "Fatigue of Metals," which extended over some twelve years, and were conducted with specially constructed machines. In many cases, one single piece of material was subjected to many million (in one case once 130 million) repetitions of load. The second conclusion, also established by Wöhler, is of even greater importance. It is, that the resistance of a material is not, *cæteris paribus*, dependent on the maximum load to which it is exposed, but to the difference between the maximum and minimum loads, that is, to the range of stress. This discovery has now been fully substantiated in principle, and there can be no doubt that the design of machinery as well as structures, so far as it depends on the strength of the material used, should be based on this law, and carried out by help of formulæ derived from it. Such formulæ have already been investigated, and some of them (notably that of Launhardt and Weyrauch's addition to it) appear to represent very well the physical conditions of the case, so far as they have yet been determined. The Bavarian Government have already gone so far as to adopt what we should call "Board of Trade Regulations," based upon formulæ of this kind. The experiments already made have not been, however, numerous enough to determine the constants required for these formulæ, and very much still remains to be done in this direction.

I am no prophet, and will only say one word as to the future of machine science. Judging from the direction taken by it hitherto, we may infer that as more and more work is done in it we shall be able to get more and more distinctly at the ideal of every machine we design, and to see more and more clearly the highest form of the object at which we are aiming. At the same time we shall understand more and more completely the physical and other conditions which prevent the actual attainment of our object in this form. The more accurately we know these conditions the more closely shall we be able to bring our machines to the best form attainable under them. More than this: as we get to know these conditions more and more accurately, we shall see to what extent they are essential, and how far we can remove them. In the one case we can admit them as modifying our ideal machine, in the other case we get over them with our practical machine. In both processes our practical work and our ideal are brought closer together. Already with some special machines, the real and the ideal have almost met. I look forward to the time—although we shall not see it—when the same condition shall have been reached in the complex machines of everyday life, and when the growth of machine science shall have made it possible to produce a steam-engine as perfect in its whole working as, say, the motions of Sir William Thomson's tide-calculating machine. "After this, the deluge."

CORRESPONDENCE.

SOME PROCESSES OF NATURE'S HYGIENE.

My attention has been directed to a report which appeared in your *Journal* of the 16th inst., of a lecture by Mr. C. T. Kingzett on the above subject, in which that gentleman, not content with lauding the merits of the solution which he has introduced to the public under the name of "Sanitas," thinks it necessary to depreciate terebene, and to accuse me of being "in great error." The gist of Mr. Kingzett's grievance against terebene appears to be that it is not so active a developer of ozone, or, as asserts, of peroxide of hydrogen, as oil of turpentine is. I could have told Mr. Kingzett this long ago, and I could also inform him, if he is unaware of the fact, that there are other volatile hydrocarbons which possess the property in question to an equal extent with oil of turpentine, but unfortunately they share with it the property of being so offensive that the public will not tolerate them either as disinfectants or deodorants. Now terebene, though admittedly inferior to these bodies in producing the effect referred to, simply because it is less volatile, happens to have a fragrant odour, and is, therefore, not only tolerated, but liked by the public.

Of its value as a disinfectant and deodorant is is unnecessary for me to speak, as those who wish to satisfy themselves on this point can easily obtain the evidence of competent authorities, or may test it for themselves. I can only mention, as a matter of fact, that it is used in hospitals all over the kingdom, and that it has made its way there purely by virtue of its own merits. Mr. Kingzett refers to its oily nature as being a disadvantage; possibly it is for some purposes, but for others, especially as a surgical dressing, for which it is largely used, this is a great advantage.

FRANCIS T. BOND, M.A.,
Medical Officer of Health.

Barton-lawn, Gloucester,
22nd February, 1877.

BIRMINGHAM SLUDGE.

In the article on "Modes of Treating Town Sewage," p. 261, it is stated, that "at Birmingham it costs £750 per annum to get rid of the sludge." As a ratepayer of Birmingham I wish this was the fact. At p. 35 of the "Sewage Disposal Report," the accounts show a cost of more than £12,000 a-year, exclusive of interest on works, &c. And the estimate of expenditure for the Saltley works for 1877 amounted to £22,000. This is exclusive of the cost of dealing with the night soil, which it was estimated would cost £48,000 for the present year.

A RATEPAYER OF BIRMINGHAM.

[In the body of the Report (p. xxii.) it is stated that the sludge is "at great cost, £14 10s. per acre, dug into a portion of the farm-land at a rate of about one acre per week, or at a loss of about £750 a-year." In the Appendix, p. 35, the cost of "cleansing tanks, removing and disposing sludge" is given at £12,778.—ED. *S. of A. Journal.*]

NOTICES.

PROCEEDINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings, at 8 o'clock. The following arrangements have been made:—

MARCH 14.—"The Treatment of Town Refuse and Sewage," by Prof. ANSTED, F.R.S.

MARCH 21.—Lecture on "Vital Air," by Dr. W. B. RICHARDSON, F.R.S.

AFRICAN SECTION.

Tuesday evenings, at 8 o'clock. The following arrangements have been made:—

MARCH 13.—"Our Commercial Relations with West Africa, and their Effects upon Civilisation," by JAMES IRVINE, Esq., of Liverpool.

APRIL 10.—"The Social State and Prospects of the South African Communities," by ROBERT RICHARDS, Esq., of Grahamstown.

APRIL 24.—"The Trade and Resources of Morocco," by Dr. ARTHUR LEARED.

INDIAN SECTION.

Friday evenings, at 8 o'clock. The following arrangements have been made:—

MARCH 16.—"The Native Indian Press," by Dr. GEORGE BIRDWOOD, C.S.I. ANDREW CASSELS, Esq., will preside.

APRIL 20.—"The Existing and Possible Commercial Communications between Persia and India," by Major-General Sir FREDERICK JOHN GOLDSMID, C.B., K.C.S.I.

MAY 4.—"Thaumato-dendra, or the Wonders of Trees," with illustrations from life, by WM. TAYLER, Esq.

CHEMICAL SECTION.

Thursday evenings, at 8 o'clock. The following arrangements have been made:—

APRIL 12.—"The Cinchona Alkaloids; their Sources, Production, and Use," by Dr. B. H. PAUL.

APRIL 19.—"Spontaneous Combustion in Factories and Ships," by C. W. VINCENT, Esq., F.C.S.

APRIL 26.—"Phosphor-Bronze and its Applications," by ALEXANDER DICK, Esq.

May 10.—"A New Process for the Production of Carbonate and Caustic Soap, without the Formation of any Noxious Waste and the Recovery of the Sulphur," by George E. Davis, Esq.

Science Lectures.

These will be given on the following Wednesday evenings, in place of the usual paper and discussion. The rules for admission will be the same as for the Cantor Lectures. Each member can admit ONE friend by giving the usual order from the book supplied at the commencement of the Session:—

March 21.—Dr. B. W. Richardson, F.R.S., "Vital Air."

April 18.—E. J. Reed, Esq. C.B., M.P., F.R.S., "The Modifications which Ships of War have Undergone during the last 20 Years."

May 2.—J. Baillie Hamilton, Esq., "New Musical Instruments."

Cantor Lectures.

Monday evenings, at eight o'clock. Second Course, "On the Chemistry of the Manufacture of Coal Gas," by A. Vernon Harcourt, Esq., F.R.S.

Lecture II.—March 12.

Ammoniacal liquor; its composition, treatment, and valuation. Purification of gas from ammonia. Scrubbers and washers. Probable effect upon gas of prolonged contact with tar and ammoniacal liquor. Purification from carbonic acid and sulphuretted hydrogen. Use of lime and of oxide of iron.

Lecture III.—March 19.

Composition of coal gas. Common impurities—carbonic acid, carbon bisulphide. Products of the combustion of gas containing sulphur. Question as to the injurious effect. Modes of purification. Action of calcium sulphide. Effect of contact with heated surfaces. Tests for sulphur.

Lecture IV.—March 26.

Principal constituents. Hydrogen, carbonic oxide, marsh gas, olefiant gas. Value for heating and for illumination. Luminous flames. Development of the illuminating power of coal gas. Burners. Gas compared with other illuminants. Different qualities of gas. Photometry. Standard burner. Unit of light.

Each member can admit one friend to these lectures. No special tickets are now required for the purpose; the tickets issued to members at the commencement of the session are available for the Cantor Lectures, as well as for the Ordinary and Sectional Meetings.

MEETINGS FOR THE ENSUING WEEK.

Mon. ...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. A. Vernon Harcourt, "The Chemistry of Gas Manufacture." (Lecture II.)

Royal United Service Institution, Whitehall-yard, 8½ p.m.

Institute of Surveyors, 12, Great George-street, S.W., 8½ p m. Continued discussion on Mr. J. Lucas's paper, "Hydrogeology: one of the Developments of Modern Practical Geology."

Royal Geographical, University of London, Burlington-gardens, W., 8½ p m. 1. Mr. J. S. Buchanan (*Challenger* Expedition), "The Distribution of Salt in the Ocean, as indicated by the Specific Gravity of its Waters." 2. Mr. J. Herbert Allan, "A Journey through Formosa, from North to South." 3. Mr. T. L. Bullock, "A Trip into the Interior of Formosa."

Personal Rights and Self-Help Association, 1, Adam-street, Adelphi, 8 p.m. Mr. Ernest Hart, Professor Hunter, and Miss F. Orme will read papers on "Exclusive Legislation for the Professions."

Medical, 11, Chandos-street, W., 8 30 p m.

London Institution, Finsbury-circus, E.C., 5 p.m. Prof. Bentley, "Ferns."

Tues....**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (African Section.) Mr. James Irvine, "Our Commercial Relations with West Africa, and their Effects upon Civilisation."

Royal Institution, Albemarle-street, W., 3 p.m. Prof. Garrod, "The Human Form; its Structure in Relation to its Contour." (Lecture IX.)

Medical and Chirurgical, 53, Berners-street, Oxford-street, W., 8½ p.m.

Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Mr. Henry Robinson, "The Transmission of Motive Power to Distant Points."

Photographic, 5a, Pall-mall East, S W., 8 p.m. Discussion on "The Silver Bath." To be introduced by Mr. John Spiller.

Anthropological Institute, 4, St. Martin's-place, W.C., 8 p.m. 1. Mr. Hyde Clarke, "On the Himalayan Origin of the Magyar" 2. Mr. Hector McLean, "The Scottish Highland Language and People." 3. "The Anglicising and Gaelicising of Surnames."

Royal Colonial, 15, Strand, W.C., 8 p m. Mr. G. J. Symons, "The Climates of the various British Colonies."

Wed....**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. Professor Ansted, "The Treatment of Town Refuse and Sewage"

National Penny Bank (at the House of the Society of Arts), 12 a m.

Sanitary Institute (at the House of the Society of Arts), 3 p.m. Sir Joseph W. Bazalgette, "Modes of Treating Town Sewage."

Graphic, University College, W.C., 8 p.m.

Royal Literary Fund, 10, John-street, Adelphi, W.C. 3 p m. Annual Meeting.

Royal College of Physicians, Pall-mall E, 5 p.m. (Croonian Lectures.) Dr. J. Braxton Hicks, "The Difference between the Sexes in Relation to the Aspect and Treatment of Diseases." (Lecture III.)

Thur....Royal, Burlington House, W. 8½ p.m.

Antiquaries, Burlington House, W., 8½ p.m.

Linnean, Burlington House, W, 8 p m. 1. Rev. Thomas Powell, "The Nature and Mode of Use of the Vegetable Poisons Employed by the Natives of the Samoa Island."

Chemical, Burlington House, W., 8 p m. Mr. M. M. Pattison Muir, "Note on a Method for Estimating Bismuth Volumetrically." 2. Dr. Stenhouse and Mr. Groves, "Note on Gardenine" 3. Prof. Gladstone and Mr. Tribe, "Preparation of Copper-zinc Couples." 4. Mr. E. Riley, "Chromium Pig Iron."

London Institution, Finsbury-circus, E C., 7 p.m. Mr. E. Pauer, "Schubert and Later Composers."

Society for the Encouragement of the Fine Arts, 9, Conduit-street, W., 8 p.m. The Second Conversazione, with Music.

Royal Institution, Albemarle-street, W., 3 p.m. Mr. William Pole, "Theory of Music." (Lecture V.)

Numismatic, 4, St. Martin's-place, W.C., 7 p m.

Royal Society Club, Willis's Rooms, St. James's, S.W., 6 p.m.

Psychological, 11, Chandos-street, W., 8½ p.m.

Civil and Mechanical Engineers, 7, Westminster-chambers, S.W., 7 p m. Mr. E. Duncan, "G.N.R. New Tunnels between King's-cross and Holloway."

Fri.......**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Indian Section.) Dr. George Birdwood, "The Native Indian Press."

Royal United Service Institution, Whitehall-yard, 3 p.m.

Royal Institution, Albemarle-street, W., 8 p.m., Weekly Meeting; 9 p.m. Mr. James Bryce, "Armenia and Ararat."

Philological, University College, W.C., 8 p m.

Royal College of Physicians, Pall-mall E., 5 p.m. (Lumleian Lectures.) Dr. George Johnson, "The Muscular Arterioles, their Structure and Function in Health and in Certain Morbid States." (Lecture I.)

Sat.......Trades' Guild of Learning and National Health Society (at the House of the Society of Arts), 8.30 p.m. Prof W. H Corfield, "The Laws of Health." Part II. (Lecture VIII.)

Physical Science Schools, South Kensington, S.W., 3 p.m.

Royal Institution, Albemarle-street, W., 3 p.m. Prof. Henry Morley, "Effects of the French Revolution upon English Literature." (Lecture IV.)

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FRIDAY, MARCH 16, 1877.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

ALBERT MEDAL.

The Council will proceed to consider the award of the Albert Medal for 1877, early in May next. This medal was struck to reward "distinguished merit in promoting Arts, Manufactures, or Commerce," and has been awarded as follows:—

In 1864, to Sir Rowland Hill, K.C.B., "for his great service to Arts, Manufactures, and Commerce, in the creation of the penny postage, and for his other reforms in the postal system of this country, the benefits of which have, however, not been confined to this country, but have extended over the civilised world."

In 1865, to his Imperial Majesty, Napoleon III., "for distinguished merit in promoting, in many ways, by his personal exertions, the international progress of Arts, Manufactures, and Commerce, the proofs of which are afforded by his judicious patronage of Art, his enlightened commercial policy, and especially by the abolition of passports in favour of British subjects."

In 1866, to Professor Faraday, D.C.L., F.R.S., for "discoveries in electricity, magnetism, and chemistry, which, in their relation to the industries of the world, have so largely promoted Arts, Manufactures, and Commerce."

In 1867, to Mr. (now Sir) W. Fothergill Cooke and Professor (afterwards Sir) Charles Wheatstone, F.R.S., in "recognition of their joint labours in establishing the first electric telegraph."

In 1868, to Mr. (now Sir) Joseph Whitworth, F.R.S., L.L.D., "for the invention and manufacture of instruments of measurement and uniform standards, by which the production of machinery has been brought to a state of perfection hitherto unapproached, to the great advancement of Arts, Manufactures, and Commerce."

In 1869, to Baron Justus von Liebig, Associate of the Institute of France, Foreign Member of the Royal Society, Chevalier of the Legion of Honour, &c., "for his numerous valuable researches and writings, which have contributed most importantly to the development of food economy and agriculture, to the advancement of chemical science, and to the benefits derived from that science by Arts, Manufactures, and Commerce."

In 1870, to M. Ferdinand de Lesseps, "for services rendered to Arts, Manufactures, and Commerce, by the realisation of the Suez Canal."

In 1871, to Mr. (now Sir) Henry Cole, C.B., "for his important services in promoting Arts, Manufactures, and Commerce, especially in aiding the establishment and development of International Exhibitions, the development of Science and Art, and the South Kensington Museum."

In 1872, to Mr. Henry Bessemer, "for the eminent services rendered by him to Arts, Manufactures, and Commerce, in developing the manufacture of steel."

In 1873, to M. Michel Eugène Chevreul, "for his chemical researches, especially in reference to saponification, dyeing, agriculture, and natural history, which for more then half a century have exercised a wide influence on the industrial arts of the world."

In 1874, to Mr. C. W. Siemens, D.C.L., F.R.S., for his researches in connection with the laws of heat, and the practical applications of them to furnaces used in the Arts; and for his improvements in the manufacture of iron; and generally for the services rendered by him in connection with economisation of fuel in its various applications to the Manufactures and the Arts."

In 1875, to Mons. Michel Chevalier, the distinguished French statesman, "who, by his writings and persistent exertions, extending over many years, has rendered essential service in promoting Arts, Manufactures, and Commerce."

In 1876, to Sir George B. Airy, K.C.B., the Astronomer Royal, for "eminent services rendered to Commerce by his researches in nautical astronomy, and in magnetism, and by his improvements in the application of the mariner's compass to the navigation of iron ships."

The Council invite members of the Society to forward to the Secretary, on or before the 14th of April, the names of such men of high distinction as they may think worthy of this honour.

DOMESTIC ECONOMY.

A meeting of this Committee was held on the 13th inst. Present—The Hon. Dudley Fortescue (in the chair), Miss Chessar, Sir H. Cole, K.C.B., Gen. F. C. Cotton, C.S.I., Rev. J. P. Faunthorpe, Edwin Lawrence, Miss Helen Taylor, E. C. Tufnell, Mrs. Westlake, Mrs. Williams, James A. Youl, C.M.G. The subjects taken into consideration were—(1) the importance of separating the subjects under the head of domestic economy upon which grants may be earned for the school, under the Revised Code of 1877; (2) the desirability of a question in the House of Commons being put to the Vice-President of the Committee of Council on Education, as to whether certain details concerning the amounts earned, numbers passing, and the subjects included under the head of domestic economy, will be specified in the forthcoming Report of the Department; (3) the desirability of holding local meetings annually in populous districts, in connection with domestic economy.

INSTITUTIONS.

The following Institution has been received into union since the last announcement:—

Aston Institution, near Birmingham.

HEALTH AND SEWAGE OF TOWNS.

The Annual Conference on Health and Sewage of Towns will be held on the 3rd May next, the Right Hon. James Stansfeld, M.P., in the chair.

CHEMICAL SECTION.

Friday, March 9th, 1877; W. H. Perkin, Esq., F.R.S., in the chair:—

The paper read was:—

THE SIZING OF COTTON GOODS.

By W. Thompson, F.R.S.E., F.C.S.

This subject is one which, since the commencement of the manufacture of cotton cloth in Lancashire and other places, has much engaged the attention of all manufacturers.

Much time and ingenuity has been, from time to time, spent in the invention and improvement of machinery required for the different processes employed in the production of cotton cloth, and the progress made in this direction has been enormous and brilliant, nor can anything be said against the machinery devised for what is termed sizing the yarn—yet, altogether, this operation, as it now stands, is one of the clumsiest, most unscientific, and least understood, with which the manufacturer has to deal.

That I may be clearly understood, it will be necessary for me occasionally to introduce other things connected with the manufacture of cloth, but which are not intimately associated with the operations of sizing, and which would be quite superfluous to those who have any knowledge whatever of the subject.

If we examine a piece of ordinary cotton cloth, we observe that it is composed of two sets of fibres, running at right angles to each other. The one set, which runs along the piece of cloth, is called the "warp," or woof; the other set, which runs across the piece, is called the "weft." And, as a rule, if the fabric be more closely examined, it will be observed that the warp is the thicker and stronger of the two sets of threads. But, whatever differences may be observed, one thing is certain—that the warp has to withstand a much greater amount of strain, and wear and tear, in the process of weaving than the weft, and, consequently, the limit of strength required by the warp is much greater than that required by the weft. I have here an arrangement which I hope will serve to show distinctly the process by which the warp and weft are woven into cloth. The warp is received by the weaver wound on to a large roller called a beam, this is placed at the back of the loom so that it may revolve, to gradually unwind the warp as it is required. The beam contains as many ends or distinct threads as are required to form the entire breath of the cloth. These threads are taken and passed through what is called "healds." Healds are formed of a series of cotton or woollen threads arranged by stretching each between two long rods; each thread is provided with a loop in the centre, and each loop is varnished to render it smooth and thus protect it as far as possible from injuring the threads of the warp on the one hand, and as a protection against the wearing action of the warp on the loop, on the other. Four sets of healds are required for each loom; they are arranged the one behind the other, and each alternate thread of warp is passed through a loop in the first, and one in the third set of healds, and the remaining alternate threads are passed through the loops in the second and fourth set. The first and third set have an upward motion, whilst the second and fourth set have a simultaneous downward motion, which is communicated to them by an arrangement of machinery called treadles. The warp threads, after passing through the healds, are then passed through an arrangement called the reeds; this is of the same construction as the healds with the exception that each fibre extending between the two rods is formed of thin flat steel ribs, the two rods being not more than about 3 inches apart, and resemble a comb, the teeth of which are fixed at each side by two long rods; generally two threads of warp are passed between each two teeth or dents of the reeds, and passing over a fixed frame, are attached to another beam or roller in front of the loom, which has a revolving motion in unison with the rest of the machinery, and on which the cloth as it is produced is wrapped. The reeds, or long comb, are fixed in a wooden frame called the sleigh, which has a motion like a pendulum, thus communicating to the reeds the same motion which the pendulum gives to the bob; the reeds thus move to and fro in a direction parallel with the warps. On the sleigh, immediately underneath the reeds, is fixed a piece of wood, slanting from above downwards to the bottom part of the reeds. Another appliance finishes the description of the loom, and that is the arrangement for introducing the weft or cross-threads of the cloth. A rod of wood about one inch in diameter and 18 inches long, called the "picking stick" has attached to one end a strap, to which is fixed a small arrangement made of raw buffalo hide, which has previously been soaked in linseed oil to give it greater tenacity; the other end of the picking stick is attached by a hinge, and a rapid jerking horizontal motion is communicated to the picking stick. One picker is arranged at each side of the loom, and the piece of buffalo hide is made to strike violently against a small oblong box fixed to the side of the loom, with a hole through the end, through which projects the point of the shuttle when at rest. When the loom is started, the two sets of healds rise at the same time, as the other two sets descend, carrying with them the alternate threads of the warp, thus forming what is termed the "shed," which resembles the letter V, the apex of which is at the point in front of where the shuttle works, the other two ends of the "V" being formed by the healds carrying with them the alternate threads. The shuttle is made from a piece of boxwood tapered at both ends, about 1½ inches in diameter at its centre and thickest part, and about 10 inches long, tipped with steel. Out of this wood is cut an oblong hole, in which the "cop" is fixed upon a steel pin. The cop is a bobbin of weft, very carefully and ingeniously wrapped, the end of which passes through a small hole in the shuttle, so that by pulling this end the thread unwraps from the cop with the greatest facility; the shuttle thus charged is placed in its box, and at the moment the shed is formed in the warps by the movement of the healds, the sleigh moves backward, so that the projecting piece of wood in front of the reeds is in an exact line with the two boxes on each side of the loom arranged to receive the shuttle, and the lower line of warps at this point is resting over the projecting wood. At this moment the picker strikes the shuttle violently at one side, and makes it shoot along the sleigh, over the lower line of warp threads, leaving a line of yarn behind it, and into the fixed box at the other side; the forward motion of the sleigh or pendulum presses up this thread of weft, then moves or falls backwards until it hangs perpendicular, and then the healds, by reversing their up and down motion, reverse the lines of the warp threads, making the upper line of the V, or shed, form the lower line. At this point, the picking stick again strikes the shuttle, and shoots it violently across the line of threads resting on the sleigh into the box from which it started; the sleigh, carrying with it the reeds, again moves forward, thus pressing each thread of weft up into the cloth thus formed; the weft at one side of the loom comes in contact with and supports a delicate arrangement called the fork, so that if the weft breaks the fork falls, thus bringing into action a series of levers which at once stop the loom.

So quickly do these machines or looms work, that at an ordinary speed the shuttle is struck by the picker 180 times per minute, thus 180 threads of weft are woven with the warp in that space of time, and as each inch of an ordinary cloth or grey shirting contains about 64 threads, or picks, about three inches of cloth are produced per minute by each loom; but some looms are worked at even a greater speed than this, namely, giving about 220 threads, or picks, per minute, and thus producing in that time, from the above calculation, about three and a half inches of cloth per minute.

It will now be observed that the wear and tear on the warp by the pulling action of the healds, &c., is very great, and the process which was first introduced with the view of increasing the strength of the warp was called sizing.

The sizing process which was at first employed was simply to pass the threads of the warp through some adhesive matter, such as flour paste, and drying it; this gave the extra strength required for the warp to pass it through the loom, but it made the cloth produced feel harsh. Tallow or oil was then boiled with the flour or starch paste to give it the desired softness, and this mixture gives all that could be desired for the absolute manufacture of the fabric; but here the progress in sizing did not end. It was observed that different modes of mixing and applying size to the threads of the warp gave to them properties which, when woven into cloth, made the fabric appear fuller and better, and so well can this process be now applied that "connoisseurs"—and there are many in Lancashire who profess, and no doubt with much reason, that they can tell how much cotton a cloth contains by simply feeling it—are often deceived by the arts of an expert warp sizer; but these gentlemen seldom think so, and so there is yet ample scope for the ingenuity of the sizer. The problems then which the manufacturer of the present day must solve are rather complicated.

First, he must arrange to produce pieces of grey cloth of a certain number of yards in length and a certain number of inches in breadth.

Second, that piece of cloth must weigh a certain number of pounds.

Third, together with the first two qualities it must possess an appearance equal to some standard, *i.e.*, it must be made so that a "connoisseur" shall be able to say—this piece is equal to the sample required, it has the proper "feel," and it contains the proper number of threads of warp and weft to the quarter inch; this last-named test is generally made by means of a small brass arrangement with a lens which folds into three parts, and when opened for use has the appearance of three sides of a box; one side serves as a stand, this has a square or round hole cut in the centre, which is exactly a quarter of an inch in diameter; the second side acts as a pillar to support the third, in which an ordinary glass lens is set opposite to the hole in the lower side. This arrangement is put on any piece of cloth to be tested, and the connoisseur looks through the lens, which magnifies the threads, and so enables him to count the number present in every quarter of an inch of cloth, and he is at once able to tell you how many "picks" or threads of warp and weft the cloth contains to the quarter inch. They say that this a 15-16, and that is 20-24 cloth, meaning that it contains 15 threads of warp and 16 of weft in the one piece, and 20 threads of warp and 24 of weft in the other, And I dare say that in Manchester this glass is as common a pocket companion as penknives are in other towns, where the pockets of the inhabitants are not filled by the looms of the weavers. The last and most important object of the bulk of Lancashire manufacturers is, to make grey cloths of specified dimensions, weight, and appearance with as little cotton as possible, the remainder of the weight, "feel," and general appearance to be made up with size.

I cannot give you any idea of all the different mixtures which are used to produce "size"—their name is legion—but I will endeavour to place before you the different substances generally used, of which two, three, four, or more, are mixed, and boiled with water to produce what is termed size, There are five different classes of substances used, viz.:—

1. *For giving Adhesive Properties to the Size.*

Wheaten flours of different kind.
Sago.
Indian corn starch.
Farina.
Rice.
Dextrine or British gum.

2. *Materials used to give Weight and Body to the Yarn.*

China clay.
Sulphate of baryta.
Do. lime.
Do. magnesia.
Sulphate of soda.
Silicate of magnesia (soap stone.)
Silicate of soda.

3. *Oily or Greasy Matters used for "Softening" the Size and Yarn.*

Tallow of different kinds.
Bleached palm oil.
Cocoa-nut oil.
Castor oil.
Olive and other oils.
Paraffin wax.
Bees'-wax composition.

4. *Other Substances used for Softening and giving Weight and Body to the Size and Yarn.*

Chloride of magnesium.
Chloride of calcium.
Glycerine.
Soap.
Grape sugar.

5. *For Preserving the "Size" from Mildew and Decomposition.*

Chloride of zinc.
Carbolic acid.
Cresylic acid.
Salts of arsenic, &c

In the first-mentioned class of materials, the most commonly-used substance is Egyptian flour, because, as a rule, that is the cheapest flour which can be purchased; but in selecting a substance from the first, or "adhesive" class, the manufacturer ought to take into consideration the purpose for which it is required. If he intends to manufacture cloths for what is called the home trade, most of which are sold direct to the bleacher or calico printer, then size is required which will give strength to the warp without giving it much weight, because a bleacher always finds how much size a cloth contains, and therefore his balance and weights are sure to keep an accurate account with the manufacturer, because, if he buys a lot of pieces of cloth each weighing 8¼ lbs., which is a common standard of weight, and finds after he has washed and bleached them that each weighs only 5 or 6 lbs., he knows there is something wrong, not only in having bought 2 or 3 lbs. of size instead of cotton in each piece, but that the extra work and material required to separate that stuff from the cotton, has made the small amount of cotton which he has left additionally expensive.

There are great differences in the properties of the different starchy matters, and also to some extent in those of the same kind grown in different places. These differences may, perhaps, be seen simply by boiling with water one part by weight of each sample with ten times its weight of water, observing the consistency of the resulting paste when boiled for three minutes, and then pouring it into a small cup, allowing it to stand for some hours to cool and set, and then examining the moulds thus produced; by tilting them from the cups into the hands, and pressing them with the fingers, note can be taken of their firmness or softness to the touch, their brittleness, elasticity, adhesiveness, &c.

Another test may be made, by boiling 1 part of each, flour or starch, with 40 parts of water, and then allowing the samples to cool to a fixed temperature, say 100° or 60° Fahr.; and then, by means of a hydrometer, taking the densities or specific gravities of the resulting solutions.

By these tests, it would be observed that farina, or potato-starch, becomes, by boiling, very much thicker than any of the others; that sago stands next in this respect; that maize, or Indian corn, starch, and rice flour, follow in order, and produce the thinnest, or least dense solution. But with respect to the moulds or shapes produced by the two last-mentioned, rice is short and brittle, and flour has a much more tenacious character.

If, then, it be desired, to put as little size on the threads of the warp as possible, a composition should be made by using farina as an adhesive, because a much smaller proportion of this ingredient will produce a size, having the required "consistency" or "body," and the threads can therefore only absorb a small proportion of it.

If, again, it be desired to put a large amount of size on the yarn, then wheaten flour is best adapted for this purpose, because an equal weight of it will boil to a much thinner liquid, and therefore the warp or yarn will be able to absorb much larger proportions. For the same reason, if it be desired to introduce a material giving greater weight, such as china clay, then wheaten flour is best adapted for fixing it to the thread; and where a specially large proportion of clay is required to be fixed in the fabric, English wheaten flour is better adapted for the purpose than Egyptian flour, because it contains a much larger proportion of gluten, and that ingredient has strong adhesive properties. The starchy matter which has perhaps least adhesive properties is rice, and this ingredient is often used to adulterate wheaten starch, and this is one of many causes of annoyance to which the sizer or manufacturer is subjected. Having bought flour, with which he mixes china clay and other ingredients in certain proportions, he finds that he is able to produce a size which gives him all he requires, viz., the desired weight of size which sticks well on the yarn, and appears to the uninitiated as if the cloth made from it were quite free from any sophistication, but, unfortunately for the manufacturer, his supply of flour becomes exhausted, and he is forced to purchase more, and possibly he buys not pure flour, but flour adulterated with finely ground rice, he uses this mixture for his size, and the result is, to express it in his own words, he "gets wrong;" when the warp is undergoing the process of weaving, the china clay, not being fixed firmly by the adulterated flour, flies off, forming a cloud of dust in the weaving shed, and when the cloth is produced, it is found not to be sufficiently heavy, and not only so, but the uninitiated would be very apt to say that the fabric had been much sophisticated, because when shaken the sophistication would reveal its presence by coming out in a shower of dust. It is important then that the manufacturer should test each sample of flour which he buys, that he may be certain that he does not get an adulterated article.

The microscope does valuable service so far as this is concerned, but before applying it, the flour must be treated by a preliminary process. Flour is composed principally of two different materials, the one named gluten, the other starch; and before examining for adulteration with other starches, the former must be separated from the latter; this is done by mixing some of the flour with water, and making it into a dough, which is then thrown on to a piece of silk cloth, of the same kind as that used for dressing flour, the sides of which are taken up and tied so as to form a loose bag round the dough; this should then be alternately dipped into a basin of clean water and pressed with the fingers, the starch will pass through the silk cloth into the water, making it milky, whilst the gluten remains behind as a soft caoutchouc-looking mass; but I should say that it has only this exact appearance when the flour is what a bread baker would term of fair or good quality. The starch, which will settle to the bottom of the water, should then be examined by the microscope, which will reveal the presence of adulteration with other starch by the form of their granula. Great differences exist in the appearance of the gluten obtained from different samples of flour, and the observation of these differences teaches us a great deal relative to the kind and quality of the sample. English wheaten flours usually leave a full homogeneous gluten, which adheres in one piece, and may be drawn out into long fibres without breaking. Again, we find other flours of the same kind, which have been damaged by moisture or other cause, leave about the same amount of gluten, but its physical properties are quite different, it has lost much of its plastic nature, and, if you attempt to stretch it, it breaks easily.

We thus descend the scale, both as regards quality and quantity of gluten present in flour, till we arrive at Egyptian flour, where we find very little gluten, of very bad quality; in some cases, so bad as to be almost devoid of plastic properties, so that it remains in the silk in small pieces, which will not adhere to each other.

It is evident, then, that when a manufacturer desires to fix in his fibre a large proportion of mineral matter—such as china clay—he ought to use flour containing a large per-centage of gluten; and this is an important point, because some manufacturers will take you into their confidence and tell you that they have lately risen to such a state of perfection that they can put over 100 per cent. of size into their warp, *i.e.*, that they take 1lb. weight of yarn, and after passing it through their sizing machine and drying, it will weigh 2lbs.; and yet the men who carry on the manufacture are, as a rule, honest. They do not hide from the purchaser the fact that their goods contain a large quantity of size, and the merchant who buys them does so quite cognisant of the fact. When the cloth suits his requirements, and he desires to ship them to some foreign country, he has but one more question to ask, and that is—is your size good? Is there no fear of mildew? And these being answered to his satisfaction, a business transaction takes place.

To show still further that sizing is not altogether dishonest, I think I can give no more forcible idea than by saying that often more than the whole margin of the manufacturer's profit lies within the size used. Still the subject will remain a mystery to many. Why put size in cloth to sell it at a less price than that for which the cloth can be produced from pure cotton? The question is not without defence. The manufacturer will tell you openly that he will be very glad to dispense with heavy sizing, but the merchant says I wish to buy from you cloth which contains a large quantity of size, and so the manufacturer has no other alternative than to supply his customer with his wants or give up business. We have thrown the onus of this apparently dishonest dealing on the head of the merchant, and we must now go a step further to hear what he has to say for himself. He will tell you that the natives of the countries to which he ships those goods make various pieces of clothing out of them, and they prefer to buy a cloth at a given price which has a full and good appearance (effects produced by judicious sizing) to paying the same amount for a cloth which is entirely composed of pure cotton, but through which the day-light would penetrate, and show every thread of the fabric; in fact, they have no objection to clothe themselves with a composition of flour, tallow, and china clay, to which a little cotton has been added to make it stick together. I am informed that, as a rule, they do not wash the cloth before wearing it, so that, if some enterprising Lancashire manufacturer could hit upon the mode of making cloth without containing cotton at all, but composed entirely of size, he would, no doubt, be considered a benefactor by his poorer foeign brethren; but although many manufacturers have approached very closely to this acme of perfection, I have not heard of any whose genius has carried them to the desired end. As much has been said and written against manufacturers for what appears to be their dishonest practices, I will venture to say something more in their justification, by taking a parallel case. Some years ago, we heard a great deal about adulterated paper, and one Scotch chemist distinguished himself by pointing out the frauds which paper manufacturers began to practice, viz., of introducing plaster of Paris and other mineral substances into writing and other kinds of paper; the public then looked with indignation on the perpetrators of such frauds, and the representatives of Her Majesty's Government, in giving their orders to paper manufacturers, always stipulated that the paper should be pure, *i.e.*, made from pure vegetable pulp, and free from adulteration. Persons who had to use many of the cheaper varieties of this "pure" paper found it to be most objectionable stuff, the pen penetrating it with the greatest facility, and the writing showing as well on the one side as the other. *Experimenta docent.* Probably many present have had the honour and annoyance of writing on pure paper, in the shape of Post-office newspaper wrappers, which were supplied some years ago. Paper manufacturers afterwards showed excellent paper, which could be produced at the same price as the objectionable stuff referred to, but alas! it, was impure. It contained about half its weight of plaster of Paris; but, no matter, it dawned upon the public generally that if good and easy writing could be made upon a sheet of plaster of Paris, it was all that they could desire. We heard nothing more of the frauds of paper manufacturers, and now there is no paper mill in the United Kingdom, of any size, which cannot consume and convert into paper with facility, in the space of six days, quantities of sulphate of lime, or plaster of Paris, and china clay, varying from one to ten tons. And if we take almost any of the paper we now use, and burn it, we find we have left as an ash a complete sheet of clay or other mineral constituent, which had originally been mixed with the vegetable pulp used to give it body or consistency; and we have now, in this respect, got so far over our prejudices that we are content to read the news of the day which has been printed virtually upon sheets of china clay or plaster of Paris.

The end justifying the means, we are a clean people, and we wash our linen before we wear it; we object to wear garments half of which are composed of china, clay, flour, and tallow, or other things, and our manufacturers are quite pleased to supply us with pure cloth. The lower classes of India and other foreign countries prefer to wear china clay and tallow, as well as cotton, and our generous manufacturers are pleased to comply with their demands. A short time ago, an illustrious Lancashire divine, ever ready with his pen and tongue to correct the faults and sins of his people, attacked our unfortunate grey cloth manufacturers, and denounced their practice of sizing as against all the laws of the Bible; but from observation I have come to the conclusion that even that gentleman prefers to wear starched linen to the pure fabric, and sometimes, therefore, prefers precept to example.

When the manufacturer uses wheaten flour in his size, he generally submits it to a peculiar preliminary operation; he throws a large quantity, generally several tons, of flour into a large cistern, adds to it about ten times its weight of water, thoroughly mixes the two together by means of revolving arms worked by machinery, and allows the whole then to remain at rest to ferment. This fermentation is produced by the unfolding or decomposing action of a ferment or living cell, exactly in the same way that the starchy matters of malt are converted into alcohol by the action of another species of living cell, called yeast in the process of brewing, or of whiskey manufacture in the hands of the distiller. The difference between the method pursued by the brewer or distiller on the one hand, and the grey cloth manufacturer on the other, in producing their different fermentations, is that the former two clearly understand that they must add yeast to their worts to produce the fermentation, and having studied the exact action of their yeast, they know the exact point at which to stop their fermentation to obtain the best results. The manufacturer, as a rule, is entirely ignorant of the fact that the fermentation of his flour is caused by a living cell at all, and I think that very few have any clear idea of what they are supposed to gain by the operation, the principle for the process being that their fathers did it before them, and they follow in their footsteps. I do not say that the process is an absurd one; on the contrary, I believe it is of much value, although I think it has been arrived at by a series of blunderings. One thing is certain, that much might be gained to the user of the size by a careful study on his part of this operation. My opinion is, that they innoculate their flour with a certain living germ, which decomposes the gluten and other nitrogenous bodies in the flour, thus preventing the remaining starchy matters from being so subject to mildew, for the same reason that we innoculate ourselves with vaccine lymph to destroy certain pabula in our blood, which, if they remained intact, would be liable to be attacked by the germs of small-pox, which would do much greater ravage to the human body than the comparatively innocuous cells of the vaccine lymph. After the sizer has run or pumped off one batch of fermented flour, he leaves some at the bottom of the vat, which contains numberless cells of the desired ferment. Fresh supplies of water and flour are added to this, the mixture well stirred, the little leaven left at the bottom of the vessel leaveneth the whole, and the fermentation is allowed to proceed for one, two, three, or more weeks, according to the whim or fancy of the manufacturer. During this time, the gluten is decomposed and dissolved in the fluid, which soon becomes more and more acid from the production of lactic, acetic, and other acids, and a copious effervescence takes place, from liberation of carbonic dioxide. A certain larger or smaller quantity of starch is undoubtedly decomposed and destroyed, and the question which I believe as yet remains to be solved is—When has this fermentation proceeded sufficiently far to obtain the maximum amount of benefit from the operation? because more harm than good is often the result of prolonged fermentation. A peculiar and interesting variation in the process takes place, which I should think was interesting to an outsider, and that is that occasionally the sizer finds that he "gets wrong" in his fermentation, and instead of the not unpleasant odour which the "healthy" fermentation produces, he may have a putrid fermentation taking place, when the smell emitted is almost unbearable, and, as a rule, the manufacturers have no idea as to how this has been caused. One thing is certain, that the flour which produces that result is condemned, although the flour may or may not have been its cause. The fact is, that some germs other than proper ones have got into the flour—probably the putrefactive vibrio—and it is quite certain that, unless that germ be destroyed or eliminated, each batch of flour will undergo the same abnormal fermentation. What ought, therefore, to be done when such takes place is to clean out the cistern and boil water in it, which, as a rule, will have the effect of destroying or rendering inactive for a time the foreign or unhealthy germs or ferment, and so allow again the "healthy" fermentation, which should be produced by adding to the flour a quantity of another sample undergoing a healthy fermentation.

When the flour has undergone this first process, it is treated in a variety of different ways by different manufacturers; some at once, without any further operations, employ it for the manufacture of their size, some only run off the supernatant acid liquor, others mix it with clean water, allow the starchy matters to subside, and run off the supernatant clear liquor, and others again wash the starch still further with water. The starchy matter in one of these conditions is transferred to another cistern, heated to about 100° F., and water is added to it, if necessary, to bring the milky mixture to a certain specific gravity (sp. gr. 1·09 to 1·12) the density being taken at that temperature, generally from 18° to 24° F. Then it is mixed with the other ingredients of the size, standing about the same specific gravity, and a sufficient quantity of some blue colouring matter is added to destroy the yellowish or brownish appearance of the size, and make it look whiter. (This yellowish or brownish shade seems to be deepened in the starchy matter during the fermentation). This total mixture is then thoroughly boiled by steam, during which the size is kept stirred by means of wooden arms kept revolving by machinery, and is, lastly, pumped to the sizing machines, where it is applied to the warp threads.

The next class of materials with which I propose to deal, are those which are added to the size to give simply body or weight to the yarn. The substance almost exclusively used for this purpose at the present time is china clay, and it is not absolutely necessary that this material should be of the finest quality. It is largely manufactured in Devon and Cornwall, from the large disintegrating beds of felspar which are found there. This felspathic rock when dug out from a considerable depth below the surface of the ground, is very hard, and contains, besides clay, silica or sand, mica, potash, silicate, and other impurities, and it is necessary to separate these ingredients from the clay before it can be used in the process of sizing. The place of manufacture is always situated by the side of a stream. A series of vats are prepared, the top of the second vat being placed in a line with the bottom of the first, the top of the third being placed in a line with the bottom of the second, and so on with each succeeding vat.

The rock is allowed to weather, and by the action of the rain, frost, and air, it gradually crumbles down to a soft friable mass; this substance is passed through a mill, by which it is reduced to a powder of a certain degree of fineness; this powder is then thrown into the first vat, water is added to it, and the whole well stirred up; the lighter particles by this means are kept in suspension in the water, whilst the heavy particles never rise from the bottom of the tank; the water holding the clay or lighter particles in suspension is then allowed to run over into the second tank, where a large portion of the suspended clay settles; it continues to flow into the third, fourth, and fifth tank, depositing in each a large proportion of the suspended matter, till it becomes evident that the finer particles will be carried furthest by the water. It is equally evident, therefore, that what are termed the "finest qualities of clay" will be deposited in the tanks furthest from the one in which the raw material is placed. When this operation has been continued for some time in one set of tanks, it is stopped, and all the water allowed to run away, when there remains in each a soft mud, which is china clay; this mud is taken out from the different tanks, and allowed to dry to the consistency of a firm dough. This is cut into brick forms, which are afterwards laid on the top of each other till they have thoroughly dried, when they are ready for the market. It becomes, then, important that the cloth manufacturer should select china clay which is absolutely free from gritty matters, and which, when mixed with water on a smooth plate or piece of glass, and rubbed by the finger, goes into a smooth, soft, creamy-looking mixture. Another good test for the quality of china clay is to place a little of the material between the teeth and chew it; if the slightest grittiness can be felt, the stuff should at once be rejected, but if it behaves well under those tests, and its colour be white and good, it may safely be employed for sizing purposes. China clay is a chemical compound of silica and alumina, although, unlike most other chemical compounds, these two bodies do not exist in any definite proportions. It may, however, be taken as a rule that as the per-centage of alumina in clays increases, the soft or oily feel increases in proportion. The following analysis gives the proportions of the different ingredients contained in china clay of average quality used by manufacturers, taken from a large number of analyses made by myself:—

	Per cent.
Silica..	46·47
Alumina	40·03
Oxide of iron	·38
Lime..	trace
Magnesia	trace
Potash and soda salts	1·24
Water, organic matter, &c. ..	11·88
	100·00

The reasons which make it necessary to use substances in sizing which are absolutely free from grit are obvious on looking to the arrangements of the loom. Each thread of the warp passes through a small loop in each thread of the healds, and it is evident that a considerable amount of attrition must take place between the warp threads and the sides of the loops through which it passes, as the healds are moved alternately up and down. If, then, the warp threads have attached to them anything of a gritty nature, the healds are very quickly cut through; but here the evil does not end, because it is a most important matter that each loom should produce its proper quantity of cloth, and those mills make the most profit where the speed of the machinery is quickest. If, then, anything interferes with the easy and constant working of the looms, the manufacturer says his "average," meaning his average production of cloth per loom, decreases accordingly. When one of the loops of a heald break, at that moment the girl who has the loom under her charge must stop it, and have the loop repaired before the machine can be again set to work. And not only is this filing action exerted on the heald, but it is exerted with equally injurious effect upon the reeds, and, in a comparatively short time, the thread will file its way through the steel teeth of the reeds, which keep moving in a direction parallel with the warps. Further, when this action has damaged the steel teeth by filing a nitch in each, that nitch reacts on the threads of the warp and cuts them, so that the loom must again be stopped till each breakage be repaired. And thus, when china clay is not carefully selected, the cloth producer suffers severely, not only in damage to plant, but in having a small "average" production of cloth, which is most probably full of flaws.

The treatment of clay required for the manufacture of size has some interesting points about it. It is boiled with water and other ingredients before it is added to the flour. I use the words "other ingredients" advisedly, because it is practically almost impossible to boil china clay alone with water; if this be attempted, the clay will settle to the bottom of the vessel, and as each bubble of steam is generated would shoot the clay out in all directions; but if soap, tallow, caustic soda, or some other substance, be dropped into the boiler, the spirting of the white mud will at once cease, and the liquid will then boil quietly and evenly for any length of time.

The other ingredients which may be and have been used for the same purpose as china clay, and which I have mentioned under the class "body and weight" giving materials, are now seldom employed. Steatite, *alias* soapstone, or silicate o magnesia, stands next to china clay as a substitute, but, as it is more expensive, it cannot well compete with china clay.

Sulphate of baryta, heavy spar, is of a gritty nature, and can never be reduced to a soft, oily-feeling powder, and although it is an excellent substance for giving weight to the yarn, its destructive effects on the healds and reeds, and the consequent loss in production of cloth, is very great. Silicate of soda, or soluble glass, was at one time tried, and promised to be a valuable constituent of size, but it was soon found that it crystallised upon the warps, causing all the numberless evils of which I have already spoken. the *bête noir* of the manufacturer. Sulphates of soda and magnesia are not often employed in warp sizing, as this *bête noir* shows itself.

With the view of softening the yarn, to allow it to weave more easily and nicely, one or more members of a class of bodies, which I have termed "softenings," are employed. Tallow is in most general use. The caution required in selecting this substance is perhaps less than that required for any of the other constituents, because it varies less in quality, and cannot well do much harm to the size, if used in proper proportions, and with proper precautions. It should, however, be as free from colour and rancidity as possible, and its melting point should not be too high, otherwise its "softening" properties will not be so great. It is important that this should be attended to, because if a size possess all the desired properties when certain ingredients are employed, the sizer should be careful when it is necessary for him to buy other supplies of these ingredients, to see that the quality of each is precisely the same as that which he formerly employed. To take the melting-point of tallow accurately, the following method should be adopted :—A piece of glass tubing with one-eighth inch bore should be selected, heated to redness before the blow-pipe, or in the ordinary flame of a Bunsen burner, and then drawn out to form a capillary tube, having a bore about sufficient to allow an ordinary-sized pin to be passed into it. A small amount of the tallow to be tested should be melted in a cup or other vessel, and any sediment which it contains allowed to settle. The surface of the melted tallow should then be touched by one end of the capillary tube, which should be two or three inches in length, when a small column of about one-eighth or one-sixteenth of an inch of the melted tallow will run into it. The tube should then be withdrawn, and the tallow allowed to cool during five or six hours. This capillary tube is then fixed to a delicate thermometer by means of a small india-rubber band, so that the end containing the tallow may be in contact with the mercurial bulb of the thermometer; these are immersed for about 1½ or 2 inches in water contained in a glass beaker; the plug of solid tallow in the capillary tube prevents the water from rising into it. The beaker is gently heated by a small gas flame till the tallow melts, when it will at once rise in the capillary tube, by the pressure of the water, to the surface. At this point the temperature is noted, and taken as the "melting-point" of the tallow. A simpler but rougher mode may be adopted by cutting a piece of the tallow about the size of half a pea, throwing it on to the surface of some water contained in a vessel, and gradually heating the water, at the same time stirring it gently with a thermometer, carefully watching the pellet of tallow as it floats. As soon as it begins to melt, which is shown by a rapid flow of oily matter from all round the pellet on to the surrounding surface of water, the temperature indicated by the thermometer is noted, which gives roughly the melting-point of the tallow.

Some of the tallow should be placed in a test-tube, and gently heated till it melts. It may then be observed whether it contains foreign matters floating in it, or water which would settle to the bottom. Pure warm water should then be added to the tallow, shaken violently with it, and allowed to settle to the bottom in a warm place. The water should be drawn off by means of a pipette or glass tube drawn out at the end; blue litmus paper being dipped into it, the degree of redness given to the paper will give some indication of the degree of rancidity.

Besides tallow, oils of various kinds are employed for softening, and lately paraffin wax has been much used. The colour of the body should be good, and it should not be too hard, *i.e.*, its melting point should not be too high. This substance, however, is most objectionable when the cloth is intended to be washed or bleached, as it is with difficulty separated from the fabric again; because, unlike tallow, and other animal and vegetable fats, it is not dissolved out by soda or soap, and is very apt to stain the goods. But it is still more objectionable when such goods are required for printing or dyeing, as the dye will be liable to adhere irregularly to such cloth. It is advisable, before employing any of these fatty matters, to melt and wash them with water, as they generally contain impurities which can be separated from them by this means. Many sizers employ soap along with the oily matters, to facilitate the formation of an emulsion, because the oily matters are apt to float on the surface of the size; in such cases, the soap and oily matter is boiled and mixed together in one boiler, and then transferred to another containing china clay and water; the three ingredients are then boiled together, and, lastly, mixed with the flour or starchy matter, to be again boiled with it for the formation of the size.

Other bodies are now largely used for the purpose of softening the yarn, which have the further advantage over tallow of communicating increased strength to the yarn, as well as weight, and, as the yarn is not so likely to break, so increasing the average production per loom of the cloth. The ingredients most commonly employed—but especially by those who wish to size their yarn as heavily as possible—are chloride of magnesium and chloride of calcium. These bodies are known generally among manufacturers by the singular name of "antiseptic;" they possess little or no antiseptic properties, and in my opinion the word "septic" would be a much more appropriate term, as I hope afterwards to show. The valuable properties of these salts depend on the fact that they are exceedingly deliquescent; so that, if crystals, or pieces of these solid salts, be left exposed to the air, they will absorb moisture, and spontaneously go into solution. When, therefore, they are introduced into yarn, they keep it always damp, and thus greatly increase its strength, because water has that power to a marked degree; and from a few experiments which I made lately I have been led to the conclusion that if cotton thread be deprived especially of its natural moisture (*i.e.*, an amount of about 8 per cent., which is always found in cotton), its strength is very rapidly decreased in proportion. I tested this point by taking nine different leas of the same yarn. A lea is a small hank, produced by wrapping on a reel, having a circumference of 54 in. 80 threads of yarn; a lea, therefore, is 120 yards in length. These were accurately weighed separately, and each placed in a stoppered glass tube; three of them were afterwards put in a water-bottle to dry at 212° Fah., and then transferred dry again to stoppered test tubes; and three were placed over some water contained in a plate, which was gently heated, under a large glass bell-jar, to allow them to absorb as much water as possible, and then placed in stoppered tubes as before; whilst the remaining three were left in the original test tubes, thus representing the yarn in its original condition. All these leas were then broken by means of the "strain" apparatus. This is an apparatus where a strong spring, fitted exactly like one used for weighing, is attached to a flat piece of wood which is laid in a horizontal position. About 2½ft. apart from this is fixed an arrangement in which slides a long flat piece of brass, with a rack on its upper side and a hook at the end. The hank is placed on between the two hooks of the balance at the one side, and the ratchet arrangement at the other. The wheel is worked, and as the pulling force becomes greater and greater, by the ratchet hook being worked along the slide, the spring is stretched out further and further. A small steel pin is fixed on the end of the spring, which passes down a line cut in the brass barrel or indicator, which covers the spring, and this pushes before it a small, loose iron pointer. At the moment the yarn breaks, the spring recoils violently, leaving the loose iron pointer at the furthest point to which the spring had been drawn out, and this, therefore, indicates at once the weight required to break the yarn. When the nine samples of yarn were broken, I weighed each, then dried them and weighed them again, and the following results were obtained as averages for each set of three leas.

Original weight of yarn. Grains.		Condition of same.		Per centage of moisture.		Breaking strain. lbs.
1° 33·21	..	unaltered	..	8·93	..	64
2° 33·33	..	moistened	..	17·39	..	69 2
3° 33·85	..	dried	..	2·89	..	39·9

These results then explain another *bête noir* of the manufacturer. In large mills hundreds of pounds per week are lost by what they call east winds, if they prevail during that time. I have made many inquiries as to this, and find that the words "east wind" are used rather vaguely. The fact is, that cold or frosty weather has a most injurious effect on the weaving, and I believe that the reason is this, a certain volume of air, say, at 70° Fah., always contains a much larger proportion of moisture than the same volume of air, say, 30° Fah. When each volume of air at these different temperatures is at, or near its "saturating point," weaving sheds are generally kept about a constant temperature, between 60 and 70° Fah., and the result is that cold, and therefore dry air enters them, and is heated up to, say, 65° Fah., when it at once begins to absorb moisture from everything which contains it, so as to saturate itself. It therefore evaporates not only the excess, but the natural moisture contained in the warp and weft, and therefore weakens the threads so that they are not able to withstand the strain of weaving, and one breaks after another; the loom must be stopped to repair each breakage, and the result is, a small average production of cloth. The fact is well recognised that much better weaving, and larger average productions of cloth, are made in weaving sheds situated in a valley near a stream, where the air is always comparatively damp, than when the shed is situated in an open or elevated position.

To counteract the effects of cold weather, many manufacturers allow fine jets of steam to escape into their sheds, and this has the desired effect of making the weaving go well; but this plan has its disadvantages, because, as the work people are paid by the number of piece, they sometimes turn on too much steam, and do not regulate it properly, so that the yarn becomes damp, and great risk is then run, as the pieces of cloth are apt to mildew if no real antiseptic has been added in sufficient quantity to counteract this influence.

The chlorides of calcium and magnesium have the advantage of always producing good weaving and a good average production of cloth, although they have some, I should say, insuperable disadvantages when used alone, as I shall afterwards show. The next two bodies which are sometimes added to size, to produce softness and strength in the warps, are glycerine and grape sugar. The former is in most general use; it is, however, much more expensive than the chlorides of calcium or magnesium, but it is not so apt to produce mildew. Excess of glycerine or grape sugar gives to the cloth a sticky "feel," whilst the chlorides of calcium and magnesium are put into the warps in such proportions in some cloths that they feel almost wet. As a matter of curiosity, I put a piece of cloth, having this "feel," under a glass bell jar, standing over a plate of water, and left it there for a few days at the ordinary temperatures of the atmosphere. I took it out, and by simply wringing, I was enabled to express from it a considerable amount of liquid.

When chloride of calcium and magnesium are employed in size for the purposes of giving weight, softness, and strength, it is necessary, and especially where a large proportion of flour is used, to add to the size one of the substances mentioned under the class antiseptics; chloride of zinc is the one now most generally used, and there is no doubt that it is a powerful preventive of mildew. From some experiments which I made with this substance, I found that, to gain its maximum effect, it was necessary to boil the chloride of zinc direct with the flour, and then to add the china clay and other ingredients, but if the antiseptic be boiled first with the clay, and then added to the starchy matter, as many sizers do, a large proportion of its effects are lost, and size thus prepared may mildew, whilst that produced by the first-mentioned method will not; the clay seems to have some effect in combining with or absorbing, but at all events in rendering partially inert the antiseptic effects of chloride of zinc, or when an insufficient quantity of chloride of zinc is employed in heavily sized goods, mildew and decomposition may result. Carbolic acid is a still stronger antiseptic than chloride of zinc, and I am surprised that it is seldom used for this purpose. The reason given by those who have tried it is that it produces a smell in the cloth, but my impression is that a sufficiently small proportion might be used to act sufficiently as a preventive of mildew and yet be imperceptible to the smell. Compounds of arsenic and also mercury have been used, but both being very poisonous ingredients, they have fortunately never been employed to any extent, and it is unlikely that they ever will be.

Having described briefly the different materials used in sizing, I come to the actual process by which the size is communicated to the yarn. There are two processes in general use, the one is called "ball," or "tape sizing," the other "slashing."

In the former, the proper number of threads required to make sufficient breadth of cloth are put together so as to form a long rope, and that rope is coiled together to form a ball; a number of these balls of warp are placed in boxes and simultaneously passed through size kept boiling in a large trough, by taking the end of each rope, and passing it between two sets of pairs of rollers placed at the bottom of the trough to press the size into the threads, and, lastly, through a third pair of rollers after it leaves the size, to press the excess of liquid out; the warps are then passed, in the form of a very long piece of tape, into a room above, where it is dried by passing over a series of hollow cylinders, made of sheet iron, heated by steam, and is, lastly, again coiled into balls and sent back to the manufacturer, because the process of ball or tape sizing is generally carried on as a separate business; the warp threads are then opened out, and wound on to the beam, to be afterwards arranged in the loom for weaving.

The next general process is that of "slashing," for the sake of giving greater regularity or evenness to the yarn when wrapped on the beam, which is an essential point. The yarn is wrapped from a number of different beams on one beam; thus, suppose it be intended to make a cloth having 2,000 threads of warp, the manufacturer takes, say, 10 different beams or rollers of the same size, each containing 200 threads of unsized yarn; the threads from each beam are all brought together and passed in a line, being kept separate by passing between guiding teeth, which project from a cross wooden beam; they are then passed between one or more pairs of rollers, depending upon the amount of size required to be introduced into the warp; the one-half of the under roller of each pair works in a box, like a cylinder cut longitudinally, which is kept nearly filled with size and heated by steam. By this means the under roller carries a layer of size on its surface, and presses it into the threads as they pass between it and the upper roller. It is lastly passed over, generally, three hollow cylinders, heated by steam, and in some places fans are kept working underneath, to aid the drying process. The threads, after being dried, are wound on to a beam, the same size as one of those which originally contained the tenth part of the threads, and this beam is placed at the back of the loom, to be woven with the weft. A beam generally contains about 800 yards of yarn, and will make about 20 pieces of cloth of about 37½ yards each. The healds will generally last, if the sizing be good, to make about five beams of yarn, and are thus capable of producing about 100 pieces of cloth, whilst the reed ought to stand, with repairing, for two or three years.

The warps on the beam are marked at equal distances required to produce certain lengths of pieces of cloth, generally about 37½ yards, and when the weaver arrives at the end of each piece, which is indicated by a daub of blue colouring matter, she puts in what is termed the heading. Each firm has its own "heading," and a manufacturer knows his own cloth by that means. A few inches of warp are left between each piece of cloth; however, when the beam is filled with cloth, each piece is unwrapped from it, and cut off, then it is folded backwards and forwards, by sticking a strong steel needle through one end of the piece, thus stretching it in the direction of its length to another strong needle, both of which stick out from a wooden beam supported from the ground, the distance between the two needles being about one yard; the cloth is doubled or folded on itself, and the ends of the double ply of cloth thus made is pushed on to the needle; the cloth is then stretched to the other needle, when it is again doubled, and the end of the fold pushed on to it, and thus fixed and returned to the second needle; thus the cloth is wrapped into plaits one yard in length; this is again folded into three parts, by laying the piece thus folded on a table, and folding one side on itself, and the other side on the top of it, thus leaving only one end of the piece visible, which has the "heading" woven into it. These pieces, thus arranged, are sold to the merchant or shipper, who puts on the back of them his trade marks, and then placing generally two lots of these pieces side by side, he packs them into bales ready for shipment. This is done by placing one-half of the necessary packing on the stage of a hydraulic press. This packing differs to a certain extent with different cloths and different packers, but the following may be taken as a type:—Two strong iron hoops are first placed on the stage; on the top of this is put a large course hemp wrapper, then a sheet of tarpaulin, or coarse hemp cloth, which has been covered with a mixture of Stockholm tar and pitch, then a sheet of fine oil cloth, then a layer of coarse brown paper, and, lastly, another sheet of finer and partially-glazed brown paper. The cloth is put on the top of this in such a position that the hoops will encircle the bale at each end the same. Successive sheets or layers, commencing with the last-mentioned, are put on the top of the bale, ending with two strong iron hoops, the hydraulic machine is set to work and the cloth compressed, under enormous pressure, to about one-half its original bulk. The first paper is then carefully wrapped round the goods and folded in at the ends, and the remaining alternate layers of material treated similarly, till the coarse external wrapping cloth is arrived at, which is folded over the bale and sewn along all the four with strong twine. The strong iron hoops are then bent over the bale, so that the bottom and top hoops will overlap each other at the middle of the side of the bale; two oblong holes are then pierced through the two iron straps, and two strong pieces of iron, like paper fasteners, introduced into these holes, and then flattened out and fixed by means of powerful pincers. This operation is made at the three other places when the hoops overlap each other, and the bale is ready for shipment.

This care in packing is necessary to prevent, as far as possible, the admission of moist air or moisture to the goods, and thus to keep them dry, because nearly all grey cloth goods contain a larger or smaller proportion of size, or flour mixture, and a small amount of moisture settling on the goods, especially in warm climates, would generally result in forming the size into a proper pabulum for the mildew, which is a name for the growth of various species of fungi, the seeds of which are generally present in large quantities in the fabric; and when the growths once commence, they are likely to penetrate fold after fold of the cloth, first attacking the size and then extending their destructive effects to the cloth ; so that, in some cases, they may entirely destroy all the cloth in the bale, making it as rotten as tinder. The actions of these fungi are twofold; they grow with enormous rapidity, sending out microscopic filaments much more numerous than the filaments of the cotton itself, in all directions, which penetrate the cotton filaments, and thus mechanically weaken the threads; and the spores will feed first upon the size, and then upon the cotton itself, converting it slowly, but surely, into carbonic acid and water, the same effects which are produced when the cloth is burned. These fungi show their destructive effects in bales of goods in all degrees, from the effects just described to forming on the sides of perhaps only a few of the pieces in a pale slight yellowish or brownish stain.

The history of mildew is most interesting. The question has, no doubt, struck many who have looked upon a bale of goods thus injured,—How has the mildew got there? or, What is mildew? From the researches of Pasteur, an eminent French chemist, and others during the last 15 or 20 years, the subject has, so far at all events as this is concerned, been thoroughly investigated. The size, after being boiled, is absolutely free from any living spores of fungi, and mildew cannot take place unless these spores are afterwards sown upon the cloth. The question then comes, but where do these mildew seeds come from? The answer is, they float in the atmosphere, and that the atmosphere of our rooms and factories is very far from being pure, may be shown by looking at the beams of sunshine as they pass through our windows, the significance of which was recently brought before us by Tyndall. In the beams of sunshine we see myriads of minute particles floating about; a large number of these particles are seeds or mildew spores, and they fall on everything that is in their vicinity; they fall upon the warps and weft of our manufacturers, and when they find they have a good soil, they burst into a luxuriant growth, and destroy his cloth.

I have here two ordinary glass shades, each half filled with flour paste, and we know that if flour paste be left exposed to the air, within a few days its surface will be covered by copious growths of fungi; but, with the view of showing that it is quite possible to keep this substance free from mildew, simply by excluding the floating particles or spores in the air, I boiled in a basin some flour with water, at the same time having placed water in two glass shades standing mouth upwards—the water in each of these was boiled. Over the open end of one of the shades, I tied two pieces of cotton cloth, between which I had previously placed a layer of cotton wool, the steam from the boiling of the water was allowed to act upon the cloth, to allow the heat to destroy any mildew spores which adhered either to it or the sides of the glass; the cotton-wool cover was then quickly taken off, the boiling water poured out, and immediately afterwards the starch paste poured into it so as to half-fill it, and immediately after this, whilst everything still remained, the layer of cotton-wool was replaced over the mouth or open end of the shade, and tied at the sides of the glass with a cord—on the other one no covering was placed. This experiment was made three weeks ago, and the results speak for themselves. The surface of the paste in the uncovered vessel is now thickly covered over with mildew growths, whilst the covered one is quite free from it, and appears now as fresh as the day on which it was prepared; and yet the air had equal access to each, the only difference being that in the one case the air which came to the surface of the paste had to filter through a thin layer of cotton-wool, whilst it came in contact with the other without filtration. The idea of using cotton-wool for filtering spores from the air was first suggested by an eminent physician (Dr. William Roberts, of Manchester). At the top of a high mountain, and especially after rain, the air is practically free from dust, and I venture to say that, if the works of a cotton manufacturer could be transferred bodily to the top of, say, Mont Blanc, and the sizing and weaving conducted there, taking the precaution to heat to the temperature of boiling water all the materials which came in contact with the cloth and size, to destroy the infection carried from our less elevated and infected atmosphere, that the goods might be left damp for any length of time, and yet they would not mildew; and if carefully packed so that the germs of our infected atmosphere could not get to the cloth, which would not be a difficult matter, the goods could then be transferred to the most filthy parts of our atmosphere, and although packed damp, they might be shipped to warm and damp climates without fear of any damage resulting to them from mildew or any kind of decomposition to the size contained in them. If, however, the packing were to be torn, then the ubiquitous spores would fall on the cloth, grow luxuriantly, spread, and ultimately destroy the entire bale. I believe that the lesson to be learned from the study of these points is a practicable one to a large extent, and may be applied to the mills of Lancashire. If they be ventilated with a copious supply of air which has previously been filtered through cotton-wool, it will go a long way towards the extermination of mildew in cotton goods, and consequent enormous losses which from time to time the merchants and manufacturers in Lancashire have suffered. If we look to the arrangements of many sizing machines, we observe that the warp is passed over hot cylinders when they are partially dried, and the drying is completed by means of a fan, which blows a current of air against the damp threads; this air, being unfiltered, contains myriads of mildew spores floating in it, and the force with which they are thus thrown against the damp threads cause them to stick, and thus the manufacturer is careful to sow these seeds of destruction along every part of every thread of his warp, and so he has to prevent them from growing by keeping his goods quite dry, or by adding to his size a powerful antiseptic; but whether or not manufacturers use all care possible to prevent mildew, there is often carelessness shown in packing, over which they have no control; and again if that process be conducted satisfactorily, the bale smay be treated carelessly after they have been shipped, and all or any of these may result in the damage or total destruction of the goods. It then often becomes a question, when goods have been damaged, to find upon whose head the loss ought to fall, or who is the guilty party, and to decide the question, the best plan which can be adopted is that which is now often practised, viz., to have an unopened bale returned from abroad, but this sample bale on its arrival is often so treated by the recipient of it, that a large proportion of the evidence against the offending party is lost. When such a bale arrives, the outside should be carefully examined for flaws in the packing, or mud or other stains on the outside wrapper, and the results noted in writing; the iron straps should then be removed, and the bale carefully undone, leaving each wrapper in position so that it may be replaced in exactly the same position which it originally occupied; any stains or flaws on any of the wrappers should be carefully noted, then all the six sides of the block of cloth should be carefully examined, and if any stains be found on them their position should be compared with the positions of any stains or flaws on the packing. It sometimes happens that salt or fresh water may have been thrown on it, or by some means allowed to come in contact with the bale, so that it has penetrated the packing and come in contact with the cloth, in this case distinct water stains will be observed, and this at once shows that the bales have been treated carelessly. The question which next arises, and the answer to which will go far to fix the blame on the offending party, is this, have the stains been produced by fresh or salt water? If the latter, it will show that the damage has resulted during shipment, or at all events when it has been in the vicinity of the ocean; this point may be roughly tested by touching the tongue first with part of the unstained and then with the stained part of the packing. It happens often that the peculiar saline taste of salt can be detected on the stained portion, whilst that taste cannot be detected on the unstained parts; this point can, however, be more surely detected by chemical means. Equal parts by measure of the stained and unstained portions of the paper wrappers should be taken, because the water will come in contact with them before it touches the goods; these pieces should then be cut into bits, and put respectively into two different glasses, the same bulk of pure distilled water should then be added to each, and allowed to soak therein for some hours; a portion of each solution should be transferred to a test tube, a few drops of pure nitric acid added to each, and then a few drops of a solution of nitrate of silver; if the solution from the stained portion turns of a milky colour, owing to the presenee of chlorine, whilst the other does not, you are justified in assuming, *prima facie*, that the stain has been produced by sea-water; but as "salt" is a combination of chlorine and sodium, it is advisable to prove the presence of the latter substance also, which may be done generally by dipping a fine clean platinum wire in the solution from the unstained portion, and placing it in the flame of a Bunsen's burner, and observing the colour which it communicates to the flame; the wire is then dipped in the solution from the stained portion, and if the latter communicates to the flame a much brighter yellow colour than the former, it may be taken as almost certain that salt water is responsible for the error, which can be further demonstrated by testing for other salts known to be present in sea-water.

The cloth should then be examined by separating several of the pieces, and examining each, fold after fold, to observe whether the damage has gone completely through each piece or not, and the results noted; the pieces should then be replaced in exactly the same position in which it was found, in case other points might suggest themselves which it would be advisable to examine. My experience in these cases shows me that seldom are any of these points attended to. The bale is generally opened carelessly, the packing thrown about in all directions, the pieces of cloth separated from each other and tumbled about indiscriminately, and it often happens that after this treatment, when they have thus destroyed most of the evidence, they request a professional man to give his opinion as to the cause of damage. I mention these things specially, because they are often important matters, about which both merchants and manufacturers seem to have but little knowledge.

Much reform is required in the interesting but conservative processes of "sizing," which I have here briefly tried to describe, and I shall be pleased if this paper, or collection of facts, should count as one brick towards the completion of the edifice where "sizing" shall be worked upon perfect scientific principles.

DISCUSSION.

Mr. Perkin having been obliged to leave before the conclusion of the paper, the chair was taken by Mr. Wills, who said that though the hour was too late for any lengthened discussion, any questions might be asked of Mr. Thomson.

Mr. Crawshaw asked if the use of antiseptics had not a tendency to make the cloth rotten? Some few years ago, a friend of his own used these substances, finding they made the web nice and soft, easy to work, and it was never affected with mildew. The class of cloths was "heavy domestics," they were mainly used in this country, and it was found that when a hot iron was passed over the cloth it made it quite tender. He was requested to analyse the cloth, but he forgot now what the result was.

Mr. Thomson said the question as to the damage caused by antiseptics was one which he had often had put to him. The base used in the instance referred to was no doubt magnesium; when chloride of magnesium was put into cloth, and it was subjected to too great a heat, the chloride would be decomposed, the magnesia being left in the cloth, and the hydrochloric acid liberated, which would have the effect of tendering the fibre.

Mr. Wills begged to move a vote of thanks to Mr. Thomson for his interesting and exhaustive paper. He had no doubt it would be carefully studied, and would be found very useful to those engaged in this branch of manufacture, especially as there was very little literature existing on the subject. Mr. Thomson had approached the question of mildew from a new point of view. M. Pasteur undertook his experiments with a view to the eradication of the disease to which silkworms were liable—*pebrine*. Professor Tyndall had studied the subject from a purely physical standpoint; and now Mr. Thomson had utilised the results obtained by explaining the cause of mildew in the same manner, viz., the presence in the size of germs floating in the air. This seemed very feasible, and it might lead manufacturers to take such precautions as would prevent these germs sowing themselves in the size which was to be added to cotton goods.

The vote of thanks was carried unanimously.

PATENT-LAW CONFERENCE.

Friday, March 9th, 1877; Major **Beaumont**, R.E., M.P., in the chair.

The Chairman, in opening the proceedings, said the discussion on Tuesday evening was very fully and fairly carried on, and it was extremely important that the subject should be ventilated as much as possible before legislation on this important subject took place. It seemed to him that inventors were perhaps more fully represented the other evening than were the public, and it must not be forgotten that the interest of the public and the interest of the inventor were really one and the same. It was quite impossible to have legislation which should be to the advantage of the one and not the other. One thing he desired to direct attention to, and that was that facts were much better than talk. The object of all their discussion was that some important result, beneficial to all, should be the result of the legislation which was about to take place. There would, therefore, at the close of the meeting, be a further resolution proposed by Mr. Hinde Palmer, in addition to those already on the paper, that a deputation should be appointed to wait on the Attorney-General with a copy of the resolutions which had been arrived at by the meeting. In conclusion, he called upon Mr. Hinde Palmer to propose the third resolution.

Mr. Campin rose to order, saying that as Sir Antonio Brady moved the adjournment of the meeting on Tuesday he was entitled to begin.

The Chairman said he was not aware that there was any business actually before the meeting at the adjournment that would entitle him to begin, as the second resolution had already been disposed of.

Sir Antonio Brady desired to inform the meeting that the Inventors' Institute had appointed a sub-committee to confer on this subject, and he would like to move that a sub-committee from this Society should be appointed to confer with that Institute, and present a joint petition which had been agreed to by that body, and which fully embodied all the opinions which had been expressed by the various speakers on Tuesday evening.

The Chairman said perhaps the better way would be for Sir Antonio Brady to defer till later in the evening the moving of his resolution, and then move that a deputation from this meeting should be appointed to frame a report on the resolutions if it thought fit.

Sir Antonio Brady felt sure there would be no difficulty, judging from the expressions which had already fallen from the various speakers, of there being a general concurrence with the petition which had been framed by the Inventors' Institute, and which was to be presented to the House of Commons by that body. There was also the question of the reduction of fees, which they ought also to consider.

Mr. Hinde Palmer, Q.C., understood that the resolutions which had already been proposed to the meeting, and those about to be proposed, were intended for the purpose of raising discussions on practical points in the Bill itself. It was competent to anybody to propose any amendment on any of the resolutions. With reference to what Sir Antonio Brady had said as to the reduction of the fees, that subject might very well be raised, he (Mr. Hinde Palmer) was himself in favour of reduction, and had, in 1871, brought a short Bill before the House of Commons, in which he proposed a reduction to the extent of one-half of the present fees. That Bill was superseded by the appointment of a Select Committee to inquire into the whole subject. The resolution with which he was entrusted went to the next branch of the bill—the question of compulsory licenses. The Bill, as at present drawn, proposed that the terms upon which licenses should be granted, in case the parties themselves could not agree upon them, should be settled by the Lord Chancellor. Those who prepared the resolutions before the meeting thought that the Lord Chancellor was not the best authority to assess the terms on which those licenses should be granted. The Lord Chancellor was not always a man practically acquainted with the subject. It might be taken for granted that there should be Commissioners properly constituted, and if that were done they would be better able to say what the terms should be than any Lord Chancellor. The object of the resolution was to substitute the Commissioners of Patents for the Lord Chancellor, as the authority to fix the terms in case of difference. There was a great difference of opinion as to the granting of compulsory licenses. Mr. Mundella had said that he was against the principle altogether. The Government, however, had evidently come to the conclusion that compulsory licences should be granted on reasonable terms to be settled by someone. Their report was based on very weighty evidence. Mr. Newton, an eminent patent agent of long experience, was strongly in favour of compulsory licences. There seemed to be an idea that the object of granting compulsory licences was to enable manufacturers to use and work the invention in their own ordinary trade. But it was very unlikely that the patentee would not be induced to grant licences for such a purpose as that, provided he had a fair remuneration. What was the difficulty which induced them to report in favour of compulsory licences? It was this; a person had a patent for an invention, someone else invented an improvement on that, and he could not put his own improvement on the invention in practice without interfering, to a certain extent, with the previously patented machine or process. The patentee said, "I have a valuable invention; I shall not grant a license; yours may be an improvement, but I shall not grant a license." It was with the view of preventing such obstruction in the way of future improvements that the system of compulsory licenses was advocated. It was that they might be able to say, "Such a patent stands in my way, and prevents my introducing an improvement which I have." The question was discussed at the Vienna Conference; and some thought, with Mr. Mundella, that there should be no compulsory licenses. Fifty-seven voted, and a majority of twenty-five were in favour of granting compulsory licenses. The Government had come to the conclusion that it would be useful to have a clause for granting compulsory licenses; and it would not be wise to interfere further than to substitute, as was proposed by the resolution, the Commissioners of Patents for the Lord Chancellor. He believed—and so did those of experience—that the proposed provision would seldom be put into execution, because, if the patentees were aware that they would be obliged to grant licenses on reasonable terms, the clause would very seldom be put in force, and the licenses would be granted. He thought it would be well to allow the clause to stand with the proposed amendment. The Bill had been introduced by the Government with an intention that it should pass, and they were entitled to very great credit for introducing it. At the time that the Select Committee was appointed, there was a strong feeling that patents for inventions should be abolished, and one great advantage of the Select Committee had been that it had set at rest for a long time the agitation for the abolition of patents altogether. That involved that the Patent-law as it existed should be amended and made as good as it possibly could be; and the Bill was in principle a most valuable improvement in the law. The Government had a large working majority at their back; if they were determined to carry the Bill, they would do so, and for that reason it would be very desirable to propose amendments in the Bill of such a character as would not go to any vital principles in the Bill; that the amendments should be confined to real practical suggestions of such a character that they would be adopted by the Attorney-General and the Government without further discussion. The amendment proposed was of a practical nature, and such a one as the Government would be likely to adopt. He therefore proposed:—"That, recognising the desirability, in the common interest of the public and inventors, of compulsory granting of licenses, as recommended by the Select Committee of 1872 on the Patent-law, this meeting considers that the provisions of the Bill should be so modified that the power of fixing the terms on which such licenses be granted, should rest with the Commissioners of Patents instead of the Lord Chancellor, and that the onus of proof should in each case lie on the party complaining or seeking the revocation."

Mr. Alexander seconded the resolution.

Mr. Brunskill Cooke believed that the clause referred to would prove not only unsatisfactory, but could not be carried out, because so much difficulty and disagreement would arise as to the amount to be paid for the granting of the licenses by the patentee. Vast expense would be entailed upon the applicant for a license under the Bill as at present framed, and it could not possibly be decided by the Lord Chancellor as to the terms on which licenses should be granted, while if the license were not granted within the three years named in the Bill it would not be granted at all, except by the free will of the inventor. Perhaps the best tribunal that could be found for the decision of the question would be the Railway Commissioners instead of the Lord Chancellor. They were at present very little occupied, and would probably be glad to accept such duties rather than have their office abolished, which possibly might be the result of their not being more engaged. If the granting a license were made absolutely compulsory, as a condition of the patent being granted, he believed that the cases would be infinitesimally small.

Mr. Pieper desired to address himself to the arguments used by Mr. Hinde Palmer. He had said first of all that the committee of 1871 proposed that a compulsory license should be granted; secondly, that it was the only way to deal fairly with an improver; and, thirdly, he had been arguing that if the clause were in the Bill it would be never used. But it must be remembered a great change had taken place in public opinion on these important questions since 1871, and he ascertained what had taken place at the Vienna Congress in 1873, where they had been forced to consider this question, owing to the policy pursued by America and England, and on the last day of the Vienna Congress a vote had been taken of 50 against 10, in favour of it. But, he asked, why treat an improver better than you do an inventor? First of all you gave the man a patent, and then it was wanted to introduce a license paragraph, because some man proposed to improve a little bit upon it. And would not the improver be better off than the original inventor? He believed it would only be an exceptional case where an improver or the public would suffer by not having a license granted at all. Why, therefore, introduce a paragraph simply because a man was foolish enough not to know his own interest? Then Mr. Hinde Palmer had said "don't fight the Government, for the paragraph would never be used." Then why introduce it into English law, for if it were the law here, the same clause would be inserted in the German law, and what would be the consequence of that? That an English inventor when he had got a patent in Germany, which he could not give licenses for except on most unreasonable terms, if he did not do so in two years' time would have only an invalid patent. Section 10 and section 23 said distinctly whenever a foreign patent lapsed the English patent lapsed too; and if a compulsory license clause were inserted, they would have to submit to what Germany or any other State might do. Mr. Hinde Palmer had said they should not be too hard on the Government, because there was a great force behind them, and they could carry this Bill. He thought public opinion, however, would be listened to, and he did not believe that the Attorney-General or the Lord Chancellor would force anything upon the House which was contrary to it; and if the general opinion of this Society and kindred societies were expressed, against the granting of compulsory licenses, it would be considered, and there would not be any clause of the kind passed.

Mr. Newton Wilson desired to propose an amendment which would not conflict with the resolution. After a long experience, he had come to the conclusion that the granting of compulsory licences would be a most beneficial act on the part of the Legislature. Looking back upon the experience of many years, he could see suit after suit of a costly character that would never have taken place had such a clause existed in the present Patent-law. He believed that if the parties could have come together and decided on equitable terms, the amount of royalty, or, in case of necessity, by means of such a Court of Appeal as was suggested, viz., the Commissioners of Patents, these suits would be avoided. One thing, however, he did object to in the proposed law, and that was that the power of granting compulsory licenses and the power of revocation were both fixed at too early a period. If five years were inserted instead of three it would be better, for that would be a comparatively short period, considering the proposed extension of the term of patents from 14 to 21 years. Often the inventor had hardly had a chance within three years to give himself a fair start in the world. He thought that would equitably meet the case, and that the provision as to compulsory licenses and the power of revocation should not be exercised till after that period. He would move to insert, after the words "the Lord Chancellor," "that the power of compulsion in regard to licenses and the power of revocation should not be enforced till the expiration of five years from the date of the patent, and that the onus of proof in each case should lie on the party complaining or seeking the revocation."

Mr. Lewis Olrick had intended to offer an amendment which was so close to Mr. Wilson's that, if he would make a slight alteration in his amendment, he would accept it in lieu of his own. In his opinion there was another question of very great importance, and that was the compulsory working, which was something quite different from compulsory licenses. In his amendment he went in for exactly the same term of five years. In the Bill it was said distinctly, in clause 22, that after the term of three years the patent should be revoked on certain grounds.

The Chairman suggested it would be better the amendment should be seconded before discussing it.

Mr. Varley then seconded it.

Mr. Lewis Olrick said, to make clear the distinction of compulsory working from the granting of compulsory licenses, he would define what he meant. The granting of compulsory licenses was obstructing industry and progress, whereas the compulsory working was to compel the patentee to take definite active measures. It was just because in the Bill, according to clause 22, subsection 1, the measures he was to take were quite undefined, that the clause would give rise to a great deal of litigation and difference of opinion. He would instance what he meant by citing two classes of people to whom a patentee might want to introduce an invention—say brewers and railway companies. They were the most conservative people in existence, and he would defy any one to bring his invention before the world within the meaning of the Act in three years.

His experience was, that, to introduce a new invention was at all times a difficult matter, and very hard work, and, when they had to deal with complicated machines, they might so make the machine as to bring it within the term of an improvement on the specification, although not such an improvement as to justify taking out a fresh patent, and it was quite natural, before you introduced it into the market, you should desire to make it as perfect as possible. When a man was busy with other things, he could not spare the whole time necessary to perfect an invention, and it would be very hard if, because he did not comply with the exact number of years—namely, three—that he should lose the benefit of his patent and his subsequent skill and labour. The addition he intended to move was this—That a patent should be revoked only after the patentee had refused to license, after being required by the Commissioners to grant it, on terms deemed reasonable by him. Also that sub-section 1, clause 22, which provides for the compulsory working, is unnecessary, and would render patent property very uncertain, and give much cause for litigation. There could be no doubt that clause would render patent property most uncertain, and a man would never know whether he had a patent or not after the three years mentioned in the Bill.

The Chairman asked if Mr. Olrick wished to omit sub-section 1 of clause 22 altogether.

Mr. Olrick said he did.

The Chairman hoped that, as a Member of Parliament, they would allow him to offer some explanation of the way in which he understood that clause was meant. The clause ran in this way—that if a patentee failed to use or to put in practice his invention, by himself or his licensees, to a reasonable extent, within the United Kingdom, or to make reasonable efforts to secure the use or practice thereof, proof to the contrary thereoi shall lie on him. Then sub-section 2 was :—"That if it is made to appear to the Lord Chancellor that in order to ensure a proper supply to the public of articles produced under the patent, or proper means for the use oı the invention by the public, licenses are necessary, and the patentee fails to grant licenses to proper persons requesting the same, on terms which the Lord Chancellor, having regard to all the circumstances of the case, deems reasonable, the patent should be revoked." His reading of No. 1 was, it was only to be put in force in the extreme case—he knew of no such case—where, from the nature of the patent, it was impossible a license could be granted. That was the interpretation the clause bore. If it were omitted it was of very small value; and if it were left in, it met a difficulty which possibly might arise.

Mr. Olrick said the clause was somewhat vague, and he had read it as to its effect on compulsory working, and also as to compulsory licenses; and, as he pointed out, there was a difference between the two.

The Chairman said it was a very moot point, no doubt. He asked Mr. Olrick whether his resolution would not take the form of moving that sub-section 1, clause 22, be omitted.

Mr. Olrick replied that he would move that sub-section 1, clause 22, in the Bill, which provides for compulsory working, is unnecessary, and would render patent property very uncertain, and give much cause for litigation. He moved that addition to Mr. Wilson's amendment.

Admiral Selwyn seconded Mr. Olrick's addition to the amendment, but he desired to move a further amendment affecting the first part of the resolution. He wished to substitute some words for the first part of the resolution, which spoke of "recognising the desirability, in the common interest of the public and inventor, of compulsory granting of licenses."

The Chairman ruled that no further amendment could be made at this stage of the proceedings.

Admiral Selwyn said what he wished to do was to move the omission of the words from "That," to the end of the words "Patent-law," and instead thereof insert the words, "This meeting considers that the provisions of the Bill should be so modified that if compulsory licenses be insisted upon the power of fixing the terms on which such licenses should be granted" and so forth, with the addition of the other amendment. Mr. Mundella had shown in his able speech what would be the result abroad to all our inventors if these provisions were carried out. As inventors they considered that compulsory licenses were objectionable—a mere pitfall, which if not likely to come into use should not be provided, and if they were they would affect the public most materially, and were most objectionable. As to the argument of Mr. Hinde Palmer about the Government majority, he thought they ought to remember Sir John Holker's words, that he was disposed and willing to listen to every suggestion which would tend to make the Bill a good Bill. As to what had been said about the committee of 1871, it must not be forgotten that though that committee gave a large amount of advice as to what was best to be done, its views were mainly coloured by the man who was its chairman, and was quite adverse to patents. That state of things no longer existed, and they were free to discuss at the greatest possible length everything which could possibly effect the interest of inventors as well as the public.

The Chairman said it was not Mr. Macfie, who was the chairman of that committee, but Mr. Samuelson, and he was not hostile.

Admiral Selwyn, in support of his argument, asked whether it would not have been worth while not only not to tax Dr. Siemens, but even to pay him for coming over? And ought not that to be the policy which should govern them, namely, give every possible inducement to inventors to come. Was not this the object of Patent-laws? For what purpose did our Legislature then frame those laws? Was it not because they were convinced that other nations were surpassing us in arts and sciences, and we have since been able to get ourselves a head of other nations. What was Prussia doing now? She said, "Come here. We will give you your invention, and if you are a poor man, you shall not pay a farthing for two years. You shall have your patent for 30s." Contrast that with the policy of this country of putting a heavy tax, which by the Bill was obviously very much increased and not reduced. And he appealed to patent agents, whether the work to be done under the Bill would not be more than doubled. It was not fair to begin, as they would if this clause became law, by entangling the patentee in a lawsuit. He also said that if the Commissioners were few, and well paid, and independent of the law courts, we should find our business going on much better.

After some further discussion, **Admiral Selwyn** moved, and **Mr. Newnham Brown** seconded, a resolution, "That this meeting is of opinion that it is not desirable to have compulsory licenses."

Mr. E. A. Cowper thought that no case had been made out for granting compulsory licenses. There was not half-a-dozen cases of dogs in the manger, or of obstructive patents or original inventions which ought to be put aside for the sake of some improvement. He could understand the improver wishing to have the whole thing, but that was not possible. The first person who made it ought to have the invention, therefore the second person, the improver, ought to sell his improvement to the patentee, or he might take a license at such a price as he could get granted him. The original invention was the valuable thing. As to any proper person being appointed who should grant licenses, considering the miserable way in which the Patent-office had been neglected, he did not think any person could be found fit to do it. It required not only that the person should be infallible, but have a thorough knowledge of all trades, arts, and sciences. How could anyone who was likely to be appointed say whether a license should be granted for aniline dyes, for instance, or for anthracine, one of the most valuable of recent discoveries and inventions. It was utterly impossible. Then, again, unless he were a thorough agriculturist, how was it possible for him to decide on the conflicting merits of the different reapers, and as to which was the best. No Lord Chancellor or anyone else could possibly settle between two reapers which was the best. A man must be an engineer, a chemist, and he did not know what. Take the case of a sewing machine; it was something fearful to go through the various sewing machines which were in existence. Then it required not only a perfect knowledge but infallibility to decide such questions. As to the extension of time, he was clearly of opinion that 14 was not long enough, and 21 years would be better. The average lifetime of a patent was 3½ years, which showed that a very large number of patents went to the wall and were not obstructive. He thought if these clauses were passed it would virtually give up property in inventions. If they gave up the right as to the terms, it was practically selling the invention.

Mr. Lincoln was of opinion that the improver should be compelled to grant licenses to the original inventor.

Mr. Huntley thought the last clause of the resolution had not been touched upon; namely, that the onus of proof should in each case lie on the party complaining. This ought to be omitted, for it subverted the principle of the Bill, which in other cases was that proof should lie on the patentee. It would be utterly impracticable. It must be entirely on the patentee to prove that.

The **Chairman** said Mr. Huntley was quite right in that, and their object was to get the action of the Bill reversed.

Mr. Lloyd Wise believed Mr. Olrick's amendment would overcome the difficulty. He believed the Bill would introduce a very great deal of uncertainty—all who had had to do with patents knew that these compulsory working clauses gave rise to a very great deal of trouble in other countries. They rendered the question of whether a patent was valid a matter of great uncertainty, and the spirit of the law was rarely carried out, though the letter was. For example, in Austria a patent was granted for one or more years, with a right of prolonging it by paying an annuity, but before you could get a prolongation you must prove you had put the invention in operation within one year from the date of the patent, and had not afterwards discontinued the working of the invention, or the making the patented article, in the country for two years. As a matter of practice, if a man took out a patent there, in which pipes and wheels were a part of the invention, he simply sent over a few odd pipes and wheels, got a bit of screwing done, and bamboozled the authorities—he was not speaking in general terms, but of facts within his knowledge—and then they allowed the patent to be prolonged. It was simply nonsense to suppose any good resulted in Austria from that provision of the law: on the other hand, it introduced uncertainty whether the patent was valid or not.

The Chairman then put the amendment:—"That this meeting does not consider compulsory licenses desirable," which was carried.

Mr. Olrick said part of his proposed amendment, therefore, had been annihilated, that compulsory working was not desirable.

Mr. Olrick's amendment was then put as a resolution, and carried—"That sub-section 1, clause 22, of the Bill, relating to compulsory working, be omitted."

Mr. Cowper moved:—"That this meeting is of opinion that the provisions of this Bill, as far as they relate to the prolongation of the term of a patent to 21 years should be extended to existing patents."

Sir Antonio Brady seconded the resolution.

Mr. Campin moved:—"That all the benefits of the Bill be retrospective, because, supposing there were to be a reduction of fees, it was very desirable existing patentees should get the benefit of it."

The Secretary suggested that this question had better be deferred till they came to the resolution respecting the stamp fees.

The Chairman said the point on which they desired an expression of opinion from the meeting was whether they did or did not attach importance to the question affecting the extension of the terms to existing patentees. The resolution now being disposed of was as important as any existing on the paper.

Admiral Selwyn said they spoke not only in the interests of inventors, but of the public, who would be seriously affected by having two classes of patents. It would introduce great difficulty in every way.

Mr. Galloway thought it would only be an act of justice, for the biography of inventors and the history of inventions alike proved that in many instances the 14 years had actually expired before the inventor received any benefit.

Mr. Brunskill Cooke thought the Legislature would not entertain the question.

Mr. Lloyd Wise moved, to add after the words "21 years," the words "and to amendments of specifications by way of disclaimer, explanation, supplement, or otherwise."

Mr Campin seconded the addition.

The resolution, as amended, was then put and carried.

Mr. Olrick proposed the fifth resolution:—"That the requirements of the Patent-office be properly provided for, and a suitable museum and public library maintained, before the funds derivable from stamp fees are used for the general purposes of the State." He did not think it necessary to waste the time of the meeting with any recommendation of it. The Patent-office had the first lien on the money paid into the Patent-office.

Mr. Murdoch seconded the resolution.

Dr. Lempriere proposed, as an amendment:—"That the imposition of an additional tax of £100 is objectionable, but that a material reduction of fees should bo effected by annual payments, the first payments being the smallest." He objected altogether to the resolution passing in its present form, because it recognised that the fees were to be disposed of according to the form of that resolution. On the contrary, he thought it wa proper for them, in dealing with the question of fees, to start with their objection to the main principle, which all persons speaking and writing on the subject had looked upon as a blot in the Bill, namely, that, instead of reducing the fees as all desired, the Bill had increased them by an additional tax, thereby burdening the already straining back. The first opportunity that presented itself at that meeting should be used in order to record their opinion as against that blot. He was decidedly of opinion that they ought to record their recommendation that a material reduction of fees should be at once commenced. It was not for them to say how far or in what direction the reduction should be made, that might be very well left to the wisdom of the Legislature and their excellent friends in it. No one could have heard the address of Mr. Mundella but must know that the feeling expressed in that room by more than one was, that they would have a fair and honourable hearing whenever the case came before the Legislature. It was not at all a party question, but one where the Government wished to do its duty between inventors and the public, and any opinion coming from a body, who had the *genius loci* of that room, would be sure to secure attention. The The meeting should, therefore, record its opinion that £100, as an additional tax, was unwise, and that a material reduction of fees in the proper direction should at once be made. He was not a patentee, nor had he ever had one farthing interest in any patent case in his life; but he took the common-sense view, and, having spent twenty years abroad, he could endorse the opinion which almost all had given, that the future commercial life of this country depended on the encouragement of invention. He thought the amount at present proposed, £262 10s., as the cost of a patent, was too much, and would, therefore, move his amendment.

The Chairman suggested that it would be more in order if the resolution were passed as it stood, and the proposed amendment moved upon resolution No. 7; the discussion on the question of fees would more properly take place when that 7th resolution was brought forward.

Dr. Lempriere desired to leave that question in the hands of the Chairman.

The Chairman put the 5th resolution to the meeting, and it was carried.

Mr. H. H. Murdoch then proposed:—"That a sufficient Patent-office and staff should be established before it is attempted to put the proposed new Patent-law into operation, and that unless this is done the provisions of that law cannot be properly carried out." It was a fact that a proper office had not been established. He was only expressing the feeling of the patent profession when he said that the Patent-office had been starved. Instead of the requirements of that office being enlarged to meet the requirements of the public, the requirements of the public had been narrowed in order that they might not trespass on the small space in the Patent-office. He would not go into old grievances, except to say that from the past they ought to judge of what the conduct of the Government was likely to be in the future. The same gentlemen who at present had the administration of the Patent-office would have it under the proposed new Bill, and although it was said that an office would be established, it did not say when. Inventors had, since the year 1852, been treated in a grudging spirit; and at the present time, in order to save space, tons of printed specifications had been destroyed. A sufficient staff of draughtsmen, who produced the best reprints of specifications in the world, had been dismissed in order to save a few pence. The specifications were now printed in such an inferior way that the lines ran together into indistinguishable blots, and they were useless for reference in court or for comparison. No Patent-law that could be obtained, however perfect, would work well unless they had means of comparing one specification with another. That was the opinion of the profession, and of Mr. Aston. They ought to have their Patent-office and staff before the Bill came into operation. That should be had as an earnest of what was to come, for he thought he saw a sharp hook through the bait held out to them. The law of 1852 provided that the Commissioners might give to inventors such numbers of their specifications as they thought fit. By section 53 of the new Bill, the Commissioners might make regulations for requiring, in any case, if they think fit, payment of all or part of the expenses incurred by them in printing specifications, &c., to be defrayed by the applicant or patentee.

Mr. Cowper seconded the resolution. Why the Patent-law of 1852 had not been put into practice was because of the want of officers and staff. That staff ought to be composed before the new law was brought into operation. All the destruction of property that had been going on was because of want of room. The idea seemed to be rather to starve the place than otherwise.

Admiral Selwyn could not support the resolution. Those proposing it seemed to have forgotten that it would be premature, before they knew what extension of inventions would come from the passing of the equitable and just law which was proposed, to make provisions which might not be wanted after they were made. He doubted if the resolution could be carried as it stood. It would be sufficient to let it stand as part and parcel of No. 5, which asserted the principle sufficiently, and did not limit the time within which they should be done.

Mr. Hinde Palmer would submit to Mr. Murdoch that everything they wished could be carried into effect under the 5th resolution. He quite agreed in principle with Mr. Murdoch, and had never missed an opportunity when he was in Parliament of pressing on the Government the necessity of its being done.

Mr. Murdoch merely wished to show that the resolutions were not identical. Under resolution No. 5, the building of the Patent-office might be adjourned *sine die*; under No. 6 it was to be set about forthwith, before the Bill was put into operation.

Mr. Galloway desired to move an amendment:—"That a Patent-office and staff should be established forthwith to be paid for out of the surplus patent fees, the fund now in the hands of Government."

The Chairman asked if anyone seconded that amendment? No one did so, and it failed.

Mr. Murdoch asked if he might put the words "And before it is attempted to put the provisions of the Act into operation" into the resolution already passed.

Mr. Campin objected, that they would nullify what they understood by the resolution.

The Chairman understood the resolution to mean that no Act should be passed till the Patent-office was built, which seemed to him to be hanging the business up for a very long time.

The resolution was then put to the meeting and lost.

Mr. Paterson wished, as Mr. Mottershead was unavoidably absent, to move the seventh resolution:—"That with a view to avoid obstruction to the production of inventions for public use by prohibiting taxation, the stamp duties on patents in all stages should be materially reduced, particularly in the initial proceedings." He did not wish to make any invidious statements as to the share which working men had had in producing inventions, but in many cases improvements which might be called small, which were necessary to the success of larger inventions, were produced almost exclusively by working men. It was only the men who had constant familiarity with the details of the operations going on that could be expected to see the need of and produce those detailed improvements in working, so necessary to the success of greater inventions. He might point to inventions which had revolutionised the manufactures of England which had come from poor men. But he rested on that; they must look to the men who were directing the operations for a whole class of necessary improvements in the operations. Upon this class the stamp duties which existed at present, and even those proposed, although far less in amount, must always act as a prohibitory taxation. That was especially felt in the preliminary stages. If a man had to pay a heavy fee before he could cultivate a field, or commence any particular branch of industry, anybody would see at once that such a fee was not only injurious to the man himself, but that its chief action was against the public, who really would be benefited by the invention. The improved price a man got for an article did not represent the whole value of the article. The patent could only be for a very short time, and after that time the whole benefit went to the public. Therefore, any taxation of a prohibitory character, whether stamp duties or anything else, that prevented men who were poor from bringing forward an invention, acted injuriously on the public at large. That prohibitory taxation did one of two things. Either a man brought his invention forward when he could not afford it, and was robbed of it; or he kept it secret and it was lost to the public. He had had much to do with working men, and the question of the inventions had come very forcibly forward in connection with an exhibition where working men had exhibited. All knew that there were disputes between workmen and employers, and whichever side might be taken, those disputes had been embittered often by the fact that most of the intelligent workmen felt that they had this grievance to pick with capital. It had been said that if the taxation was removed, they would be flooded with useless patents. But either an invention was useful because somebody wanted it, or useless because nobody would want it. If it was useless, nobody would want it; if anybody did want it, it showed it was of use, and the man who produced it should be paid for it. Any argument as to the multiplicity of claims should be met by a better arrangement of the Patent-office. They must adjust their offices so that all just claims, however complicated, might be attended to. Trouble might be given to the lawyers, the officials, or the manufacturers, but that would be rewarded by the number of small but valuable inventions that would be placed at the service of the manufacturer and the public. He thought there was a case for reducing the initial charges. They were of no use for revenue, and went very little towards keeping up the office, and yet a great deal of harm was done by having them. He pressed for the reduction of the charges in the first instance. Let it be made an annual payment, beginning with the fifth or sixth year. If they must get the blood and bones of the inventor, let them tax him when he was able to pay; but they ought not to come in before he had got any money and say, "You shall not begin this till you pay me a certain sum of money which you have not got."

Mr. Varley seconded the resolution. It was to encourage inventors to come to this country that he would advocate the reduction of the fees. It would be desirable for artisans to make an annual payment, as that was a thing they might manage to keep up. He would support the proposition for a reduction of fees in all stages.

Mr. Wilson agreed with the mover and seconder of the motion, but they were not sufficiently explicit. He would, therefore, propose, as an amendment, "That this meeting disapproves of the proposed high scale of charges for stamp duties at three, seven, or twelve years respectively; and in lieu thereof, recommends that after the completion of the initial stages, a uniform duty, not under £5 per annum, shall be charged to the expiration of the patent." It had been frequently said that the high duties of £50 and £100 had been the means of weeding out worthless patents; but he thought they had been far more successful in weeding out valuable patents. His observation had been, that in most cases where patents had ceased to be kept up at the end of three or seven years, it had been from inability to find the money rather than from the patent not being wanted. He thought a duty not exceeding £5 per annum should be paid to the Crown.

Dr. Lempriere felt bound to second that amendment.

Sir Antonio Brady hoped that gentlemen who moved specific resolutions on the matter would not press them. It would be better to carry an abstract resolution rather than one which went into detail, and so leave the thing open, as the Inventors' Institute were going to do by their petition. The brain-power of the country should be encouraged to come forward, and not be overweighted with duties of taxation, which were not only unjust but impolitic. The Americans made a large revenue from their patents, and yet the amounts for each was very small. Why should inventors in this country be placed in a more unfavourable position with regard to their patents than foreigners? He would move, as an amendment to the resolutions before the meeting:—"That it was not desirable to go into details, but only into the principle involved, in order that inventors in this country might not be placed in a less favourable position than those of other countries."

Mr. Paterson would be willing to accept Sir Antonio Brady's suggestion.

Mr Wilson could not accept it.

Mr. Campin thought that there was no necessity for such a rider, and that it would confuse the meeting.

The Chairman thought Mr. Paterson's was the more clear and sensible way of putting it.

Mr. Paterson merely wished to suggest to the meeting that an alteration should be made, and they should take as much as they could get.

Mr. Campin thought Mr. Wilson should withdraw his amendment,

Mr. Lloyd Wise thought the original motion a good one.

Mr. Hale felt that if it was understood that the Government would look at the matter from the point of view that the British inventor should not be at any disadvantage with those of other countries, that would do.

Mr. Pieper seconded Sir Antonio Brady's amendment.

The Chairman asked if Mr. Paterson would withdraw his resolution in favour of Sir Antonio Brady's.

Mr. Paterson considered the suggestion of Sir Antonio Brady a very useful one. All he should object to in the amendment of Mr. Wilson was, that he did not wish to see the resolution pinned to a scale. He wanted to place before the Government what he believed to be the state of the public feeling on the matter, and the public requirements.

The Chairman said the principle of Sir Antonio Brady's proposition was, that inventors in this country should not be in a worse position than those of other countries.

Sir Antonio Brady assented.

The Chairman would, therefore, put to the meeting the proposal of Sir Antonio Brady:—"That it is not desirable that the fees or stamp duties levied on inventors, in respect of patents for inventions, in the United Kingdom, should materially differ from those in other States likely to be competitors in manufactures."

Mr. Paterson asked if that was to supersede the resolution, or amend it?

The Chairman—To supersede.

Mr. Paterson would be glad if Sir Antonio Brady could adopt words which would put his idea into the original resolution. It was necessary that the Government should be told that the heavy stamp duties in the initial stages were a prohibitory tax.

Mr. Mottershead hoped the meeting would pardon him for not being there in time to propose the resolution which stood in his name. He would like to draw attention to the vagueness of Sir Antonio Brady's amendment. It should be clearly stated that patents should be lower in the interests of the poor inventor. Sir Antonio Brady's amendment conveyed the idea that inventors must be put on the same footing as those of other countries. If so, how were they to stand with regard to Russia, where the price of a patent was £80. There could be no objection to stand with the lowest if that could be put in the resolution; but he had watched the House of Commons, and much preferred that a definite principle should be put into an Act of Parliament. Let them have distinct lines when making resolutions. Those he represented felt, as an artisans' committee, that their order was unfairly robbed. They felt from the workshop often came the real movers of an invention, and yet they never got their rights seen into. The charges frightened the working man from going in for his rights. If Sir Antonio Brady's amendment fixed the amount at the lowest adopted by other countries, he would agree to it.

Mr. Paterson would accept Sir Antonio Brady's amendment if it were added to the resolution he had moved, as it would strengthen it.

The Chairman wished to know if Sir Antonio Brady would accept that.

Sir Antonio Brady—Certainly.

Mr. Wilson did not know whether the seconder of his amendment wished it to be withdrawn, if not, he should abide by it. He agreed that they ought to have as great advantages as those of other countries; but if they went to the Attorney-General in the way he desired, it would be better than presenting an abstract resolution.

The Chairman considered both of the resolutions much too long. If he were going to frame the resolution it would be, "That this meeting is of opinion that the patent fees as provided by the Bill are too high." He would remind the meeting that there was before it the original proposition, with Sir Antonio Brady's proposal added to it; and also the amendment of Mr. Wilson.

The original motion as moved by Mr. Paterson, with Sir Antonio Brady's addition, was put and carried.

Admiral Selwyn wished to move:—"That in the opinion of this meeting it is desirable that our fellow-subjects throughout the Empire should be offered participation in all the benefits of any change in the law; and that also in India, Australia, and Canada, British subjects should be invited to participate in the benefits of our Patent-law." It would be a holding out of the hand which should at the present time be done. We had taken so much charge of India lately that we were bound to remember our fellow-subjects there. Such a proposal would command much support from those who had only recently left England for the colonies. He would move:—"That the subjects of the British Empire wherever found shall be offered participation in any improvements in the existing law as far as their colonial law will allow them to accept it."

The Chairman might perhaps point out that the colonies had perfectly separate and independent legislation, with which we had nothing to do.

Admiral Selwyn believed that when they came to England they were treated as foreigners.

The Secretary—No.

The Chairman understood that the American Patent-law gave protection to American inventors. English inventors had no such protection, and every foreigner and colonist was treated as they were themselves.

Mr. Pieper did not think that was so.

Mr. Lloyd Wise said that in some colonies a patent for invention, which had been previously patented here, died with the English patent.

Mr. Hinde Palmer submitted that the proposition was very valuable as a general one, but if the Attorney-General were to accept it, it would be very difficult to introduce into the proposed Act of Parliament. It was very good, benevolent, and proper, but rather difficult to embody in actual legislation.

Mr. Campin thought that Admiral Selwyn's proposition referred to what they already had in the Bill, and not to any general ideas about the colonies. In the Bill it was for the first time enunciated that a subject o the Queen in the colonies should be put on a par with a foreigner.

Admiral Selwyn said that it was that to which he objected.

Mr. Campin thought it a new idea imported into the Patent-law.

Mr. Lloyd Wise desired to move, as an amendment:—"That the last three lines of clause 23 be struck out of the Bill."

The Secretary said that would carry the principle of Admiral Selwyn's proposition.

Admiral Selwyn expressed his readiness to accept that, and desired to have it put to the meeting.

Mr. Campin would second that.

The Chairman put it to the meeting, and it was carried.

Mr. Campin moved:—"That any reduction of stamp duties shall be, as far as possible, rendered available for the holders of patents heretofore granted."

Mr. Smartt seconded it.

The Chairman pointed out that "as far as" was nearly as bad as the word "if."

The Secretary suggested that it should run:—"That any reduction of stamp duties be made applicable to all existing patents."

Mr. Campin and **Mr. Smart** accepted that, and it was carried.

Mr. Hinde Palmer moved:—"That a deputation be appointed to wait on the Attorney-General with a copy of the resolutions, and, in case he shall not accede to the same, then that the Chairman, or some other member of Parliament, be requested to propose in committee amendments in conformity with the resolutions." That resolution was desirable because, if what had already been done were left without such a proposition, it would not have any practical result. By waiting in that way upon the Attorney-General, it was probable that some of the resolutions which had been carried would be adopted by him. If, however, the Attorney-General declined, then, in the terms of the resolution, "The Chairman or some other member of Parliament" would propose in Committee amendments in conformity with the resolutions which they had passed. It was a mere matter of business, but unless such a resolution was passed, what they had been doing would be futile. Sir Antonio Brady had suggested that they should join with the Inventors' Institute, but it would, he believed, have greater weight if they went separately. It would be well to confine their movements entirely to the objects of that meeting. Whatever differences of opinion they might entertain amongst themselves, or which the public might entertain, as to what the Patent-laws ought to be, there was one subject on which they were all unanimous, and that was that the public was much indebted to the Society of Arts for the steps which they had taken from first to last in promoting the object they all had in view, and in endeavouring to bring about a practical system of legislation.

Dr. Lempriere seconded the resolution, and felt that they had reason to congratulate themselves on having so able and impartial a Chairman, by which not only was a fair hearing obtained, but a ventilation of all the points which came up for discussion.

The Chairman put the resolution to the meeting, and it was carried.

Mr. Pieper proposed the following resolution:—"That the provisions of sections 10 and 23 of the Patents for Inventions Bill involve an insuperable difficulty for English as well as foreign inventors, because section 10 prescribes that application for warrant cannot be made for nine months, whereas section 23 requires that application be made within six months of the application abroad, where the whole specification is published within one to three months. Thus, an English inventor cannot apply for foreign patents until he has the seal in England, and a foreign inventor can never get a patent for a longer period than his foreign term, *i.e.*, 5, 10, 15 years, for it lapses by section 23, paragraph 4."

Dr. Lempriere seconded the resolution.

A short discussion here ensued, in which members expressed the difficulty of understanding exactly to what Mr. Pieper's resolution applied, and eventually the resolution was withdrawn.

Mr. Lloyd Wise proposed:—"That in the opinion of this meeting sub-section 4 of clause 23, which is as follows: 'The patent shall cease on the cesser of the foreign patent or such one of the foreign patents (if more than one) as first ceases' be struck out."

Mr. Pieper seconded it.

The Chairman observed this was a proposal of considerable importance, and in his opinion it would be very ill advised to urge it upon the Government. It was a late hour to go into a discussion of that kind, but, speaking for himself, it appeared to him that the principle was right that if a foreign patent was allowed to lapse the English patent ought to drop too.

Admiral Selwyn seconded the resolution, which, in his opinion, was of the utmost importance. Since the Bill professed to give a patent 21 years, it surely should make provision that the patent taken out abroad should not cease to exist.

After a short discussion the resolution was put and carried.

Mr. Campin suggested that a resolution should be passed to the effect that models should not be required in all cases.

Admiral Selwyn said the subject of models was specially provided for in the Bill.

Mr. Hinde Palmer read a clause to the effect that the Commissioners were to make regulations as to providing models in such cases as they thought fit. The matter having dropped,

A vote of thanks to the Chairman concluded the proceedings.

The following therefore are the resolutions passed by the Conference:—

1. That this meeting is gratified to perceive that the necessity for additional Commissioners of Patents is recognised, but at the same time it desires most strongly to express the opinion that such Commissioners should be paid, the meeting being of opinion that unsalaried officials cannot be expected properly to perform the important duties required of them.

2. That no adverse report of an examiner, even with a right of appeal, ought to preclude an applicant from obtaining a patent, at his own cost and risk. And further, that reports containing opinions of Patent-office authorities ought not to be made public, but that opportunity should be given to the applicant of amending his specification, by inserting reference to matters discovered by the authorities, with a definite statement of what he nevertheless claims.

3. That compulsory licences are not desirable.

4. That sub-section 1 of clause 22 of the Bill, relating to compulsory working, ought to be omitted.

5. That the provisions of the Bill, so far as they relate to the amendment of specification by way of disclaimer, explanation, supplement, or otherwise, and to the prolongation of the term of a patent to 21 years, should be extended to existing patents.

6. That the requirements of the Patent-office be properly provided for, and a suitable museum and public library maintained, before the funds derivable from stamp fees are used for the general purposes of the State.

7. That with a view to avoid obstruction to the production of inventions for public use by prohibitory taxation, the stamp duties on patents in all stages should be materially reduced, particularly in the initial proceedings, and that it is not desirable that the fees or stamp duties, levied on inventors in respect of patents for inventions in the United Kingdom, should materially differ from those in other States likely to be competitors in manufactures.

8. That any reduction of stamp duties should be made applicable to all existing patents.

9. That the three last lines of section 23 of the Bill should be omitted, viz.:—"The provisions of this section relating to a foreign patent shall extend and apply to a colonial patent (that is, a patent granted in any part of Her Majesty's dominions out of the United Kingdom)."

10. That sub-section 4 of section 23 of the Bill should be omitted, viz.:—"The patent shall cease on the cessor of the foreigh patent or of such one of the foreign patents (if more than one) as first ceases."

11. That a deputation be appointed to wait on the Attorney-General with a copy of the resolutions, and in case he shall not accede to the same, then that the Chairman, or some other member of Parliament, be requested to propose in committee amendments in conformity with the resolutions.

AFRICAN SECTION.

Tuesday, March 13th, 1877; Vice-Admiral Erasmus Ommanney, C.B., F.R.S., in the chair.

The paper read was—

OUR COMMERCIAL RELATIONS WITH WEST AFRICA AND THEIR EFFECTS UPON CIVILISATION.

By James Irvine.

Just eight years ago an educated African, thinking over the condition of his native land, was impressed with the fact that while for 400 years white men had come to its shores, they had never penetrated more than a few miles into the country, and the world knew therefore absolutely nothing of the interior. Looking behind him, his eye rested on a range of mountains, and he was seized with a desire to know something of the people beyond. Obtaining permission from his employers he started on a journey of exploration. His first day and the following three led him through familiar scenes of mangrove swamps, beautiful, but moist with the steam of malaria; the fifth day the country became more open and more elevated, and the mountains looked nearer and clearer. The sixth, and the following seven days carried him higher, through districts gradually becoming less like his own home on the sea shore, and through people more and more removed from whatever forms of civilisation had followed four centuries of contact with Europeans. He was approaching not only the watershed of the Kong Mountains, but what practically was the watershed (if I may use the term in connection with races) of the tribes. He had arrived at the limit of what was known, and he would have returned, but a brighter atmosphere and the exhilaration of opening out the unknown led him on, until only a few days later he reached the highest ridge. Here, at his feet, within 180 miles of the sea coast, lay a town, hitherto unknown, except by the most vague rumours, with a civilisation of its own. It had its schools, its mosques, its town-hall, its wide clean streets, and its system of municipal government all complete. The traveller had in his bag a dozen Arabic Testaments; these, by intimation posted on the town-hall, he proposed to distribute, and in less than half an hour they were all off his hands.

In this place, within 14 days' easy journey of the sea coast, where did this civilisation, this learning, come from? From this traveller's home which was only 14 days off, and which had known the white many for so man centuries? No, England knew nothing of this place only 180 miles from its ships. All the enlightment and education had come across the hot Sahara, had gradually filtered, in the process of centuries, from the shores of the Mediterranean, and now lay there, some may think, a satire on the value of commerce as an educator and civiliser.

But that commerce is not to be blamed I shall try to show; and, first, I shall speak of it in its present form; second, refer to the difficulties lying in the way of improvement; third, give proofs that improvement is gradually going on; fourth, suggest the means to be adopted for ultimately modernising commerce; and lastly, anticipate what may then be expected.

The most fitting introduction to the first head would be a description in detail of the present mode of trade, but as that has already been so well done by Mr. Swanzy, Mr. Babington, Mr. Bruce Walker, and others, I need not take up time by following in their footsteps. I shall only remind you that the trade is now, mainly, what it has always been—one of barter, that is to say, that for every ton of palm oil purchased from a native merchant, you give him Manchester cloth, Birmingham knives or guns, salt from Cheshire, and so on, one or more of a hundred things going to each transaction, according to its size. The proportions in which these articles are consumed differ according to each market, and not only do they vary in amount, but they vary in style. The goods suitable for Cape Coast Castle are utterly unsaleable in Lagos; the cloth bought for Bonny would be worthless in Old Calabar, though the two are only 100 miles apart; and the camp oven of Gaboon might be turned into a drum on the banks of the Congo.

Speaking from my own experience, the proportions in what is called the "river trade," that is, the trade in the Bights of Benin and Biafra, are as follows:—Manchester goods, 43 per cent.; tobacco, 18 per cent.; Birmingham and Sheffield goods, 14 per cent.; timber, 7½ per cent.; provisions and rice, 6 per cent.; gunpowder, 4 per cent.; salt, 3 per cent.; earthenware pipes, &c., 1½ per cent.; beads, 1 per cent.; soap, 1 per cent.; fishing nets, bags, &c., 1 per cent. From this list I have omitted rum and spirits, not having anything to do with either of them; but, unfortunately, it is well known that their consumption is enormous, and yearly increasing.

The simple reference to the proportions enumerated above conveys but the faintest idea of the number of things required to conduct this barter trade. They are counted not by tens, but by hundreds; and when it is realised that each has to be handled and bargained over before a transaction is concluded, a faint conception is given of the rudeness and primitive condition of our commercial relations with Western Africa. Among themselves, however, I think I am correct in stating they have almost everywhere a circulating medium. In one district it is the cowrie; in another, it is a certain thickness and length of brass wire varied by a corresponding value in copper wire; while, in a third, it is the peculiar horse-shoe "Manilla," made of bronze.

Each of the districts referred to has one or more subsidiary articles, holding a fixed value, and which are, therefore, used as additional mediums of circulation. Thus, in Bonny, where the manilla is used, real coral beads, costing from £1 to £20 each bead, are largely held by the wealthier natives, and used not only among themselves, but in their intercourse with Europeans, to whom they are often given as security for the due payment of accounts.

Trade thus conducted must necessarily be of the rudest and most primitive description, and, being so, its effects, as a civilising influence, are comparatively aimless and weak. But not only is it thus devoid of a healthy generous tone in itself; it has customs guiding it which are positively bad.

Putting aside any further reference to the evils arising from the wholesale distribution of rum, I shall only mention the system of credit-giving—which, however, I am glad to say, is rapidly becoming a thing of the past—as one of the worst features in the trade between Europeans and natives.

Doubtless it is well known that, with the single exception of the trade in the Niger River, and which is only a growth of the last ten years, it is nowhere conducted direct with the producing tribes; in every instance—at all events, in the majority of instances—the Europeans have their factories at the mouths of rivers, or on the actual sea-coast, just as they had centuries ago, and have to employ the natives near them as middlemen.

When trade was in its infancy, the credit system no doubt was a necessity, but as the natives themselves became wealthy, that necessity ceased, and the practice ought to have ceased with it; but then, unfortunately, competition, to which the term excessive might justly be applied, had begun, and thousands of pounds worth of goods were forced upon the not unwilling native trader, who thus, for the time, found himself in command of large capital, and, unable to realise a future reckoning day, squandered it in adding to the number of his slaves or the plurality of his wives. But the reckoning day assuredly came, and brought with it scenes of the worst description, having anything but a civilising influence.

Perhaps a slight digression for a minute may be allowed, to record one bright instance of genuine honesty; and it is not the native merchant himself I wish to praise, although he and his ancestors were so marked for their nobility of nature, that the surname "Honesty" became theirs, and the family of King Eyo Honesty, of Old Calabar, hold as proudly to their title as do the oldest of our nobility. It is of three of their slaves I wish to speak. The Eyo Honesty family had always been the leading traders in their own country, and when the third of that name died in 1860 or 1861, he had large open accounts with nearly every European house in the place. According to old custom his property, which was very large, would have been claimed by his uncles, and by them assuredly squandered, leaving the European creditors out in the cold, but the slaves I refer to, knowing the character of the uncles, said, "No, these stores of goods were intended by our master to trade with; they were obtained from the white man; to the white man they still belong; we will not allow you to touch a single bale; our master would have paid his debts had he lived, being dead, we will protect his name; we will trade with these goods, and will pay his debts." And pay his debts, amounting to nearly £10,000, they did, though it took two whole years, and entailed not only enormous labour, but endless petty sufferings arising from the hatred of the socially powerful, but impoverished, uncles. All honour to you, Eyo Hogan, Otu Edim, and Bassey, for your noble and unselfish act; though done in a distant and dark corner of the earth, your good deed will not die.

To return to our subject, which is the present form of trade, it will be seen how little there is in it of a civilising character; not only is it rough as a whole, but its details are filled in with such dark colours as the credit system I have referred to, and by others equally injurious, though less known.

One other only I shall mention. In a civilised country it would be called commission, and would be kept within reasonable limits; in Africa it is called a "top" or a "dash," or a "shake hands," and it means that whenever an interior native has produce to sell, if it is not taken from him by a forced sale long before he reaches the sea-board, he is only allowed to come in contact with the European merchant through the medium of a leading local chief, who invariably claims this "top" or "dash," which in some places is apparently reasonable, though in others it amounts to a very large per-centage of the whole, and leaves the poor, quiet, unpretending fellow from the interior, to whom one always wishes well, no richer, more probably (when you allow for his long journey of a week or ten days), poorer than when he started from home, and, if so, little disposed to renew his venture.

I will now pass on to the next part of my subject, viz., the difficulties lying in the way of improvement. These are numerous, the most formidable arising from the unhealthiness of the climate, necessitating the constant employment of new, young, and inexperienced agents. It is quite true that the climate has a very much worse name than it deserves, and if you could insure even the moderate and judicious use of stimulants, good, well-cooked food, non-exposure to the weather, and general common sense in following rules of health, with constant employment, you would yet further reduce the chances of ill health, and remove the dread contained in the couplet—

> "Beware and take care of the Bight of Benin,
> As for one that comes out forty went in."

But, when all is said and done, you have a powerful enemy to fight in the unhealthiness of the climate; and when it is remembered, or realised, how little good has resulted from the Ashantee War, owing to the unfortunate haste with which it was closed off through dread of the climate—a dread carried to an unmanly extent; I say, when it is realised how thoroughly all the bright hopes we held regarding the results to be expected from the Ashantee War have been disappointed from this cause, it will be seen that, even by those who fear it less and dare it more, a very hard fight is constantly waged, and waged under the conviction all the time that, sooner or later, the climate will score against them.

Under such conditions, it is not to be wondered at that, when the trade was a profitable one, Europeans made what money they could out of it as quickly as possible, and then left it to be followed up by others, who, again, came only to make money, and with no thought beyond this—to them—first and only necessity; and it is to this rush into Africa and out again we have to look, more than to anything else, for the small effect on civilisation which the trade of the past has had. Were some one here to advance that there are merchants engaged in this trade who have been in it for half a century, I could not accept it as a counter remark to the one just made, inasmuch as the man who leaves his mark is not the merchant at home—he is only a myth to the native African; it is the agent who comes daily in contact with them.

At a later stage of this paper, I shall try to show that no material improvement can be looked for so long as the Europeans keep hugging the coast; and, meantime, as affecting this part of the subject, it is to the point to say that, until those who go there have an interest in the country beyond their own immediate wants, no permanent good can be expected from the simple, selfish interchange of commodities.

The same law affecting the constant change of agents of mercantile houses, affects the employment of consuls by the Government. No sooner has her Majesty's consul or governor, as the case may be, gathered experience, often dearly bought, than he is called away to some other better or healthier sphere, and another is appointed who has to learn from the very beginning that theory seldom squares with practice in dealing with the keen, shrewd African. I have used the words keen and shrewd intentionally. The notion is current at home that the African is simple and easily deceived. Simple and easily deceived he may be in the heart of the continent, though even there I have my doubts; but he who would steal a march upon the ordinary native trader, must "get up very early in the morning."

It is not in the province of this paper to suggest improvements to her Majesty's Government in the mode of dealing with their consular service—though I hold strong views on the point—but as touching the people, I may be allowed to say, that business will continue more or less unprofitable, and little good will come from it with regard to its effects on civilisation, until each mercantile house ceases the present prevailing form of engagement and remuneration, and adopts one which will seek to have responsible, well paid, high-class men, whose interest in their business will not cease when they have made a little money. If we had educated, thoughtful men as agents in charge of all the factories on the coast of Africa—and such men could be found, if they knew that sooner or later they would be admitted as partners in the house at home—we should have such a change in the whole aspect of things, both as regards the well-being of the natives, and the pecuniary results of the trade, that in half a generation we should be unable to realise the condition of things as they now exist.

I find, however, that I am lingering too much over this part of my subject, and to keep the paper within due limits, I can only mention one or two important points arising out of trade and yet hindering the advancement of civilisation.

The first of these evils, I think, is the universal desire of every African to trade; it is the fashion in a sense inconceivable in England; it is the one single idea which takes possession of them from the day of their birth, and it leads to the great evil of causing them utterly to neglect the cultivation of the soil, without which no country can ever become civilised. As has been shown by Livingstone and others, and lately by Cameron, in that wonderful walk of his "Across Africa," Africa is teeming with vegetable and mineral wealth, but it requires cultivation and extension, and these at the present moment you cannot have. The wants of the African are so easily supplied, that the mere buying and selling of palm-oil, palm-kernels, and a few minor products, give them readily all they require, and you cannot stir them up to further exertion. I have often thought that, like the potato disease of 1845 to Ireland, it would be a great blessing to Africa if a blight were to come over the palm-tree. When resident among them some fifteen years ago, I repeatedly tried to induce them to plant and cultivate the cocoa-nut tree, but all to no effect, and although it was an easy matter to show them how simply the oil could be expressed, their reply was ever the same, "We have no patience to wait until it grows," or, "Our fathers did not do it, and we intend to follow in their footsteps only," and so on they go, year by year, living on the wonderful palm-tree, which grows without attention, and which blesses, God-like, the just and the unjust.

Another difficulty lying in the way of improvement in the form of conducting business is so enormous, that I can only allude to it—I mean the system of domestic slavery. This is a matter of the highest importance, but it would require a paper for itself. Depend upon it, however, the knot is not cut by simply, with a stroke of the pen, decreeing the freedom of every slave in our dominions. I have the gravest doubts as to the wisdom of our proceedings in this matter in the Gold Coast Protectorate; but it is done, and we can only now hope that the grand principle of knocking off the fetters and letting the oppressed go free may not suffer in the house of its friends.

Before closing this part of my subject, I may be allowed to allude, in a passing way, to the constant drawbacks to civilisation and to the prosperity of merchants, European and native alike, which follow in the wake of the petty wars of the country. These do not deserve the name of wars, for, as a rule, they consist simply in this: that a few armed men lie in some perfectly secure hiding-place and only issue out when it is safe for themselves, attacking then women and children and murdering them in cold blood. These are recognised as wars by our Foreign-office, and they are allowed to run on for years, when a word spoken in earnest by her Majesty's consul, or the commander of a gun-boat, would put a stop to them in a single day. In 1869, one of these wars broke out in Bonny, causing three or four years of misery to the natives, and entailing enormous losses on the English merchants. A settlement was finally come to through the intervention of the British consul, but, though well meant, it was an unjust settlement, weighing to this day, as it does, very heavily on Bonny, and giving all the advantage to the man who commenced the troubles.

As a further proof of the evils arising from these petty feuds, I may mention the case of the Cavalla river, lying within the territory of Liberia. The trade was then in the hands of the Americans, and as many as thirteen ships have been known to be in the river at one time, but for years the place has been utterly abandoned, and only because tribal quarrels drove the trade away. I venture to think that a nation standing by when these things are going on does not realise its duty, and will one day have to account for a sin of omission.

I come now to a pleasanter part of my subject, viz., to the proofs that improvement is gradually going on. From the commencement of trade until within the last few years, it was not possible for an agent to begin business, or, having begun, was it possible to deal with the cargo of a recently-anchored vessel, until he had feasted the king and all his leading chiefs, by giving them what was called a breakfast. This was no easy task, as each chief brought with him 20 or 30 followers, who all expected to partake of the good things, and standing in rows eight or ten deep, the dishes handed to the king or chief were merely tasted, and passed over the shoulder to the nearest, and so on, so that a dish which was expected to reach the outer circle must have a considerable supply at the start. These feastings, beginning, no doubt, in a simple enough way, had become not only extravagant in their cost, but they gave rise to the worst saturnalia conceivable, having utterly demoralising effects; so bad, indeed, did they become, that the king and his chiefs themselves felt disgraced, and nothing of the kind is now dreamt of. This may appear a small indication of progress, but to those who know the working of these things it carries a satisfaction, and gives hope for the future far beyond its apparent insignificance. The result did not altogether arise out of the fact that these breakfasts had become demoralising and expensive, but the natives themselves, under the influence of growing intelligence, had begun to realise that they were somewhat *infra. dig.*, and were rather glad than otherwise to let the old custom die out. In a previous part of this paper mention was made of "tops," "dashes," &c.; these have also existed from time immemorial, but in not a few instances they are now given up, and I expect within the next five or ten years that they also will become things of the past; indeed, all round our forms of dealing with the African are undergoing change, and decidedly in the direction of improvement. The system of giving twenty or thirty articles to each ton of oil is fast disappearing before the simple wholesale method of a single bale of Manchester goods, or case of silks, for one or more tons of oil, and even this itself has repeatedly within the last few years given way to a metallic basis, if I may so say, that is, that the goods are valued in English currency, and paid for by oil, kernels, or other produce, also valued in the same way. But this could not be done unless the natives were growing rapidly in intelligence and civilisation; this is a pleasant fact, and capable of easy proof. Material prosperity and well-being are visible in the multiplication of good houses, fashioned after the model of English taste, and with adaptations to suit the special localities. These are made of wood or of corrugated iron—brick or stone houses not being possible, except in the most isolated cases. It will be understood that I am referring now, and all through this paper, to the districts known as the Delta of the Niger; for in Sierra Leone, the Gambia, and the Gold Coast, the houses are substantial buildings, but in the Bights of Benin and Biafra the absence of stone, and the difficulty of getting clay for bricks, render this style of building an impossibility. The natives also with whom the merchant comes in contact are better fed and better clothed than they were ten or twenty years ago.

Perhaps one of the strongest proofs of growing intelligence is to be found in the articles now required for trade, inasmuch as this indicates an increase of civilisation in the interior, where these things are purchased. Formerly, beads and many classes of trumpery were absolutely necessary; now, although there is still a demand for these, it is not one fourth of what it was twenty years ago, and in their place many things of real utility are sent. I have not heard that Plimpton's roller skates have ever been asked for, but not long ago I had an order from a leading native trader for a bicycle; which, however, from prudential motives, was not sent. It is a pleasing feature also that an increasing demand exists for many English comforts; notably, tea, sugar, Huntley and Palmer's biscuits, and provisions generally.

And is it a dream of the future that Africa may yet take off the great surplus supply of silver which has so upset the calculations of financiers during the last twelve months? More unlikely things, truly, have come to pass. The value of the English florin is well known, and as it is an article over which the cankerous climate has no power, few things command, to a moderate extent, a readier sale.

I have already alluded to the difficult subject of domestic slavery, and only again touch upon it by saying that the most far-seeing of the native chiefs already realise its unprofitableness, and it happened to me only last month to discuss the matter with the eldest son of, perhaps, the most powerful chief on the whole West Coast of Africa. He assured me that if he could get free labour it would be much more profitable, as well as infinitely more agreeable, to him, and although it is to be feared it will be generations before this view is understood by the African nations, it is much to hear it accepted as a fact by one so able and intelligent, and one who will ultimately take a leading part in the Government of his country. Undoubtedly, the most powerful proof of the spread of civilisation is the desire, yearly becoming more apparent, for an English education, and this not only by the chiefs for their own sons, but in many instances for their slaves. It is true that the desire is prompted solely by the wish to make them better traders, but what of that? the desire is legitimate in itself, and education grows upon what feeds it.

It is by no means an uncommon thing to find a chief who in his youth would have been called a "painted savage," not only having his children receiving the ground-work of their education at the schools of the missionaries, but at great expense sending them to England to finish at a college, and to end with twelve months at a merchant's desk.

I now pass on to the fourth division of my subject, viz., the means to be adopted for ultimately modernising trade, and with it directly civilising Africa, under which head I fear I may be only going over ground already taken up by Mr. Swanzy in his very interesting paper read in this room two years ago, and advocated also by Commander Cameron on the 23rd January last. The subject, however, is so important, that I feel sure you will allow me to press it once again upon your attention.

I opened my paper by telling you of an educated Negro suddenly awaking to the fact, that though Europeans had had intercourse with his country for several hundred years, and though he himself had travelled over one-half the world, it had never once occurred to him to get beyond a range of mountains visible on a clear day from his own door. This was no fanciful sketch, no mere tale from which to point my moral, but the relation of a sober fact, that during all these long years, from causes I have referred to, not a single step has been effectually taken—except in the case of the Niger river merchants, and, to a small extent, at MacCarthy's Island on the Gambia—to get into the interior of Africa, which Commander Cameron, with Livingstone, and others before him, has recently shown us is teeming with wealth. I therefore name as the one great thing towards the extension of legitimate commerce and the civilisation of Africa the absolute necessity of moving up from the unhealthy sea-board into the interior, and among the producing tribes. Commander Cameron's recent work and his various addresses have brought such a suggestion prominently before the country, and the world would rejoice if his chartered company could be started. Regarding it, I may say in passing (and I hope Commander Cameron will pardon my boldness in venturing a criticism), that he is making a mistake by going in for much too large and unwieldy a scheme. To use a commercial phrase, he will "never raise the capital," and if the capital could be raised, his scheme would not pay. Large capitals are dangerous friends—they make good dividends impossible—and they lead to carelessness in detail. It is true philanthropy will go a long way and will do much, but when this scheme is worked out—and worked out it will be, sooner or later—it must be upon sound business principles. Nothing would be more disastrous to Africa herself, than that a large scheme should be started and fail; it would throw civilisation back half a century, and lead to a reforging of the chains of darkness. Instead, therefore, of the large scheme, would Commander Cameron permit a suggestion that one with a capital of £100,000 at the very outside—which amount, furthermore, need only be called up by degrees—would do all that is required. I have no hesitation in saying that such a company, formed to carry out his suggestion, if carefully worked by experienced men, would be made profitable to the shareholders and ennobling to Africa. And Goverment might fairly be called upon to assist, as they have often done before, and, in many instances, are doing at the present day; let them give a subsidy for the next 20 years, of £10,000 a year, for carrying the mails up the Congo, or, better still, let them guarantee 5 per cent. on the capital of the company for the same term of years. This is no unprecedented request—the principle has long been conceded in the Indian railways with excellent results—and equally excellent and profitable results would follow its adoption here. Some such plan as Commander Cameron's is among the first requirements of commerce. A word of caution is necessary, however, and it may be given in this connection, and pray do not let it pass as one of uncertain sound. We speak of Africa teeming with wealth and we mean what is said, but it is to be feared that an entirely wrong impression is conveyed to the uninitiated. It is not too often that the delightful stories of Prescott's Conquest of Mexico and of Peru, or at all events the traditional wealth of "John Company," give vividness and help to fill in the colouring of the picture; and, if so, nothing could be further from the truth. The pursuit of wealth in opening out new places in Africa has always been, and must, in the nature of things, continue to be, a stern chase and a long chase. Remember that you have, as the gronnd work of the whole, an entirely savage people who do not know the riches of the country, and who are without wants, and with whom, therefore, your dealings for some time would be so small that a profit, considering your enormous expenses, would be out of the question.

With this word of caution, to prevent disappointment, I proceed to say it is pleasant to know that this necessity of making a way into the interior, has already received some development on the East Coast from Mr. Cotteril and Mr. Young, and under the auspices of the various missions now settling on Tanganyika and Lake Nyassa. It is also gratifying to hear that a company is being formed to run steamers on the Zambesi, but one would have much brighter hopes of its success, and of the good it would do to its shareholders and to the progress of Africa, did we know that it was out of the hands of the Portuguese, whose presence curses as with a blight wherever their shadows fall. I speak commercially. Of the Portuguese in Europe no one has anything but good to say, but against the Portuguese trader in Africa it would be difficult to say too much. It is not aside from the subject of this paper to refer to the recent utterances here and elsewhere on the relation of the Portuguese to the question of slavery, as nothing more vitally affects the civilising influences of commerce. The Portuguese House of Parliament has spoken since the remarks I refer to were made, but it seems to me quite beside the mark. No one charged the country with complicity—their noble deed of freeing the slaves in their colonies so recently as twelve months ago is sufficient to clear them from even the suspicion; but, on the other hand, it is well known that their colonial officials shut their eyes to an enormous amount of evil, and Commander Cameron has done good service in bringing this to the light.

It is not, however, to the question of slavery alone that I refer when I speak so disparagingly of the Portuguese; their system of protective duties is such that it effectually stops all progress. One proof of this comes to my mind as I write. Adjoining their old colony of St. Paul de Loanda, a considerable trade sprang up a few years ago, to secure which they branched out and took possession of the rising little place, to which they had some claim, inasmuch as it was on their side of the river Loge, the northern boundary of the province of Angola. At this place, now known as Ambriy, they immediately established a custom-house, under a full fig of officials. On the opposite side of the river stands another trading station, known as Kinsembo, from which, before the occupation of Ambriy by the Portuguese, large quantities of copper ore were exported, 30 to 50 tons being a common ballast for a vessel; but, since the arrival of the Portuguese on the opposite shore, this trade has absolutely died out, and whenever you ask the natives the reason of this they tell you quite openly that if they showed the riches of their country, the Portuguese would come and take possession of it. Within the last few months the Portuguese have actually laid claim to this very place, to Ambrigette, to Banana, and up to the Congo, the Congo itself included, but on representations being made to her Majesty's Government, such decided steps were taken by Lord Derby, that by last mail instructions went out from the Government at Lisbon to the Governor of Angola, to withdraw absolutely from any attempt to extend their territory beyond what is now recognised as theirs in virtue of actual occupation.

But I have wandered very much from the consideration of the point before us, viz., that of improving commerce by getting into the interior. The first great difficulty arises from the determined opposition which has always been made—and very naturally, as their occupation would be gone—by the governing tribes on the seaboard. When Captain Burton was acting as her Majesty's Consul at Fernando Po, about the year 1860 or 1861, a decided effort was made in this direction under his leadership in the Old Calabar River—the anchorage of the ships was changed to a favourable position, which would allow a free opening up of the trade to the interior tribes, enabling them to avoid the necessity of paying the black mail, or "topping" previously referred to. A treaty was signed under which the old Calabar people agreed to allow free intercourse with these tribes, and an excursion was planned at an early date to introduce the matter to the tribes themselves. But the whole thing was an abject failure, not however before it was seen how fruitful of good results it would have been. Within a week of the signing of the treaty, I had myself the pleasure of buying a considerable quantity of produce—several hundred pounds' worth—from a most intelligent young fellow, who came straight down in his canoes from a large and influential town in the interior—known then, as now, by report; but this was the only transaction, for, immediately afterwards, the expedition was carried into effect, and came to an ignominious failure at the extremity of the Old Calabar territory proper, by the natives turning out in force, armed, and what was worse, drunk. Fortunately, there was no bloodshed, but it came very near it; and, although retribution was afterwards exacted from the King and chiefs of Old Calabar, whose hands were easily traced in the attack, yet it had the effect of throwing everything back into the old channels. Dissension and jealousy displayed themselves among the short-sighted Europeans, "Burton's Anchorage," as the new place had been fondly christened, was broken up, and in six weeks' time Old Calabar was once more paramount. I feel inclined to say, "and so it will ever be," the difficulties are so numerous. The unhealthy climate, and the powerful, united natives, on the one side; on the other, disunion among Europeans, who work without a prolonged, definite purpose, added to which you have the certainty that the first houses in the field will lose. But I do not say, "and so it will ever be." The reverse is certain, sooner or later. The law of progress is invincible, and the greater the difficulties now the more sure will be the ultimate victory.

I had intended to speak on the encouragement which should be given to the natives to cultivate the soil; on the necessity of opening out roads in districts where it is practicable—in the Gold Coast territory, for instance, and inwards from Lagos. I would like also to have referred to the want of results in the Ashantee campaign, and to have shown how easily we might have done a great and permanent good there; but the paper is already too long. Before, however, I leave this part of my subject, let me refer to a modest and retiring, but steady effort, now being made in the truest interests of civilisation by a Mr. George Thomson, on the Cameroons Mountains. Mr. Thomson is a gentleman of independent means, who retired from his profession, that of an architect, in Glasgow, about five years ago, and who has given himself to the good of Africa. His object is to erect a sanatorium up the Cameroons Mountains, far above fever height, and in a region which he and others who have been up describe as most delightful and invigorating. This sanatorium is intended mainly for the use of the many missionaries who are labouring in the unhealthy districts around the base of the mountain, and also where a high-class school, with workshops of every kind, may be founded; but it will also be open to Europeans, missionaries or otherwise, who may seek its shelter. Already Mr. Thomson has cut his road, and has put up temporary houses, three in number, one on the sea shore, another some 300 feet up, and a third out among the heather, far away from the last sign of tropical vegetation, in addition to which he has opened small trading stores to encourage the few natives who are around him to bring in whatever they have which is merchantable; he has also taken down seedlings of the famous Liberian coffee, and is planting everywhere all kinds of fruit trees, hitherto unknown there. It was also his intention, knowing the difficulties of getting to the interior, from the causes I have mentined, to endeavour to effect an entrance along the ridge of the Cameroons range of mountains, but I suspect he will find enough of work without attempting this; he will, however, have done much if he carries out the one portion of his plan, and affords thereby a basis of operations for any adventurous Cameron who may be inclined to force his way into the interior from this point. And there is no point now on the whole map of Africa so utterly a *terra incognita*.

We have Gerhard Rholf's and Dr. Leared's travels and discoveries in Morocco; we have the old, but in interest ever new, Mungo Park, opening out Senegambia and revealing the sources of the Niger; we have Thomson—brother, by the way, of the Mr. George Thomson just referred to—dying at Foutah Ialloh, with only his little Willie near him, aged nine, to whom he gave his last commands, and who brought down the Government party of over forty men, delivering them, with his father's despatches and treaties, to the then governor of Sierra Leone, General MacDonald; we have Laing, Beaver, Reade, Anderson, Blyden, and a number of others, known and unknown, all doing their work bravely around Sierra Leone and Liberia. Denham, Clapperton, and Landor told us years ago of the Niger, and now Manchester, Birmingham, and African homes are made more comfortable by the trading steamers of to-day carrying their manufactures to the feet of sable sultans one thousand miles from its mouth. German explorers are even now unravelling the mysteries of the mighty Ogowai. Our own plucky Cameron and glorious old Livingstone have told us of the Congo, and have unlocked the secrets hidden since the creation in the provinces behind the Angola seaboard. Charles John Anderson, Baines, and others describe the more southern reaches. Cape Colony is Britain, as we hope the disturbed districts north-east of it will soon be. The Zambesi and its tributaries are household words. Burton, Speke, Grant, and a roll of worthies, have opened out the lake districts; and the golden chain, encircling poor Barth and scientific Schweinfurth, is linked in one by the magnificent achievements of Baker and Gordon. I have said linked in one, but there still remains, as you will have seen, the district between the Niger and the Ogowai, in the middle of which stand in grand magnificence the Cameroons Mountains. And it is on this Mr. George Thomson is doing his quiet, unpretending work, forming the ground, let us hope at no distant date, for some one to pierce the darkness that at present hides from our view whatever lies beyond.

I confess I have a strong hope, perhaps I may say an expectation, that sooner than we anticipate the chain may be completed by the intrepid Stanley. You will remember that the last time we heard from him—in April, 1875—he had turned his head westwards, and we know enough of his determination to feel sure that, barring his fight with disease, nothing will stop him until he reaches the sea, which event may be looked for any day, and within a few degrees north or south of the Cameroons Mountains. Perhaps he may be able to prove that the "Welle" of Schweinfurth is the Ogowai of the West Coast—Dr. Pogge's recent statements connecting the Ogowai with the sources of the Congo, notwithstanding—and at all events, he will have an exceedingly interesting chapter of discovery to relate. It is, perhaps, worth a remark in passing that when reading Schweinfurth's book, nothing struck me more than the number of customs, superstitions, and surnames he met with among the Shillooks and neighbouring tribes, exactly resembling those we were surrounded with in Old Calabar, on the West Coast.

Having now filled in the details, as far as time will allow, of the first four divisions of my subject, and indirectly included the fifth and the last, I wish, before closing, to pay tribute to three elements which have done much for the advancement of Africa, especially during the last thirty years, and from which in the future very much more may confidently be expected. First, let me acknowledge how much good in a humble, but very real way, has come out from the Krooboy. You are aware that the labour required in the working of ships and factories cannot be relied on when procured from the boneless natives of the districts where the greater proportion of African trade is done, and, consequently, it has to be sought from a line of coast familiarly known at the present time as the Kroo Coast, a district lying east of the Republic of Liberia, and closely allied to it. The natives of this district, with whom even domestic slavery is unknown, have long given themselves to maritime pursuits, and no vessel, whether belonging to the navy or merchant service, thinks of duty until a complement of these hardy, willing, faithful fellows is engaged. Formerly their engagement was for a period of three years, but the employment of steam bringing extra facilities, has gradually reduced the time, until you can now rarely get them to remain beyond twelve months. The engagement is made in their own country, to which you have again to return them, and during the period they are with their employers, if treated kindly, justly, and, above all, firmly, they are absolutely invaluable.

The accomplished traveller, W. H. Palgrave, in his recent work on Dutch Guiana, boldly advocates a system of free emigration from Africa to the West Indies. Here, then, the system is already at work, and has worked well for more than a generation, even without the regulations and safeguards provided for the Coolie emigrants of Bengal and Madras to which he alludes; and even now it is receiving a still more extended trial, owing to the delivery from slavery of the labourers in the Portuguese Islands of St. Thomas and Princes, which happy event took place, as already referred to, early last year. Large numbers of these tribes have gone down during the past twelve months in the steamers and in private sailing ships under agreements extending over three years. I confess, however, that I have grave doubts regarding the working out of this experiment, owing to the disposition of the Krooboy, who will work with a will in connection with ships, boats, and desultory rolling of palm-oil casks, and—a very important item—under his old friend the Englishman, whom he loves as his father, but who, I much fear, will not serve the Portuguese, whom he does not like, on land, and among coffee plantations, which he likes less. This question of free emigration is an important one, and will one day come to the front, but when it does I hope every member of the Anti-Slavery Association will be on the watch. I think it would be possible, if it were not pushed too far in each district, to procure a fair number of really free emigrants; but anything in the most distant degree approaching pressure would infallibly re-open the slave trade in the interior, as the scheme inaugurated by the late Emperor Napoleon unquestionably did under our own eyes in 1858.

The second element desiring acknowledgment is one which, from easily understood reasons, has hitherto been all but overlooked as a power in the regeneration of Africa. I allude to the small, and let me acknowledge insignificant, negro Republic of Liberia. That they have not done much in the past I readily admit, and it is not be wondered at, the wonder really is that they have done so much, and made themselves what they now are. When you remember their origin, and realise that they have now fairly consolidated themselves as one of the nations of the earth, though yet little more than free from swaddling bands, I think we may hopefully look forward to a vast stride in progress before another generation passes away.

Liberia possesses at the present moment quite a number of educated native merchants; clear-headed, shrewd, honest, who are alive to the mistakes of their predecessors, who know that the "spread eagleism" brought with them from America, which has so much offended their friends, must be given up, and who, now that coffee-growing has fairly taken root in their land, feel that honest dealing and hard work will ere long have their reward. But it was a hard thing—a very wrong thing on the part of some one—to push a loan upon them in 1871.

Regarding this loan of 500,000 dollars, I can give the bondholders some information, which has often been asked for, but never, I think, supplied. Sometime ago I made a series of inquiries, and received definite replies. Briefly, and without comment, therefore, the information is as follows:—

I asked—1. "Do you know how much of the loan ever reached Liberia?" Answer—"60,440 dollars in coin and bills on England, and 67,005 dollars and 89 cents in merchandise."

2. "If any reached Liberia, what was done with it?" Answer—"A large amount of the coin was used to pay indemnity bonds to the English Government for depredations said to have been committed by Liberians on certain natives of Sierra Leone, in 1869. The balance of the coin was used to pay Government officials here and in England. The merchandise was sold, and proceeds applied to taking up all kinds of Government scripts and obligations."

3. "Do you know if there is any amount of it still in England?" Answer—"There is nothing of the loan now in England to the credit of the Government. There were some five hundred pounds a few months ago, but it has all been frittered away in lawsuits."

4. "Can the Republic pay the dividends, and will it ever repay the loan?" Answer—"Very doubtful; their will is good, but they have not the means. Circumstances have gone beyond their control."

5. "What are the funds of the Republic?" Answer—"The Government receives in its own paper currency about 85,000 dollars per annum for duties on imports and exports. Our poll and property taxes amount to about 20,000 dollars, but as they are rarely collected, I only put down that which the Government receives. Our national expenditure amounts to 120,000 dollars per annum, or 33,000 dollars over and above our income."

Not much comfort here, I am afraid, to the bondholder.

The third element which has done much for the advancement of Africa is one which can not be overlooked in any paper on such a subject, even when that paper is treating progress purely from a commercial standpoint. I refer to the work of Christian missions. It has, unfortunately. been too much the fashion for travellers and others to decry missionaries, and say hard things of their work because they had met somewhere one who offended their taste, as if they themselves were in all respects perfect, and I am glad of this opportunity of saying, not as a mere passer by, but as a resident for years in one of the largest mission fields in West Africa, that to the missionary Africa ows infinitely more than it does to the merchant. I do not wish, however, to encourage anything like an invidious comparison between Christian missions and commerce viewed as civilising influences—both have their work to do, and when rightly done, the one becomes as noble as the other; they are not rivals, they are sisters working hand-in-hand towards a grand object; let us trust, therefore, that the dawn which we have this night been viewing, will ere long, by their united efforts, be turned into the full day of freedom, peace, and abounding prosperity.

DISCUSSION.

At the conclusion of the paper, Dr. Mann drew attention to some specimens of native cloth, also currency, and a very beautiful specimen of carved ivory.

Mr. Jumbo said his experience enabled him to endorse every sentence expressed in the paper, and he hoped the movement which had of late been set on foot in England for the benefit of Africa would have every success.

Mr. Irvine explained that Mr. Jumbo was the son of the chief to whom he had alluded in his paper. He had spent some years in England in completing his education, and was now one of the rising merchants in Bonny; he was in England for the benefit of his health.

Mr. Woodward asked if the native travellers really valued European education, and what use of English methods they cultivated, and whether they were not shrewd enough to conduct their business on their own methods.

Mr. Irvine said they had very good memories, and did the larger part of their business by that means; but English education was increasing, and they constantly sent their slaves and sons to missionary schools, as Bishop Crowther would be able to testify.

Bishop Crowther, having spoken in high terms of the value of the paper, said if the sentiments therein expressed had been more common many years ago in Sierra Leone, and Lagos, Africa would have been in a very different state to what it was now. The difficulty in the way of improving the country arose, in great measure, from the objections of the merchants. The natives were, themselves, ignorant and selfish, and did not wish tribes beyond themselves to be benefited, and when the missionaries attempted to get into the interior the same difficulties arose to keep them back. However, in the Providence of God, a way or two had been opened by which they had access to the interior, out of the control either of the natives or the unprincipled merchants. By way of Lagos, you could now go even to Tripoli and Tunis. Moorish travellers had come down in that direction, sometimes bringing despatches from the North and delivering them at Abeokuta and Lagos; for he had received one sent from Holland in order to test whether such despatches could go that way. The other way which had been opened up into the interior was by way of the river Niger. Some thirty-two years ago this country sent a large expedition up that river, but owing to ignorance of the country it did not fulfil its object. Still it opened the way, and since then the native chiefs and those in the interior had shown a great desire for intercourse with white men, and now of late years commerce had found its way in that direction. Three mercantile houses were now trading there, and missionary stations were established at the very furthest point which that expedition reached in 1841. He was quite persuaded that if commerce were pushed into the interior with a desire not only to get produce, but to benefit the natives and introduce silver money in the place of bulky cowries and barter, the natives would soon appreciate the mode of exchange. In Omoroo and Massodah, 400 miles from the coast, which he visited every year, there was a large trade in silver, and chiefs requested their friends and merchants to bring as much as they could, and its use was much appreciated in Abeokuta. Formerly a bag of cowries, worth 20s., required a man to carry it in three or four days to Lagos, but since the missionaries had got access into the interior with silver in their pockets, whenever a native wanted to go down to the coast, he went to the missionaries and got £6 or £10 in silver, giving cowries in exchange, and this silver money he would carry down with great facility and convenience. They, therefore, began to find out that to make use of English money was the best mode of doing business. He was very thankful that such a paper had been written to inform commercial men and philanthropists how the way could be opened into the interior, so that commerce, as well as Christian civilisation might be introduced.

Mr. Hutchinson said that, in the absence of that fostering care which the Government might fairly exercise over the Africans, with whom its subjects came into contact, such papers as were read in this Section were of great value, and had during the last two years been of great value in enlightening public opinion; but none would serve the purpose better than the present one. The opinions advanced as to the class of men who should deal with Africans were of the greatest importance, and if merchants would look upon Africa, not merely as a country from which to draw the largest amount of wealth in the shortest space of time, but as a place in which they should endeavour to exercise a useful influence, much good would result. He earnestly desired to see some community of opinion as to the general question of dealing with Africa, and should be very glad if some union could be formed amongst African merchants, so that they might agree that certain things should not be allowed, in particular that the trade in spirits should be limited or prohibited, and that every possible means should be taken for elevating the character of commerce, keeping in view the idea that it should act as a help-meet in improving the condition of the natives. As had been said by Bishop Crowther, anything which would facilitate the improvement of the currency was of importance, and he was glad to find that silver was being introduced on the Niger. He quite agreed with Mr. Irvine that efforts should be made to bring Europeans into the more healthy parts of the country, and he was glad to hear of what Mr. Thompson was doing on the Cameroons. His brother, who had been referred to in the paper, was sent to the station where he died by the Church Missionary Society to learn the language, and unfortunately he had used an unintelligible shorthand which could not be deciphered. The point to which he had recently been especially directing his attention for penetration into the interior was behind Lagos. The Niger was a water-way of considerable importance, which had been well explored up to its confluence, and the Tchadda branch had been pursued to a considerable distance, but the Quorra branch had not yet been followed further than Broussa; but the question now was whether efforts could not be made to penetrate to it from behind Lagos. All must be glad to hear that peace was to some extent restored; and if the natives could be made to understand the importance of roads being made, and that if the produce could be carried more economically it would pay them very well, they would no doubt assist in making these roads. The missionaries tell us that it was sometimes quite piteous to see, on a narrow path leading from Abeokuta to the coast, a jar of palm oil, representing the concentrated industry of a whole family, broken and its contents wasted, simply by a false step by the carrier, owing to the badness of the road. He did not agree with Mr. Irvine that it was desirable to encourage the Kroomen to emigrate from Africa, but, on the other hand, he understood there was now a remarkable movement taking place in America amongst the negroes, who were getting rather tired of the dead-lock in the Southern States, and desirous, many of them, of returning to their native country. One of the great objects of the Jubilee Singers was to raise funds for this purpose. The Church Missionary Society had indicated to them one or two points on the coast where the presence of men and women accustomed to the cotton industry, would be of use; and they had sent two agents there to make inquiries. Unfortunately one of them took the fever and died, but still he believed the idea was being followed up. One great want in Africa was that of people who could turn their hands to work. In Sierra Leone, many of those who had experienced the benefits of contact with Europeans were now suffering from the want of a little more paternal supervision on the part of the Government. In the old days, when it was flourishing, it was a producing place, those who were first placed there on their liberation from slavery having been accustomed to labour; but their children were sent to the missionary schools, and when their education was completed, Government should have stepped in and insisted on their being taught agriculture or some useful industry. But it did not do so, and the consequence was that a large population grew up which was fit for nothing but clerkships and petty trade. That, in fact, was one great cause of that universal love of trading which had been spoken of. After what Mr. Irvine had said about the Liberian settlement, he did not know that he was justified in terming it one of the elements of a civilising character, since it appeared that the bondholders were not likely to receive anything from its Government, indeed, he was not sure that the gentlemen alluded to by Mr. Irvine had not left Liberia under circumstances which almost amounted to anarchy. He was very thankful for what had been said with reference to missionary influence, because such kindly words, coming from an independent source, towards those who devoted their lives to this work, were very encouraging. During the last few years he had been glad to see that the tone used about these things was changed, and that there was a readiness on the part of all educated people to accord to missions their true position. The scheme suggested for opening up Africa was quite in accordance with the views he had heretofore expressed, and should have to bring forward again on the 27th inst., with regard to forming a road from the East, and he quite agreed that the effort should be made on a moderate scale at first. He had recently been informed by a gentleman representing a large firm of engineers, that they were projecting a railway in Eastern Africa, and he went on to say that they expected to bring down 20 tons of ivory per week. On making a little calculation he found that about 19,000 elephants would be necessary to furnish this quantity, so that it appeared as if the framers of the scheme were rather large in their conceptions. There was, however, no doubt that a road of some kind would be made from the eastern coast to the interior, which would have one good effect, that, namely, of removing the Europeans into a more healthy district.

Mr. Hale thought we must not be too ready to blame the Government for not interfering more in foreign countries, as great circumspection was required in such matters. He regretted the paper did not contain more statistics as to the capabilities of the country, and more detailed suggestions for its development. He doubted the wisdom of forming a company after what had been said about the Liberian bonds, and thought the two first things required were roads and better education amongst the natives.

Mr. Ashcroft, having been acquainted with the West Coast of Africa for 18 years, confirmed all that Mr. Irvine had stated, and was glad to say that there was a much better class of traders there now than when he first knew the coast. He hoped the number of those who, like Mr. Irvine's firm, did not deal in spirits, would greatly increase.

Dr. Ewen also desired to corroborate the statements in the paper, having been on the coast when Mr. Irvine came out, and having lived with him a long time. He at once showed that he had not come merely to trade, but that he had the interests of Africa at heart; and more such men were wanted in order to raise the tone of commerce there.

Mr. Trelawney Saunders said it must be very encouraging to the African Section to find so distinct a mark of progress in the direction to which it devoted itself as this paper afforded, and also that there was such unanimity of opinion as to the great difficulty which prevented communication with the interior, viz., the obstacles imposed by the native chiefs to any progress beyond themselves. It was obvious that hitherto private traders and travellers had failed to overcome these obstacles, as a rule, and if the efforts made some centuries ago in another direction had been conducted in the same way, they would not have had now the great Indian Empire of which they were all so proud. He was not an advocate for large companies in all cases, for he would contend for individual enterprise wherever it could accomplish its object, but for opening up trade with the interior of Africa it was quite inadequate. It was quite clear that nothing would overcome these obstacles but superior force, and it was equally clear that the exercise of such force could not be entrusted to private individuals. If any good were to be done, therefore, it seemed to him it must be through the instrumentality of properly constituted companies, and to that object he thought they should direct their aim. The case of Mr. Anderson, of Liberia, showed that even native traders were obstructed by the chiefs, and this would naturally be much more operative against foreigners. It was only through foreign instrumentality, therefore, that these obstructions could be removed. The richness of the vast territory of the Soudan, stretching from the Niger almost to Abyssinia, was constantly held out to traders; and he had been much struck lately by an article in *Fraser's Magazine*, which was said to be written by a pure black, not only on account of the excellence of the literary style, but also from the remarkable absence of prejudice in a Christian writer dealing with the operations of Mohammedanism in Africa; and he thought the remarks made by this writer should receive the attention of those who conducted missionary enterprise, and came into contact with Mohammedans, and that they should remember that ritualism and forms generally should give way to the sense of individual responsibility, which seemed to be the main feature of Mohammedanism in its purity. The great aim of commerce should be to reach the Soudan. Mr. Winwood Reade had shown how easy the road was from Sierra Leone. Mr. Irvine's remarks about the obstacles to commerce with the interior, seemed almost too discouraging when compared with the evidence given by a former governor of the Gambia, who spoke of natives coming from a distance of a thousand miles for the purpose of cultivating a bit of land in the neighbourhood of the settlement, raising oil-nuts, selling their crop, and, after paying the rent of the land and the numerous imposts to which they were subjected on their journey, reaching home with perhaps 25 per cent. of their gross returns. This would seem to leave a margin of something like 75 per cent. for the British merchant to work upon, if he could get into the country. Many of them had feared there was no chance of getting African merchants out of the old groove in which they seemed to have stuck since the days of the slave trade, but Mr. Irvine was an example to the contrary, and this was the greatest encouragement they had yet received.

The Rev. W. W. Hechler said there was no doubt about Africans valuing European education, for not only did they send their children and slaves to the mission schools, but he knew an instance in which an African chief sent a lady to whom he was engaged to England for three years, to be educated in one of our best schools, and then came over and married her. He had in his hand the Lagos almanac, published and got up by Mr. Paine, a native, which gave an immense deal of interesting information. For example, in the town and neighbourhood there were 21 day schools, where about 1,300 children were being educated; he also referred to a night school, and to a training institution for schoolmasters. There was further a record of various places of amusement, concerts, gymnastic clubs, a scientific society, &c., most of which were supported solely by the natives. He remembered when a night school was started at Lagos for the Krooboys; about fifty attended the first night, and gave in their names, such as Tea-kettle, Saucepan, Soup-basin, and so on; and they certainly did value the instruction they received. He only wished they had a few more merchants such as Mr. Irvine and Mr. Porter, at Lagos; but the time was past when traders met the missionaries, as they once did, complaining that they spoiled their trade. He knew an instance in which a merchant said to a missionary that, before the latter came, if he bought 25 casks of oil from a native, he could give him a receipt for 18 or 20, and he would not know any better; but now he would ask the first little boy to read what was on the paper, and would at once protest against being cheated. They had better men now on the coast, and better results in every way might be expected to follow.

Mr. Hutchinson said his society knew perfectly well who was the author of the article to which Mr. Saunders had referred, and they thought their missionaries in Africa had a much better knowledge of Mohammedanism and the way to meet it than he had. It was believed that that gentleman had presented an Arab chief with an elegant copy of the Koran, saying that it was a gift from the Queen of England.

Bishop Crowther said they had two ministers labouring amongst the Mohammedans, under a Mohammedan Government, and they never found any difficulty, but on the contrary were on the best terms with the chiefs, and even received valuable assistance from them. They did not abuse the Mohammedans, or dispute or quarrel with them, but simply preached the Gospel and left it to the consciences of their hearers, and the consequence was that many attended their services, and acknowledged that they received more instruction from the Bible than from the Koran. When the church at Lagos was enlarged, many Mohammedans assisted in the work, and a large number attended at the opening service.

Mr. Irvine said that, within the last twelve months, treaties which Mr. Thomson had made forty years ago had actually come into force for the first time, showing that one could never tell when good work done in Africa would bear fruit. A number of chiefs had come down from Timbo to trade under the treaty which Mr. Thomson made when he was there. He had no idea of the Kroomen being induced to leave their own country, and had merely alluded to the project as showing that if free emigration were gone into, there was a probability of its being carried out. He had purposely omitted statistics because they had been gone into so fully on former occasions.

The Chairman, in proposing a vote of thanks to Mr. Irvine, said he had been particularly pleased to hear his remarks on the execrable conduct of the Portuguese officials on the coast of Africa, and thought they might view the discussions which had recently taken place in the Portuguese Chamber as a proof that that Government was coming to its senses, and was about to take the matter up in a proper spirit. The Krooboys were most valuable in assisting the working of vessels on the West Coast, and must be particularly serviceable as stokers on board steam ships. With regard to the encroachments of Mohammedanism, it was important to bear in mind the exertions now being being made by the Khedive of Egypt to enlarge his dominions and powers in Africa. Great powers had been conferred on Col. Gordon, and it was to be hoped that what he was doing would not operate in any way to prevent the planting of Christianity in those countries. They knew there were certain kingdoms which had been visited by Baker, Grant, and others, especially that of King Mtesa, which appreciated the advantages of good government, and where there was every prospect of establishing Christianity, and they must take care that this was not interfered with by the operations of the Khedive. He looked upon the present paper as one of the most practical ones they had had, and they were much indebted to Mr. Irvine for bringing it forward.

The vote of thanks was unanimously carried, and the proceedings then terminated.

FIFTEENTH ORDINARY MEETING.

Wednesday, March 14th, 1877, Major-General Henry Y. D. Scott, R.E., C.B., F.R.S., in the chair.

The following candidates were proposed for election as members of the Society:—

Conyngham, Lord Francis, M.P., 46, Half Moon-street, Piccadilly, W.
Harrison, Henry, Maple-lodge, Surbiton, Surrey.
Hay, James A. C., M.I.M.E., A.I.C.E., Royal Arsenal, Woolwich.
House, Joseph, 41, Bruce-road, Bromley, E.
Huntley, George Thomas, 191, Tooley-street, London-bridge, S.E.
Southall, Thomas, Town Clerk of Worcester.

The following candidates were balloted for, and duly elected members of the Society:—

Comber, Arthur, C.E., Town-hall, Kidderminster.
Danvers, Juland, India-office, S.W.
Falshaw, Sir James, Bart., Lord Provost of Edinburgh.
Griffin, Charles, 22, Garrick-street, W.C.
Hastings, Henry Mitchell, F.C.S., 16, Vicarage-gardens, Campden-hill, Kensington, W.
Hearder, William S., 195, Union-street, Plymouth.
Hill, Captain R., Kingston-on-Thames.
Jennings, Francis W., Brookfield-house, Cork.
Lawrence, Edward, 47, Maddox-street, Regent-street, W.
Leslie, Walter Alexander, 9, Thurlow-road, Hampstead, N.W.
Reed, George, M.D., Royal Infirmary, Manchester.
Roberts, Henry Croydon, 27, Royal-crescent, Notting-hill, W.
Roberts, Hugh Lloyd, 1, Pump-court, Temple, E.C.
Stokes, Colonel John, R.E., Brompton Barracks, Chatham.
Tyrer, Thomas, Garden Wharf, Battersea, S.W.

The Paper read was—

ON THE TREATMENT OF TOWN REFUSE AND SEWAGE, AS RECENTLY INTRODUCED AT MANCHESTER AND PREVIOUSLY TRIED AT SALFOLD.

By Professor D. T. Ansted, F.R.S.

The refuse of towns consists of the following materials:—

Solids.

(1.) Solid excreta of man and animals.
(2.) Animal refuse from slaughter-houses.
(3.) Animal matter intended for food, but condemned as unfit for human consumption.
(4.) Vegetable matter in a decaying state, collected from houses and markets.
(5.) House refuse, consisting of ashes, dry rubbish of all kinds, and the dry waste of factories.
(6.) Street sweepings.

Liquids.

(7.) Urine and house slops.
(8.) Waste water from dye-works, breweries, and various manufactures.
(9.) Waste water from water supply and rain.

In towns, such as London, provided with a system of drainage more or less complete, intended to connect with every house, and in which a large proportion of the houses are provided with water-closets, almost the whole of the human excreta, both solid and fluid, the whole of the house slops, the waste water from washing, from breweries and from manufactures, as well as the ordinary and extraordinary rainfall, are presumed to pass into the sewers and to be carried to a distance, to be delivered into some natural channel either before or after treatment.

In any kind of treatment, the solid matter must be retained and in some way rendered innocuous. The fluids must also be so far purified as to avoid their being a nuisance or injurious to health, when allowed to enter a running stream.

In towns where earth-closets, or what is called the pail-system,* is adopted, the human excreta, both solid and fluid, must be deodorised and carried to some convenient receptacle for further treatment.

It is in the highest degree desirable that decaying animal matter and fœcal matter should be rendered innocuous before being removed; and for this purpose there are no better materials known than dry ashes, dry earth, powdered charcoal, and organic charcoal treated with carbolic acid to render it disinfecting.

It is clear, therefore, that for the treatment of town refuse, a system that proposes (1) to manufacture charcoal in an available form from part of the refuse; (2) to burn off as fuel a quantity of otherwise useless material, in order to feed furnaces employed to manufacture charcoal, and thus dispose of another part; (3) to utilise much, if not all, of the products of combustion obtained in this manufacture; (4) to utilise the waste heat of the furnaces in evaporating off part of the water from the liquid contents of pails, and reducing that material to a thickened fluid having a definite manurial value; (5) to produce an available manure by deodorising and disinfecting the fœcal matter and decayed animal matter, and mixing this with charcoal and the thickened urine; and thus practically to get rid of the whole of the town refuse, is a system which is well worthy of consideration and trial, and which, if as successful and as economical as it purports to be, is likely to replace methods now in operation and settle the question as to the treatment of sewage.

The process recently adopted at Manchester professes to do all this; in other words, to dispose of the whole of the town refuse, yielding as the results of treatment several perfectly innocuous materials having a definite value in the market, and reducing the remainder to a perfectly inert and innocuous residuum. All this is to be effected without involving any nuisance whatever in the process of treatment.

Part of the system was tried in the town-yard of Salford for nearly two years, commencing in the autumn of 1873. This part had reference only to street sweepings. The resulting valuable product, consisting of charcoal, was mixed with excreta purchased from the corporation of the borough to form manure. An analysis of the street sweepings is given in the Appendix A, and of the resulting charcoal and manure in Appendices B and C. An account of the system will be found in the Report of the Sewage Conference, p. 45.

On the 1st July last, the treatment of the sweepings of the vegetable markets and the lighter part of the house refuse was introduced in the town-yard of Manchester. It has since been carried on continuously, and is still in full operation.

In the early part of September was commenced the destruction by burning of the heavier portions of the house refuse, consisting of materials not likely to afford much charcoal. The furnace used for this purpose is connected with apparatus that evaporates off the watery parts of the liquid contents of the pails by means of waste gases. This apparatus came into operation at the same time as the furnaces, and has been continued without cessation to the present time.

The treatment of the street sweepings came before the authorities for consideration at the commencement of 1877, and, as the apparatus used at Salford for the manufacture of filtering charcoal is now lying in the yard ready for erection, it is probable that the charring process will soon be tried in Manchester, on such a scale as to ensure a determination of its economical value, as compared with the present mode of disposing of street rubbish.

It is considered that, when the whole system is in operation, the results will be as follow, viz.:—(1) The treatment of the street sweepings will yield organic charcoal in a granular state, available either for grinding up with the fœcal matter and animal refuse, as at Salford,* or as a filtering sand of very high quality, decolorising completely dye-waters, and rendering sewage-water fit to enter rivers; (2) the treatment of the house refuse will produce powdery charcoal, adapted to deodorise the liquid contents of pails, deodorise and stop the putridity of decaying animal matter, and render harmless the sludge or solid fœcal matter of the pails; (3) by mixing this charcoal with carbolic acid, a disinfectant will be obtained at a cost almost nominal; (4) the treatment of the liquid contents of pails will yield a substance rich in ammonia and nitrogen, which, mixed with the solid contents of the pails and the animal refuse already deodorised and disinfected, becomes a perfectly innocuous and useful manure; (5) the clinkers and waste material from the furnaces will, when ground up with lime, make saleable mortar.

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* The system described as the "Rochdale System" in the Report of the Sewage Conference, p. 42, is that here alluded to, but in the Rochdale system the treatment of the collected material is different.

* See Appendix C, where the value of such manure, manufactured at Salford, is given.

Before proceeding to explain the methods adopted to produce these important results, I propose to describe briefly the nature and extent of sewage work in the important city of Manchester.

The drainage system consists of a common sewer, which carries the contents of water-closets, street surface water, rainfall, waste water from house use, house slops, drainage from dye-works, breweries, and other manufactories, and discharges into the River Irwell. There are 10,000 water-closets, the rest of the night soil either entering cesspools, which are emptied from time to time or received with part of the house slops into pails, removed by the Corporation in receptacles and carts prepared for the purpose. The contents of the pails are deodorised with ashes, and the solid part or sludge is estimated to consist of one part human excreta and two parts ashes.

Twenty-five thousand houses now employ the pail system, and about 200 houses per week are added to the number.[*] The total number of houses not using water-closets is still about 18,000, so that in little more than a year and a half it may be expected that the pail system will have received its full development. Two years ago, 20,000 tons of privy contents, ash-pits, market sweepings, decayed fish, and animal refuse were stored up till removed by canal boats and market carts into the country districts around.

The combined result of this mass of decomposing organic matter, and the entrance of the unpurified effluent sewage of the town into the Irwell, on the health of the city has been frequently described.

The street sweepings of the city are carted into part of the town-yard, distinct from that which receives the house refuse and the market and *abattoir* waste. A separation there takes place, part being sold, and the bulk tipped into hollows outside the city.

The house refuse and the contents of the pails, the material from the cesspools and the waste of the markets and slaughter-houses, are carted into a division of the town-yard devoted to them. It is an area of about three acres, fitted with conveniences of various kinds, and a steam engine of 40 horse-power, with a tall factory chimney well adapted to carry off waste gases and noxious vapours.

The carts conveying house refuse and pails consist of two divisions, the fore part divided into cells, each containing a block tin house-pail, holding 12 gallons, having a cover fitted with caoutchouc rings, hermetically sealing the contents. The hinder part is a receptacle for ashes and other refuse, and is exposed to the air.

The contents of the pails, when brought into the yard and removed from the carts, are received in a partially covered room with a floor so constructed as to separate the solid contents from the fluids, which latter fall into a well-hole, whence they are pumped at once into a receptacle connected with an apparatus, called a concretor, where the aqueous parts are evaporated.

The solid contents of the pails, consisting of one part fœcal matter and two-thirds ashes, are ground up in mills like mortar-mills, with slaughter-house refuse, decayed fish, the concentrated urine obtained from the concretor, to be presently described, and a small quantity of gypsum to fix the ammonia. The result is a manure containing 25 per cent. of organic matter, chiefly animal, without smell, and dry enough to be put into sacks and carried by rail. This substance now realises 12s. 6d. per ton in the yard, but its manurial value is considered to be much higher. The average quantity now manufactured and sold is 40 tons per week.

The material from the cesspools and unaltered ash-pits and privies is carted separately and tipped into barges, whence it is conveyed to a distance and sold to farmers. It fetches about 3s. per ton, but is necessarily a source of nuisance injurious to health. The part of the pail contents not treated by the new method is got rid of in the same way. Such vegetable waste, garbage, and house rubbish as are not consumed in the furnaces are also now sold to farmers for manure.

The liquid contents of the pails not inspissated by the machinery in operation is passed into the River Irwell.

The total quantity of refuse carted into the town-yards during the year ending 31st August, 1876, was 220,528 tons.

This total is made up as follows:—

	Tons.	Tons.
Sweepings of streets	54,600	
Market sweepings	2,600	
		57,200
Contents of middens and ash pits—		
Night soil	47,953	
Rubbish carted	63,581	
		111,534
Contents of pails (new closets)—		
Excrement and ashes	21,870	
Urine	12,150	
Dry rubbish	14,587	
		48,607
Animal waste—		
Slaughter-house refuse	3,083	
Fishmongers, tripe dressers, and market stuff	104	
		3,187
		220,528[*]

Of these, the street sweepings and carted dry rubbish (say nearly 450 tons per day), the house refuse and garbage (say 230 tons per day), and the liquids (say 9,000 gallons per day), are or may be treated directly, in furnaces and other apparatus, supplied with fuel by the ashes screened and sifted from the mass. The resulting materials (charcoal and concreted urine), mixed and ground up with the sludge or solid matter in the pails and the animal matter from the *abattoir* and markets, are capable of being worked up into saleable manure.

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[*] See report by Dr. Renaud, published in November last.

[*] I am indebted to Mr. Whiley, the manager of the Manchester Sewage Works, for the figures here given, and for great assistance in obtaining information on the subject.

The methods, already partly adopted to obtain this result, are as follows:—(1) Special patented furnaces, formerly in use at Salford, adapted to treat the street sweeping; (2) sets of furnaces of special and patented construction, now employed in the town-yard for manufacturing charcoal, and called carbonisers; (3) other furnaces resembling reverberatory furnaces, called destructors, also in use in the town-yard; and (4) concretors, evaporating the liquid contents of the pails at a low temperature by utilising the waste gases from the destructor furnace.

The Salford apparatus consisted of a cylindrical vessel, so constructed as to receive the street sweepings in hoppers, and conduct the material over a large surface of iron, kept at a high heat sufficient to convert the animal and other carbonaceous matter alone, or mixed with argillaceous matter into a granular sand containing from 18 to 20 per cent. of carbon. This sand is admirably adapted for use as a filtering material, entirely decolorising dye-water, decolorising, deodorising, and disinfecting effluent sewage water, and is well fitted for use on a large scale in filtering waters for town use. The process has been examined, and I believe reported on, by Mr. Smith, one of the Government inspectors of the Local Government Department.*

Each set of cylinders at Salford treated between 10 and 12 tons of street sweepings per day, according to their nature and the amount of moisture they contained. The resultant charcoal amounted to upwards of 40 per cent. of the weight of material charred. The fuel used was coal. The breeze or ashes from the house refuse might be employed as fuel in large part, if not entirely, if the quantity is sufficient.

To convert into charcoal the whole of the street sweepings of Manchester would probably require 15 such sets, and the total cost of each complete set is stated at £180. To this cost must be added that of steam power to drive the shafting and carry on the work connected with the machinery. It is probable, however, that the sale of the resulting charcoal would render this a source of profit on manufacture, and repay at least part of the cost of collecting the street sweepings. In addition to the profit on the charcoal, the resultant clinker and stony matter after sifting is available for grinding up with lime into mortar.

The house refuse and sweepings of markets consists partly of ashes, which are separated by screening, and partly of rubbish of all kinds. The screened ashes or breeze are employed as fuel for the carbonisers† or furnaces constructed for the combustion of the moist refuse and garbage, and also for the destructors.

The carbonisers now working at Manchester form one nest of eight furnaces built on the ground, and having a low platform constructed over them to receive the refuse for burning. From this platform the rubbish is thrown into hoppers from time to time, as needed. Each furnace is built of fire-brick, and within it are a number of thick projecting plates of cast-iron, near enough together to prevent the material thrown in at the top from reaching the bottom (where the fire is burning) without remaining for a time in contact with each plate in succession. The heat thus carbonises all the vegetable and animal matter, and partly fuses the remaining material.

The quantity of vegetable matter from the markets, and the lighter part of the house rubbish and general garbage passed through the nest of furnaces constructed in the yard per day of 24 hours is 17 tons, and the quantity of sifted breeze and ashes consumed as fuel, 3 tons, no other fuel being required. From these 20 tons of waste are derived 3½ tons of sifted charcoal, containing about 18 per cent. of carbon and 8½ tons of clinkers, consisting largely of broken pottery and glass half melted, and a considerable quantity of silica derived from the cinders. About 8 tons per week of the sifted charcoal is mixed with 6 or 7 per cent. of carbolic acid (115 gallons per week), and thus produces a disinfecting material used in deodorising the contents of the pails. There remain 16½ tons of sifted charcoal and 60 tons of clinkers per week, as the result of consuming 140 tons of refuse.

The cost of constructing a nest of eight furnaces of this kind is stated to be £700, and, with care in the management, they would last for many years without repair, as the heat employed is not excessive.

The sifted charcoal is at present largely used in deodorising, and there is some surplus. It might, no doubt, be used away from the works, and probably be sold at a profit.

About 24 tons of dry rubbish per day are consumed in a reverberatory furnace constructed for this purpose, and called a destructor. The waste gases of this furnace are conducted to the closed cylinder called a concretor, and there used to evaporate the liquid contents of the pails. No fuel is purchased for use in the destructor, the dry rubbish containing ashes and coal sufficient to be combustible of itself. There results from the combustion about one-half the weight of material burnt (12 tons per day), consisting of clinkers, resembling those obtained from the carbonisers.

The concretor is an evaporating apparatus resembling those used in sugar refineries. It contains a revolving axis provided with knife blades, each passing into and becoming wetted with the liquid from the pails which is introduced below. The blades thus moistened rise with each revolution, and pass through a current of hot air consisting of the waste gases of the destructor. These enter the cylinder at a temperature of 600° F., and emerge at about 100°, evaporating at a low temperature the aqueous part exposed without removing its valuable manurial contents. The apparatus connected with the one destructor now in use acts on 2,500 gallons of pail water per day, reducing it to 250 gallons of a thickened fluid, which as it cools crystallises, and contains a very large per-centage of valuable manurial products, of which an analysis is given in the Appendix.* No offensive odour is given off during the process.

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* As already stated, this sand was used at Salford for the manufacture of manure, being ground up with the fœcal matter purchased of the town.

† The furnaces used for the street sweepings were also carbonisers, and were built on the same general principle. They differed in exposing the material to a higher heat for a longer time, and produced filtering carbonised sand in place of powdered charcoal.

* See Appendix D.

The cost of the destructor furnace and its connections with the concretor is £300. The cost of the concretor is £400.

The present daily average of liquid from the pails being 9,000 gallons, and the quantity evaporated by one concretor 2,500, it is clear that four destructor furnaces and concretors would deal with the whole of the liquid, and with more than 8,000 tons of dry rubbish in the year, yielding nearly 1,000 gallons per day of inspissated urine to mix with the solid contents of the pails and the slaughter-house refuse and decayed fish. I was not able to ascertain how much of the derived organic charcoal and carbolic acid would be needed to mix with this in order to perfectly deodorise and disinfect the whole mass.

The clinkers obtained from the carbonisers and destructors are not only perfectly inert and harmless, but they have been found also to have a distinct value. They are ground up with about twice their weight of quicklime, and produce in this way a valuable mortar always saleable in the neighbourhood of towns to any extent. In Manchester, the quantity of mortar at present made from these waste products is 300 tons per week, which sells at 4s. 6d. per ton, and leaves 1s. 9d. per ton clear profit on the cost of manufacture.

Let me now briefly recapitulate the operations and results concerning the town refuse of Manchester, as at present collected, assuming that the various processes described are successfully carried out.

First. The street sweepings will be converted into two-fifths their weight of animal charcoal and mineral matter in a granular state, adapted for use in filtering beds, and capable of clarifying a very large quantity of foul water, or mixing with animal refuse and condensed urine to make manure.

Secondly. The house refuse, rubbish, and garbage, will yield about 1,000 tons sifted charcoal, available partly for deodorising the whole of the pail contents, partly for admixture with about 6 per cent. of carbolic acid, to make a disinfectant applicable to the various materials among the town refuse that would otherwise be dangerous. There would be a part also that might be sold. The liquid contents of the pails will yield 90,000 gallons, or 400 tons, of inspissated urine for admixture with the solid contents of the pails.

Thirdly. The solid matter from the pails and the miscellaneous animal matter, mixed with such part as is needed of sifted charcoal, and with the inspissated fluid from the pails, will yield, say 35,000 tons of manure.

Fourthly. The residuum from the furnaces, or clinkers, estimated to amount to 7,500 tons per annum, may be manufactured with lime into 20,000 tons of mortar.

At present, the quantities operated on and the returns are stated to be as follows :—

	Tons per Annum.
17 tons per day house and vegetable refuse, say	6,200
24 tons per day dry rubbish	8,750
3 „ „ ashes used as fuel	1,100
2,500 gallons liquid from pails	400
Animal matter and solid pail contents, to make 40 tons manure per week	1,600
Total	18,050

The result obtained is as follows :—

	Tons per Annum.
3½ tons per day sifted charcoal, say ..	1,280
40 tons per week manure	2,080
100 tons per week clinkers worked into mortar	5,200
Total	8,560

As much, therefore, as 9,500 tons per annum are got rid of, and the rest utilised.

Assuming the organic charcoal to be worth 20s. per ton, the manure 10s. 6d., and the profit on mortar 1s. 9d. per ton, as stated, the returns on the whole of the refuse, of which only one-ninth part is under treatment, would have a value certainly exceeding the cost of collecting and treatment.

It will be evident that if the very large quantity of organic charcoal, containing, say, from eighteen to twenty per cent. of carbon that would be obtained by the treatment of the whole of the street sweepings and house refuse of several large towns by this process, were thrown into the general market, the supply would be beyond the demand, unless some use can be found that should involve a large consumption. The decolorisation and disinfection of dye-water and sewage water would, however, insure a constant demand, and the use for filtration may require all that remains. At any rate, the sanitary problem would be solved, as organic charcoal could under no conceivable circumstances become a nuisance.

It is, perhaps, hardly yet possible to estimate with any approach to accuracy the profit and loss account if these new methods of treating sewage are fully carried out. I am not aware of the present outlay at Manchester, so far as regards these methods, nor do I know the cost of the town-yard. The net cost of disposing of the night soil in 1875, after deducting receipts was £22,839 2s. 7d., and of scavenging £22,151 7s. 11d., or a total, say, of £45,000.

The cost of 15 carbonisers for the street sweepings at £180 each would be £2,700, and four destructors and concretors which would be required to evaporate the whole of the liquid contents of the pails at present would cost £2,800.[*] The existing nest of eight carbonisers for the lighter house refuse and garbage would be sufficient. Additional mills would be needed, and a general increase of the plant, but it is clear that the amount to be expended would bear a very small proportion to that which has already been spent in the town-yards, and would be well within the average cost per head of population incurred in other towns.

It would be unreasonable to estimate the removal of the town refuse as other than an expense, but I submit that the work is not yet carried on anywhere with elements of economy more clearly indicated than by the method here described, and that under no system at present proposed is there so much prospect of obtaining a satisfactory settlement of the great difficulty, namely, how to get rid of the refuse of our large cities, thoroughly and effectually, without enormous cost and without nuisance. Manufacturing out of part of the refuse itself the material which most completely and most effectually gets rid of all that is disagreeable and dangerous in the other part, and reducing that which is not saleable to a condition of absolute safety, is certainly no trifling matter.

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[*] The addition of 17,000 additional houses treated on the pail system would add, say, 6,000 gallnos of liquid, and a corresponding quantity of solid matter. It is possible that the ashes from the house refuse might not be sufficient to feed the additional destructors, and in this case the use of the ashes in the solid part of the manure might become profitable.

The system adopted in Manchester of removing the house sewage and slops in pails, though also adopted in several other of the Lancashire towns, is by no means universal. In all towns, however, the street sweepings and the house and market refuse, the waste of slaughter-houses, condemned meat and fish, and waste vegetable matter, need treatment, and the sludge or solid matter separated from sewage, as well as the effluent sewage water and the impurities of water produced by dye-works and factories, are matters that must be attended to.

The system, therefore, if successful, will be everywhere available. It requires no chemicals, no large extent of land, no costly apparatus, and no superior intelligence to work it. It wastes but little, and it utilises much.

I ought, also, to point out that the concretor is not only a useful adjunct to the destructor, as here described, but may be applied directly wherever there is waste heat to utilise the large quantities of urine that runs to waste in public sewers.

Where urine is collected on a large scale, as in railway stations, public buildings, and large factories, the advantage of securing a valuable and inodorous manurial product in small bulk at very small cost, and at the same time getting rid of a nuisance, is too important to be neglected. The first cost of the concretor is so small that where waste heat can be obtained the work can be carried on incessantly at no more cost than that of a single attendant from time to time.

Before concluding this communication, I desire to point out the weakness of an argument often made use of to show the assumed impossibility of introducing the dry earth or pail system into general use, founded on the necessity of a double system of sewage required in such case. The fact is, that in almost all our large towns a system of surface-water drainage is already in existence on a sufficient scale, even where the water-closet system is only partially introduced.

I find* that the following ten towns, among others, are in this condition. None of them has less than 50,000 inhabitants; their total population approaches two millions. They are Manchester, Birmingham, Leeds, Sheffield, Salford, Leicester, Blackburn, Oldham, Nottingham, and Rochdale. In all these ten towns together less than 40,000 houses are supplied with water-closets; more than 80,000 have adopted the pail system; and at least 120,000 have at present no other resource than the midden, or privy, occasionally emptied, and sometimes connected with the ash-pit. I also find that, in 1869, in reply to questions sent by a committee of the British Association—of which I had the honour to be a member—only 44 out of 200 of our principal towns, excluding London, had a complete system of water-closets and sewage connected, and that the population of these 44 towns was only about one million. The 156 towns not so supplied had a population of six millions. It is certain that the water-closet system is by no means universally adopted, and I venture to suggest that it is by no means universally applicable, or, in any true sanitary sense, desirable.

It seems to me to be forgotten by the advocates of a water-carriage system of sewage, that the effect of increasing the number of water-closets in our manufacturing districts can only be to carry into a number of small streams (chiefly the upper tributaries of the Trent and the Yorkshire Ouse, which unite to form the Humber, and partly a few much smaller rivers, running westwards into the Irish Sea) a quantity—amounting to many thousand tons per day—of offensive sewage, very little of which can possibly reach the sea, or be conveyed beyond tidal influence. Most of this must, beyond all doubt, be left on the land on the shores of these streams; and, however small the evil may be for a time, or however it may be corrected by utilising a portion for agricultural purposes, the excess is cumulative, and, as the country is thickly peopled, will in time become a serious and perhaps an irremediable evil.

But if, by the adoption of a dry sewage system, combined with combustion, this constant accumulation of human refuse can be checked, and the streams be permitted to carry only waste and storm water to the sea, the result could hardly fail to be of benefit in every sense. Real economy is to be obtained by looking at ultimate results, not at immediate profit; but, even in this lower, but not unimportant sense, I believe it will be found that inland towns can get rid of their sewage at smaller cost, and with greater certainty, by following the example of Manchester, than by establishing sewage farms, or endeavouring to obtain profit by the manufacture of a weak manure, that cannot, under any circumstances, bear the cost of distant transport.

No doubt the treatment and disposal of sewage must admit of very different methods being adopted, according to circumstances. There is no universal method, and it is not at all my intention to put forward combustion as the universal panacea. But inland towns, near the sources not the mouths of rivers, where land is valuable and labour costly, should, I think, seriously consider the advisability of adopting some such method of avoiding injunctions and indictments for nuisance, and diminishing their death-rate, as that now on its trial in Manchester, and described in this communication.

Appendix.

A. Analysis by Dr. Charles A. Burghardt, of street sweepings of Salford, made 15th October, 1873 :—

	Per cent.
Carbon	19·50
Silica	59·33
Sesquioxide of iron	9·86
Alumina	6·61
Oxide of calcium	3·11
Magnesia	1·44
Tricalcic phosphate and calcium sulphate	traces.
	99·85

B. Analysis by Dr. A. Voelcker of two samples of charcoal obtained from street sweepings, and house refuse, by the processes of the Universal Charcoal and Sewage Company, to determine their value in organic matter :—

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* See Report of Sewage Conference.

	Rough street sweepings charcoal.	House refuse charcoal.
Moisture	·81	1·05
Carbon and organic matter	17·40	18·14
Mineral matter	81·79	80·81
	100	100

C. Analysis by Dr. A. Voelcker of the manure prepared by grinding the solid pail contents, consisting of ashes and fœcal matter, the waste animal matter from the slaughter-houses, and decayed fish, with the charcoal as manufactured by the Universal Charcoal and Sewage Company, and some gypsum:—

		Per cent.
Moisture		2·64
Organic matter		19·71
Oxide of iron and alumna		10·01
Phosphate of lime		·96
Carbonate of lime		·85
Sulphate of lime		1·03
Alkalies—Magnesia containing:—		1·60
Potash	0·47	
Chloride of sodium	0·29	
Insoluble siliceous matter		63·20

D. Analysis by Dr. Burghardt, Grimshaw, and Co., of the inspissated urine manure manufactured by the concretor now in operation in the town-yards of Manchester:—

	Per cent.
Water	68·47
Nitrogen* (on the wet)	7·07
Ammonia (free)	1·76
Sesquioxide of iron, alumina and calcium sulphate	7·76
Sodium chloride	1·85
Calcium phosphate	1·20
Silica	2·95
Organic matter	8·64
	99·70

DISCUSSION.

Mr. Ford asked what was the opinion of Sir Joseph Heron, the Town Clerk of Manchester, as to this plan; would he prefer it to the water-closet system if the latter were available?

Prof. Ansted said this method had been commenced some months ago, was still in operation, and he believed the machinery for it was being increased. He could not say what would be done if circumstances existed which did not exist.

Lieut.-Col. Hope, V.C., desired to warn the meeting that the question was not so easily solved as Prof. Ansted would have them believe. The process of combustion seemed very simple when described, but you could not burn water, and the great difficulty of dealing with sewage was the large quantity of clean water which was constantly coming in, and going out dirty. The question of dealing with the solid excreta was really of small consequence, for if the sewage were applied to the land, you would still want to abstract the solid matter in order to do so properly. Whether you extracted it before or after it got into the sewers was of little consequence, but still you had to deal with the water. A large quantity of urine and similar refuse would always get into the sewers, for it was in vain to expect the chamber-maids to walk about the house looking for the right place to throw away the refuse; they would put it down the first opening that came. It was the real difficulty having this vast quantity of liquid to deal with, and any attempt to deodorise it by charcoal or anything of the kind was a physical—though not a chemical—impossibility. Of course, with sufficient charcoal you could deodorise anything, but the quantity of sewage escaping from the majority of English towns, with a good water supply, was so great that you could not purify it by any other means than applying it to the land. Even complete chemical purification was almost impossible, and though he believed General Scott had succeeded in a very difficult operation which did purify sewage, he believed he would hardly recommend it as a practical process. The excretive refuse of towns had a certain value as manure, and there had been a good deal of discussion about manufacturing it into a saleable product—but all attempts had failed because the value was so small in proportion to the bulk. The average contents of town sewers were worth about 2d. per ton, and therefore, any attempt to make this into a manure like guano would always fail commercially. The only way was to apply it to the land and allow nature to follow its own course. The committee of the British Association, of which both Prof. Ansted and himself were members, had published tables for many years, to which he had often called attention, showing the results obtained on his farm, near Romford, and those tables showed he did convert the nitrogen he obtained into vegetation. He kept a record of all the nitrogen that came down, that escaped in the effluent water, and that he recovered in the crops, and the results showed he actually recovered the full theoretical proportion of the nitrogen received. That showed the nitrogen in sewage had the same value as guano, nitrate of soda, or farmyard manure, and that, therefore, the value put upon it by chemists was not theoretical, but practical. Of course, chemistry was at the root of the whole question. There were in town sewage certain elements which had a marketable value, a value which could be ascertained at any time from the commercial papers; but the proportions of these elements in town sewage were but small, and that was the measure of the cost to which you could go in utilising it. He did not say you could recover that value in money, but you might in vegetation. Hitherto there had not been a single instance of a town utilising its sewage to a profit, but it was simply from the ill-management of local boards of health—in which there was no consecutive plan followed out, owing to the continual change in the constitution of the boards; and members of the boards were generally all town-bred men, ignorant of agriculture, who get some half-educated labourer at 30s. a week, to manage their sewage farms, and then wondered that they lost money. He did not think the difficulty could be solved by the simple word "combustion," and doubted whether even Prof. Ansted had given sufficient attention to the matter to be able to take a large town in hand, and save it money. Where there was such a large expenditure in manual labour, it was evidently an open question whether it would not be better to undertake a large capital outlay in the first instance, which would diminish that cost.

Mr. Eachus said he could confirm the remarks of Mr. Hope with regard to the general bad management of sewage farms. At Edmonton, a farm had been tried for a few years, but the sewage was only applied to 8 acres out of 14; these works were put up for treating the sewage chemically, and then after a time the local board adopted Hillé's system, which had given satisfaction to the conservancy board, and had since been adopted at Tottenham. But he believed the sewage farm would have answered if it had been properly worked. With reference to chemical processes, he thought it would be a great advantage if chemists, in addition to giving the analyses of sewage and of the effluent water, and sometimes of the sludge, and of the chemicals mixed with it, would also give in the form of a simple equation the result of the processes they described. He agreed with the Professor, that it was not advisable to go on sending all the refuse into the rivers, though where it had been done, it would not be wise to go to the expense of taking it out again. Where possible, the best course was to take the sewage direct to the sea, utilising the sewage on the line of the outfall sewer, by applying it to the land under a system of intermittent irrigation, which in fact amounted to downward filtration.

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* The available nitrogen may be expressed as 9·88 per cent. ammonia.

Mr. Rawson (Managing Director of the A B C Company) said he had expected to have to answer some of the stereotyped attacks on precipitation processes, which generally took place when the treatment of sewage was discussed. He felt quite satisfied that the 10,000 water-closets now existing in Manchester would continue, for, in large cities, people would never return from the water-carrying system to the old pail system, or any other under which the refuse from the privies was carried away in the open streets. Col. Hope stated broadly, as he had often stated before, that no precipitation process could ever answer commercially; but practical experience was better than theory, and he could give the results of that experience over a period of seven or eight years. The A B C process accomplished three things. It produced an effluent water fit to go into any river; it did so without any nuisance in any part of the operation; and it produced a manure which would, at all events, sell to cover the cost of treatment. Mr. Keats and Dr. Letheby had certified to the purity of the effluent; and Mr. Keats, after carefully watching the process, stated that it was perfectly free from nuisance; while as to the value of the manure, they had sold more than 1,400 tons of it, at an average price of nearly £3 10s. per ton. He did not care what chemists said; he believed they only took notice of two constituents, ammonia and phosphates. That was theory; but they had gone direct to farmers and gardeners, and those who had taken five tons for a trial, had come back for 20, or 100, or 200 tons. They had printed three books of testimonials from practical men, with the names and addresses, so that there could be no mistake about it. At Leeds, with a population of 285,000, they tried the A B C process last September for nine days. Dr. Letheby analysed the effluent water, and reported that it was within the requirements of the Rivers Pollution Commissioners, though it came from probably the worst sewage in England, owing to the mixture of dyes and manufacturing refuse of all kinds. The borough engineer had carefully taken the cost of the materials employed, and he found that the use of chemicals and labour for the whole town of Leeds would be at the rate of £13,000 per annum. The result in native guano would be about 20,000 tons, and they had absolutely made a contract for selling the whole of it at 12s. a ton, so that the whole cost to the town for dealing with its sewage would be about £1,000 a year. Of course, the guano from such sewage would not be equal to that from a residential town, without dye water; and the fact was, that for the manure produced at Aylesbury they had booked more orders than they could supply for some time at £3 10s. per ton. The cost of the process there, including commission and everything, did not exceed £2 10s. per ton, so that there was a clear profit left of £1 a ton. It was, therefore, an entire and wicked mistake to aver that it was impossible to make a paying manure from town sewage. No doubt if you put lime into the sewage, the manure was utterly valueless, and even properly treated the result was not suitable for carriage to long distances, but it would meet with a ready sale amongst the farmers in the vicinity. Another very remarkable peculiarity of this native guano was, that any animal refuse, such as the carcases of dead dogs, were very speedily destroyed if covered with it, leaving a perfectly clean skeleton, and thus of course the value of the manure was greatly increased.

Mr. Addis said he had always understood that one of the characteristics of guano was that it possessed a strong odour, and he should like to know whether that produced by the A B C process had any smell.

Mr. Rawson replied that it possessed no odour at all, but if it were treated with caustic potash the ammonia immediately escaped from it, as if from a bottle of Preston salts. He added that it would be only fair for those who disputed the value of this manure to give it a practical trial, but he did not believe Col. Hope had ever made this experiment, and, therefore, he did not consider his opinion was worth so much consideration as his name would naturally carry with it.

Dr. Voelcker said there could be no doubt that night soil, as well as sewage, was always considered an intolerable nuisance, which must be got rid of somehow, but it was not the custom to consider anything a nuisance from which any profit could be derived. But whether sewage in the liquid form, or human excreta *pure et simple*, or the same materials prepared into manure, were used, he defied anybody to show that it had been found profitable to the purchaser, so as to induce him to come for it again. In none of the Continental towns, where no manufacturer's process whatever was applied to the human excreta, where it was carried direct on the land, was it ever found that the cost of collection was less than the value of manure to the farmer, and this was the best practical test you could have. It stood to reason then, that if anything were added to it, whether charcoal, or alumina, or anything of the kind, you must dilute the excreta and refuse. It was all very well to say that by some manipulation or mesmerical process you could increase the value, so that farmers should find it profitable no matter what the chemists might find—but they were all agreed that you must have certain materials, and if they did not come from the excrement they must come from the materials added to it. You could not make good beef-tea from mere bones. You must have beef to begin with. He should like to know whether the manure made at Aylesbury was in any way fortified, for instance, with sulphate of ammonia, which he knew was sometimes added?

Mr. Rawson—Certainly not.

Dr. Voelcker said he had found some manure so fortified, and it might be worth £3 10s. per ton; but if the materials themselves had not that value, he could not understand how, by any kind of manipulation, such increased value could be obtained. He understood that the "A B C" Company had been in operation for seven years, during which time they had sold about 4,000 tons; but that was a mere flea-bite, and the question naturally arose, how it was that this manure did not find more favour with the agriculturists? The practical farmer was not so stupid a man as he was sometimes represented, and was apt to try new things, but he soon relinquished them if they did not answer his purpose. As regards testimonials, he had a most curious collection; in one book, 100 *bona-fide* testimonials, some from the highest personages in the land, and others from agriculturists of undoubted skill and veracity, all testifying that a certain kind of manure had produced most excellent effects. He referred to the "British Economical Manure," which made a great noise many years ago, but which had now been entirely driven out of the market. It was a mere manufacturing refuse, consisting mainly of sulphate of iron, but it was sold at something like £12 per ton, and many people had testified that it was an excellent manure—far superior to the best Peruvian guano. In fact, you might sell almost anything if you spent enough money in pushing the sale, and gave handsome commissions to the agents. He remembered a manufacturer who sold coloured sand, which he called magnetic sand, at something like £6 per ton, and he got splendid testimonials. In all these things, you required comparative trial, and unless the native guano were tried by the side of other manures, and under precisely the same conditions, you could not get a fair estimate of its practical value. He denied *in toto* that chemistry was not able to discover the hidden merits of any description of manure. The plan described by Prof. Ansted for dealing with town refuse and the contents of the pails seemed very feasible, as it secured the carbonisation of bulky refuse which had no great value, and its conversion into a deodoriser and excellent absorbent for the contents of the pails; but he did not suppose the authorities of Manchester expected to derive much profit from the sale of the manure. His impression was that in order to make it worth any one's while to remove the night soil from a town, he ought to have a subsidy of 1s. per head of the population. The removal must be paid for, and the proper people to pay for it were the ratepayers, and they must consider what, under the circumstances of the case, was the cheapest plan of dealing with it.

Mr. Liggins though the paper a very important one, and regretted that it had been so little discussed. It struck him there was one weak point about the plan which would not commend it to such places for example as London, and that was the intolerable nuisance of the daily collection. The probability was that the water-closet system would increase rather than diminish; it was so simple and easy a method of getting rid of the sewage from each house that no system which created a constant nuisance at the door of each house, and an interference with the duties of servants in order to deliver it, was likely to come into favour. On the other hand it must be remembered that the Town Council of Manchester probably consisted of intelligent educated men, and they must have gone carefully into the matter before bringing the method to a large practical scale; for this was not merely a little experiment. No system yet brought forward was likely to be a commercial success, for he did not see how a profit was to be made out of a poor material. Town sewers would always be necessary to carry off the surplus water from the heavens, and if that and the sewage generally could be utilised on the land, it appeared the most natural course of things. He believed the authorities of Paris had adopted the sewage farm system in preference to any chemical system of deodorising; and the same plan seemed coming into favour in the neighbourhood of London. The sewage farm at Wimbledon was just getting into work, and he was told promised to be a great success. The Beddington farm was successful so far as regarded the object for which it was established, that of getting rid of and utilising the sewage, but from bad management it was not pecuniarily successful. The paper he considered a very valuable one, and he should certainly bring it under the notice of the authorities of his own parish.

Professor Ansted, in reply, said he would mainly confine himself to the objection which had been made to the general use of the pail system. He would repeat what he had already said, that the conditions and customs of London did not necessarily apply to other parts of the country. There were towns in the north of England with a large and poor population in which the water-closet system was not the best, simply because the people could not be educated up to it. The lower classes in the large manufacturing towns had no more idea of working this system properly than savages. They allowed the closets to get choked up, simply from not letting the water pass through them. The pail system was not intended to be applied to the better class of houses, but was essentially adapted for the lower class, which was of course a very large class. In Manchester there were 10,000 water-closets, but this was but a small number for such a town; the number of closets to which the pail system had been applied by the Corporation was about double this, and there were perhaps more unadapted. A similar state of things existed in other large towns, and it was a great point that the quantity of material which passed through the sewers should not be so very large as it must be if all the houses had water-closets, and if they were all properly used. In these matters they must deal with facts. In London the sewage was conducted a long way down the river, by a most expensive system, and in that way was supposed to be, but was not proved to be, got rid of. No doubt certain quantities were still drifted up the river, and large deposits of sewage matter were formed not far from the outfall. It was true that the bed of the river was not choked up by it, but dredging was constantly going on, and the material dredged was to a great extent sewage material. Only last year indications of sewage were detected on the piers of Westminster-bridge. The water-closet system, therefore, although very good where it could be used, was not necessarily the only thing to look to. With regard to other systems, there was the one of carrying it on to the land, and where conducted with the energy and intelligence of his friend, Col. Hope, this was attended with as much success as could be hoped for, but even he had not made a fortune out of it. Other processes were, as a matter of fact, none of them commercially successful, and he did not suppose any method of getting rid of sewage could be. You could not get more out of anything than it was worth; and if this material was not worth the expense of carting in its concentrated form, it was not likely it would be when largely diluted with water. The question was not so much whether the system he had described was adapted to London, as whether, in many cases, it might not be a very useful adjunct to other systems. He had nothing personally to do with it, but he had been much struck by it himself, and thought it would be useful to bring it under the notice of those interested in the question. There was no nuisance involved; the pails were deodorised before they were put into the carts, and no nuisance was to be detected in the town-yard where the operations were conducted. The water system would, of course, continue to be employed, and the water would contain a certain quantity of sewage matter. The effluent water from the drainage of a town must contain a certain quantity of sewage matter, but so must every river; and the movement of a river, in its course from the mountains to the sea, was a continual process of purification. It was all very well to say that it still contained certain contaminations, but practically people had been drinking such water since man first appeared on the earth, and they would continue to do so. Practically almost all the towns in the north were supplied with water from a distance, and very few other places were so well supplied as most of these towns; but this water had all to be got rid of, and the purer it was when it was got rid of the better for the after condition of the river.

The Chairman then proposed a vote of thanks to Professor Ansted, which was passed unanimously, and the proceedings terminated.

CORRESPONDENCE.

PROFESSOR KENNEDY'S LECTURE.

Your report of my lecture on the science of machines was published so soon after delivery that I had no opportunity of seeing it in type. Some printer's errors—due, very likely, to my MS.—have found their way into it; and, as some of these are in proper names, I should be much obliged if you would publish the following *errata*:—For "Leising," read "Zeising;" for "Leuner," read "Zeuner;" for "Eualterus," read "Gualterus;" for "Eytelivcin," read "Eytelwein;" for "Aranhold," read "Aronhold;" for "Culman," read "Culmann."

Alex. B. W. Kennedy.

University College, W.C., March 12, 1877.

DR. YEATS'S PAPER.

A gentleman writes from Holland on the 4th inst.:—"On page 304 of the *Journal of the Society of Arts*, you provide Holland with mills set into motion by water. Now, there is scarcely a mill of this description in the kingdom. Our water-mills are wind-mills for pumping water out of the polders." The Society of Arts will, I am sure, join me in welcoming corrections at any time.

John Yeats.

7, Beaufort-square, Chepstow, 7 thMarch, 1877.

SOME PROCESSES OF NATURE'S HYGIENE.

It is with no intention of entering upon a discussion with Dr. Bond that I take note of his letter relating to the above subject, published in your last issue. Quite recently I have had occasion to give denial to many statements made by your correspondent, and to expose attempts made by him to confound "sanitas" with the terebene preparation sold under his name. Those of your readers who may care to look into the subject will find the matter discussed in various numbers of the *Pharmaceutical Journal*, published during December and January last, and in the report of my paper alluded to by Dr. Bond.

But I should like to add, that I sent a personal invitation to Dr. Bond to attend my paper, in virtue of a promise previously and publicly given to present him with an opportunity of defending the merits of terebene.

As for this substance itself, I should never have deemed it worth my while to take any notice of it, had it not been for the attempts of Dr. Bond, above referred to, to throw doubt on my researches and to lay claim to my discoveries.

As it is, I have only to repeat that terebene will do nothing more than turpentine will do, either as antiseptic or disinfectant, and to again state that it will do much less. As for the merits of "sanitas," I trust that the scientific basis upon which these rest, has been amply established in my paper, and no amount of discussion in the world will suffice to overthrow its correctness, so long as that discussion consists of hypothetical statements arising from the imagination, instead of being based upon the only method acknowledged in science, namely, that of experiment.

When Dr. Bond can claim the position arising out of such a condition of things, I shall be prepared again to meet him.

Charles T. Kingzett.

1, Victoria-street, Westminster, S.W.

[This subject has been so fully discussed in the *Pharmaceutical Journal*, that there can be no necessity for further correspondence in these columns. Any further communications must therefore be declined.—Ed. *S. of A. J.*]

GENERAL NOTES.

The Iron and Steel Institute.—The annual meeting of the institute will be held in London, commencing Tuesday, March 20th, 1877. The inaugural address of the President, Dr. C. W. Siemens, F.R.S., will be delivered on Wednesday. The following is the list of papers and subjects for discussion:—"The North Lincolnshire Iron District," by Mr. Geo. Dove, jun.; "Some Features of Revolving Puddling Furnaces and their Products," by Mr. Henry Kirk (with supplementary paper); "On Welding Iron," by Mr. R. Howson (with supplementary paper). Mons. F. Gautier, Paris, "On Solid Steel Castings" (Acier sans soufflures)" Mr. I. L. Bell, M.P., F.R.S., "On the Separation of Carbon, Silicon, Sulphur, and Phosphorus in the Refining and Puddling Furnace, and in the Bessemer Converter;" Mr. E. Riley, F.C.S., "On the Estimation of Manganese and Iron in Iron Ores and Spiegeleisen;" Mr. Riley, F.C.S., "On Chromium Pig Iron made by the Tasmanian Iron Co.;" Mr. Henry Simon, "On Chaudron's Method of Shaft-sinking through Water-bearing Upper Strata;" Mr. Pearce, "On the Manufacture of West Yorkshire Iron."

NOTICES.

PROCEEDINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday evenings, at 8 o'clock. The following arrangements have been made:—

March 21.—Lecture on "Vital Air," by Dr. B. W. Richardson, F.R.S.

African Section.

Tuesday evenings, at 8 o'clock. The following arrangements have been made:—

March 27.—"The Best Trade Route to the Lake Regions of Central Africa," by Edward Hutchinson, Esq., Lay Secretary of the Church Missionary Society. The chair will be taken by Sir Samuel Baker, F.R.S.

April 10.—"The Social State and Prospects of the South African Communities," by Robert Richards, Esq., of Grahamstown.

April 24.—"The Trade and Resources of Morocco," by Dr. Arthur Leared.

Indian Section.

Friday evenings, at 8 o'clock. The following arrangements have been made:—

March 16.—"The Native Indian Press," by Dr. George Birdwood, C.S.I. Andrew Cassels, Esq., will preside.

April 20.—"The Existing and Possible Commercial Communications between Persia and India," by Major-General Sir Frederick John Goldsmid, C.B., K.C.S.I.

May 4.—"Thaumato-dendra, or the Wonders of Trees," with illustrations from life, by Wm. Tayler, Esq.

Chemical Section.

Thursday evenings, at 8 o'clock. The following arrangements have been made:—

April 12.—"The Cinchona Alkaloids; their Sources, Production, and Use," by Dr. B. H. Paul.

April 19.—"Spontaneous Combustion in Factories and Ships," by C. W. Vincent, Esq., F.C.S.

April 26.—"Phosphor-Bronze and its Applications," by Alexander Dick, Esq.

May 10.—"A New Process for the Production of Carbonate and Caustic Soap, without the Formation of any Noxious Waste and the Recovery of the Sulphur," by George E. Davis, Esq.

Science Lectures.

These will be given on the following Wednesday evenings, in place of the usual paper and discussion. The rules for admission will be the same as for the Cantor Lectures. Each member can admit one friend by giving the usual order from the book supplied at the commencement of the Session:—

March 21.—Dr. B. W. Richardson, F.R.S., "Vital Air."

April 18.—E. J. Reed, Esq. C.B., M.P., F.R.S., "The Modifications which Ships of War have Undergone during the last 20 Years."

May 2.—J. Baillie Hamilton, Esq., "New Musical Instruments."

Cantor Lectures.

Monday evenings, at eight o'clock. Second Course, "On the Chemistry of the Manufacture of Coal Gas," by A. Vernon Harcourt, Esq., F.R.S.

Lecture III.—March 19.

Composition of coal gas. Common impurities—carbonic acid, carbon bisulphide. Products of the combustion of gas containing sulphur. Question as to the injurious effect. Modes of purification. Action of calcium sulphide. Effect of contact with heated surfaces. Tests for sulphur.

Lecture IV.—March 26.

Principal constituents. Hydrogen, carbonic oxide, marsh gas, olefiant gas. Value for heating and for illumination. Luminous flames. Development of the illuminating power of coal gas. Burners. Gas compared with other illuminants. Different qualities of gas. Photometry. Standard burner. Unit of light.

Each member can admit one friend to these lectures. No special tickets are now required for the purpose; the tickets issued to members at the commencement of the session are available for the Cantor Lectures, as well as for the Ordinary and Sectional Meetings.

MEETINGS FOR THE ENSUING WEEK.

Mon. ...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. A. Vernon Harcourt, "The Chemistry of Gas Manufacture." (Lecture III.)
Society of Engineers, 6, Westminster-chambers, 7½ p.m. Adjourned Discussion on Mr. J. W. Pearse's Paper, "The Mechanical Firing of Steam Boilers."
British Architects, 9, Conduit-street, W., 8 p.m. Mr. R. H. Carpenter, "The Benedictine Abbey of St. Mary, Sherborne, with Notes on the Restoration of its Church."
Medical, 11, Chandos-street, W., 8.30 p.m.
Asiatic, 22, Albemarle-street, W., 3 p.m.
Victoria Institute, 10, Adelphi-terrace, W.C., 8 p.m. Rev. A. Castle Cleary, "New Analysis and Scientific Solution of the Problem of Language."
London Institution, Finsbury-circus, E.C., 5 p.m. Mr. A. Tylor, "Waves and Tides."
Social Science Association, 1, Adam-street, Adelphi, W.C., 8 p.m. Dr. Alfred Haviland, "Physical Geography in Relation to Sanitary Science."

Tues. ...Iron and Steel Institute, Westminster Palace Hotel, 3 p.m. Annual Meeting for Receiving Report of Council, Electing Officers and Members, and for Routine Business."
Royal Institution, Albemarle-street, W., 3 p.m. Prof. Garrod, "The Human Form; its Structure in Relation to its Contour." (Lecture X.)
Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. 1. Discussion on "The Transmission of Motive Power to Distant Points." 2. Mr. J. B. Redman, "The River Thames."
Statistical, Somerset House-terrace, Strand, W.C., 7¾ p.m. Captain P. G. Craigie, "The Cost of English Local Government."
Pathological, 53, Berners-street, Oxford-street, W., 8½ p.m.
Zoological, 11, Hanover-square, W., 8½ p.m. 1. Mr. Charles G. Danford and Mr. Edward R. Alston, "The Mammals of Asia Minor." 2. Mr. A. G. Butler, "The Myriopoda obtained by the Rev. G. Brown in Duke of York Island." 3. Prof. A. H. Garrod, "Notes on the Anatomy of the Musk Deer (*Moschus moschiferus*)." 4. Mr. Edward Bartlett, "Remarks on the Affinity of *Mesites variegata*."

Wed. ...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Science Lecture.) Dr. B. W. Richardson, "Vital Air."
Iron and Steel Institute (in the Rooms of the Institution of Civil Engineers), 25, Great George-street, Westminster, S.W., 10.30 a.m. Inaugural Address of the President, Dr. C. W. Siemens. Presentation of Bessemer Medal. Reading of Papers and Discussions.
Meteorological, 25, Great George-street, S.W., 7 p.m. 1. Rev. Herbert A. Boys, "Results of Meteorological Observations made at Patras, Greece, during 1874 and 1875." 2. Mr. Robert H. Scott, "Contributions to the Meteorology of the Pacific.—Fiji." 3. Mr. Samuel H. Miller, "Local Diurnal Range."
Geological, Burlington House, W., 8 p.m.
Royal College of Physicians, Pall-mall East, S.W., 5 p.m. (Lumleian Lectures.) Dr. George Johnson, "The Muscular Arterioles, their Structure and Function in Health and in Certain Morbid States. (Lecture II.)
Archæological Association, 32, Sackville-street, W., 8 p.m.
Royal Horticultural, South Kensington, S.W., 1 p.m.

Thur. ...Naval Architects (at the House of the Society of Arts), 12 a.m. Annual Report of the Council. Address by the President. 1. Mr. N. Barnaby, "The Fighting Power of the Merchant Ship in Naval Warfare." 2. Mr. E. J. Reed, "Citadel Ships." 3. Mr. Michael Scott, "Improved Ships of War and Defence Against Torpedoes." 7 p.m. 1. Mr. J. Scott Russell, "The Merchant Steam Ship of the Future." 2. Mr. E. de Rusett, "The Lengthening of the S.S. *Poonah*." 3. Mr. W. Denton, "The Self-Training Screw Collier."
Royal, Burlington House, W., 8½ p.m.
Antiquaries, Burlington House, W., 8½ p.m.
London Institution, Finsbury-circus, E.C., 7 p.m. Prof. Clifford, "Spinoza."
Society for the Encouragement of the Fine Arts, 9, Conduit-street, W., 8 p.m. Mr. John Warwick, "A few Remarks on Early Mezzotinto Engraving."
Royal Institution, Albemarle-street, W., 3 p.m. Mr. William Pole, "Theory of Music." (Lecture VI.)
Iron and Steel Institute (in the Rooms of the Institution of Civil Engineers), 25, Great George-street, Wesminster, S.W., 10.30 a.m.
Inventors' Institute, 4, St. Martin's-place, W.C., 8 p.m.
Philosophical Club, Willis's-rooms, St. James's, S.W., 6½ p.m.

Fri. ......Naval Architects (at the House of the Society of Arts), 11 a.m., Special Meeting to consider the proposed New Bye-Laws. 12 a.m., 1. Mr. W. Froude, "The Results of Experiments upon the Effect Produced on the Wave-making Resistance of Ships by Length of Parallel Middle-Body." 2. Mr. W. John, "On Strains of Ships." 3. Commander Grenfell, R.N., "Cast Iron, Wrought Iron, and Steel, considered in Relation to their Powers to Resist the Attack of Heavy Projectiles." 4. Lieut. Raskaroff, "A New Naval Gun Carriage." 7 p.m., 1. Mr. Latimer Clark, "Raising Sunken Ships." 2. Mr. J. Inglis, jun., "A Method of Recording and Comparing the Performances of Steam Ships." 3. Mr. J. Fortescue Flannery, "Safety Valves."
Royal United Service Institution, Whitehall-yard, 3 p.m.
Royal Institution, Albemarle-street, W., 8 p.m., Weekly Meeting; 9 p.m. Professor Gladstone, "Influence of Chemical Constitution upon Refraction of Light."
Royal College of Physicians, Pall-mall E., 5 p.m. (Lumleian Lectures.) Dr. George Johnson, "The Muscular Arterioles, their Structure and Function in Health and in Certain Morbid States." (Lecture III.)
Quekett Microscopical Club, University College, W.C., 8 p.m.
Clinical, 53, Berners-street, W., 8½ p.m.

Sat. ......Naval Architects (at the House of the Society of Arts), 12 a.m. 1. Mr. Latimer Clark, "A New System of Blocking, enabling the Heaviest Loaded Ships to be Docked with Perfect Safety." 2. Mr. W. John, "The Stability of Ships." 3. Mr. J. W. Shepherd, "Launching." 4. Mr. W. Simons, "Dredgers for the River Clyde."
Trades' Guild of Learning and National Health Society (at the House of the Society of Arts), 8.30 p.m. Prof. W. H. Corfield, "The Laws of Health." Part II. (Lecture IX).
Royal Botanic, Inner Circle, Regent's-park, N.W., 3¾ p.m.
Royal Institution, Albemarle-street, W., 3 p.m. Prof. Henry Morley, "Effects of the French Revolution upon English Literature." (Lecture V.)

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JOURNAL OF THE SOCIETY OF ARTS.

No. 1,270. Vol. XXV.

FRIDAY, MARCH 23, 1877.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

HEALTH AND SEWAGE OF TOWNS.

The Annual Conference on Health and Sewage of Towns will be held on the 3rd May next, the Right Hon. James Stansfeld, M.P., in the chair.

INDIAN SECTION.

Friday, March 16th, 1877; Andrew Cassels in the chair.

The Chairman, in introducing Dr. Birdwood, said that his name was so well known to everyone who took an interest in Indian affairs (and who in the room did not?), for few had had more experience in Indian matters, or laboured more zealously, or was so high an authority in all that concerned the welfare of India, that he need say nothing more in introducing him. The subject Dr. Birdwood proposed to bring before them was both interesting and important; interesting inasmuch as almost everyone desired to know what the feelings of the natives were towards us, and important because the influence of the press upon the habits and thoughts of the people could not possibly be overrated. No one was better acquainted with the subject than Dr. Birdwood, and he thought that the Council of the Society of Arts did well when they gladly availed themselves of his offer to read the paper.

The paper read was—

THE NATIVE PRESS OF INDIA.

By Dr. George Birdwood, C.S.I.

My subject is a good one, in which I have been practically interested for twenty years, and about which I have collected a great deal of out-of-the-way information; and I regret the more, therefore, that at the last moment, owing to the press of other engagements, I have not been able to give that attention to the preparation of this paper which it deserves, and which I intended when I first undertook to write it.

The native press is the most striking and suggestive result of English education in India, one full of hope for the future of the country; and the ill-favour with which it has from the first been regarded by Anglo-Indians is almost altogether due to the selfish and arrogant jealousy of Anglo-Indians generally of anything like even a show of independence and self-assertion on the part of their native fellow-subjects.

Nothing could be more thoroughly loyal than the prevailing tone of the vast majority of the native newspapers towards the British Government, and this is most true of the most read and most influential of them, such as the *Hindu Patriot*, *Native Opinion*, *Rast Goftar*, and *Indu Prakash*, all of which have something like a real circulation, and are all equally distinguished at once by their genuine independence and unequivocal loyalty. The scare about the native press, which so fluttered Anglo-Indians at home and in India a few years ago, was caused, indeed, by an article in the *Indu Prakash*, the leading Anglo-Mahratti newspaper of Bombay, with a circulation of about 1,200, and edited in my time by Keshew and Luxamon Shastrees, both personal friends of my own, from the establishment of the paper, in 1860, until I left Bombay in 1868, and for whose perfect loyalty, if there were any serious question about it, I would answer anywhere.

The article set forth that the British Government is not "the paramount power" in India —which it most incontestably is—but only "the leading power," a distinction without much difference, and with which, surely, the editor of the *Indu Prakash* might have been allowed to amuse himself in peace. But my friend, Mr. Caldwell, thought otherwise, and at once, on receiving his copy of the *Indu Prakash*, published a sensational letter, addressed to the editor of the *Times*, in which the formidable allegation was devised "that the whole body of the Mahrattas—they number, it is said, upwards of 40,000,000 of souls—is in a state of suppressed ferment." The population of the whole Bombay Province, including Sindh, numbers, according to the census of 1872, 16,352,623; that of the Central Provinces, 8,201,519; and the population of "the Mahratta country," between Broach and Vingorla, and Nagpore and Dharwar, the extreme limits, probably, of the circulation of the 1,200 copies of the *Indu Prakash*, numbers nearer six millions than forty, the Brahmin caste numbering about 500,000. I suppose that the whole Mahratti-speaking people in India do not exceed ten millions. The following morning, the *Daily News*, the *Pall Mall Gazette*, and the *Observer*, all had articles on Mr. Caldwell's letter, and the fact being telegraphed out to India, it set all the Anglo-Indian press also writing against the vernacular press. The *Daily News* affirmed that, "Arguments like that of the *Indu Prakash*, are, it is said, published in hundreds of native journals." There are 11 Anglo-Mahratta, and 27 Mahratta journals in the Bombay Province, 3 Anglo-Guzerati, and 23 Guzerati, 1 Hindustani, and 1 Persian, altogether 66 native newspapers. In Bengal there are about 30, nearly all in Bengali; in Madras, about 25, half Tamil and Telegu, and half Hindustani; and in the North-West Provinces, Oudh, and Central Provinces, &c., about 80, nearly all in Hindustani; about 200 native newspapers for all India. The *Pall Mall Gazette* wrote, on the *Indu Prakash* article:—"We have to free our hands, to deal strongly and sharply, if the occasion should arise, with what threatens to be a serious danger to our rule—the seditious writings of the native journals." The *Pall Mall Gazette* was writing on the Guicowar's case, and pertinently added to the above warning, "and a first step to this is to supply them (the native journals) with no more blunders to attack." The portentous warning was not, however, the less misleading because of the sound and thoroughly virile rider added to it. Mr. Caldwell, formerly editor of the Madras *Janavinodini*, knows India well, but he seems to have written his Bayswater letter of the 13th of May, 1875, without sufficient sense of the responsibility of his knowledge, as if only for sensation.

Very few native papers have any real circulation. In Bombay, the Guzerati *Rast Goftar*, established in 1851, and afterwards amalgamated with the *Sankya Prakash* (so long edited by the late Karsandas Mooljee, the gentlest and bravest of the school of "Young Bombay" reformers, and the Mahratti *Subodha Patrika* has the largest circulation of all the vernacular newspapers in the Bombay Province, amounting to about 1,600 copies each. The Guzerati *Daftardun* has a circulation of about 1,000. The rest run from 50 to 500 each. Most of the native Bengali papers circulate 250, 350, and 500 each; the *Soma Prakash*, 700; the *Amrita Bazaar Patrika*, 2,217; and the *Salobha Samarchar*, so it is said, 3,000; while the scores of smaller prints in the North-West Provinces, Oudh, and the Central Provinces have probably not an average circulation of 50 copies each; and it is amongst these smaller fry of the native press that anything like a consciously seditious spirit and tone is ever to be found. In fact, the majority of the vernacular papers are merely the organs of the persons who edit or who own them. Frequently, the whole circulation of one of these smaller papers is paid for by some native of property or position, to promote his personal views and ends, or it may be simply for the pleasure of circulating his praises amongst friends and neighbours. We have a countless host of educated natives in India, taken chiefly from amongst the poorest of the poor, and educated at the public charge. We have unfitted them thereby for manual labour, and disgusted them with the position in life in which they were born. We have indeed educated the country beyond its needs, and its capacity for providing for educated men, and yearly the ranks of the educated are swollen by thousands, but there is as yet no livelihood for them—no learned professions of the Church, the law, and medicine. There is nothing but the strictly limited uncovenanted Government service, for the army is absolutely closed to natives, and also the covenanted Civil Service practically. Therefore, when the uncovenanted Civil Service is filled, there is nothing left for the educated native so perfectly congenial to him, as an educated man, as the native press, and he becomes the editor and probably the proprietor of a vernacular newspaper. He took to education as a livelihood, for the sake of the Government grants and scholarships, every youth in India, while at school and college, under our eleemosynary system, being in fact a Government servant; and now his education is completed, he not only cannot get an uncovenanted appointment, but loses at once all his educational allowances. He is in fact a discontented, soured man to begin with, and we have educated him in the manner best calculated to perfect and point the expression of discontent. The best English literature is the literature of discontent, and opposition, and attack. Content, indeed, seldom finds expression in any literature but that of the national age of faith, and against attack the surest defence of power is also silence. It therefore happens that the native students of our Indian schools and colleges have been nurtured in the strength and spirit of the masterful English literature of the last century. Locke on "Toleration," and Burke were set for the B.A. examination by the Bombay University, and an edition of the former work published at the expense of the Bombay Government, expressly to train natives to independence of thought and speech; and to this day you will find Locke on "Toleration" and Burke at the bottom of most of the best political articles in the Bombay native press. Of course, also, for every native who gets a Government appointment, at least a hundred have lost it; and these hundred victims of higher culture have all their two hundred eyes watching the one fortunate winner of the official loaves and fishes, which is the reason of the almost microscopical scrutiny with which the pettiest details of administration in India are watched, and of the bitter spirit in which the shortcomings and misdeeds of individual officials are exposed: and the perfect impartiality with which native, no less than English, officials are always attacked when caught napping or caught tripping should go far to disarm the resentment to which Englishmen are apt to abandon themselves whenever one of their own number happens to fall under the keen lash of the native press. In short, the native press of India is the first and chief refuge of destitute Indian University graduates. There are, of course, honourable exceptions all over India, such as the editors of the *Rast Goftar*, *Samachar*, and *Jame Jamsed*, the *Indu Prakash*, and *Native Opinion* in Bombay, some of whom are men who would distinguish themselves anywhere, and have indeed distinguished themselves in other callings than that of journalism, and for their disinterested public spirit; but these are not the men who write the gross personal attacks and trashy sedition of the obscure up-country vernacular sheets, provoked only by personal spite, and written without any sense of responsibility for their possible effects. But this sort of abuse of the liberty of the free press is common to the early history of all journalism, and is regarded with as much aversion and contempt by educated and respectable natives in India, as the same debased style of European journalism is regarded by Englishmen, and Frenchmen, and Americans. It must be remembered, also, that in India especially it is well worth tolerating the utmost abuse of a free press short of treason and sedition. Englishmen in India are, as a body, absolutely ignorant of the steady undercurrent of native opinion as expressed in the current popular literature of the people—standard or ephemeral. The native newspapers are the only form of native literature which comes before them, or of which they have a clear idea; and the study of the native press, therefore, is becoming more and more important, as Englishmen in India mix less and less with the natives. The studious habits in which our officials are now trained for service in India tend to unfit them for association with men of inferior culture, especially as rulers amongst a subject race. The athumy—the exhaustion of all energy, and heart, and soul—to which the studies and anxieties of their youth has reduced so many of them, prevents them often from even apprehending that you cannot rightly govern a people you have not learned to know familiarly. The Government, therefore, is under the necessity of carefully studying the native press. It is thus that the native press plays a most important part in the Government of India, in which even the most obscure papers have their use, in watching the working of the machinery of the Government in every part of the country. But it in no way represents the public opinion—particularly the political opinion—of the people; and the notion that a Bengalee Baboo or Bombay Purvoe can know anything of the mind of men like Scindia, or the Maharana of Oodeypore, is too absurd to be seriously suggested for a moment. Real native opinion can only be got at by familiar and confidential intercourse with all classes of the natives, and in its final and permanent expression by the study of the popular literature of the age; of which practically nothing is known amongst Englishmen. Professor Garcin de Tassy has published every year, for the last 30 or 40 years, an address on the Hindustani literature of the year, in which he has also from time to time reviewed the principal Urdu newspapers published in India, and the opinion he has formed of their intelligence and general loyalty is a valuable testimony in favour of the native press, when it is considered that most of the Hindustani newspapers belong to the North-West Provinces and Oudh, where the recollections of Mohammedan supremacy are still fresh in the popular mind, and have to be counted with as a political force by the Government; and that it is principally the occasionally violent writing in these Hindustani newspapers which has brought the native press of India into disfavour amongst Englishmen for its imputed scurrility and disloyalty. Surgeon-Major Balfour has written two papers, one on the medical literature of India generally, and one on the registered English, Tamil, Telegu, Hindustani, and other vernacular books published during the present century in Madras, and no one is better qualified than he is to extend his inquiry until it includes every vernacular work published in the Madras Province. Colonel Laurie also has a very interesting gossiping paper on "Anglo-Indian Periodical Literature" at the end of his little volume of "Sketches of Distinguished Anglo - Indians." In Bombay we have only the usual quarterly lists of registered publications. Native printing presses, Mahratti, Guzerati, English, Sanskrit, Hindustani, and Persian, are established all over the Province, in Bombay, Poona, Ahmednugger, Sa Hata, Kolapore, Belgaun, Dharwar, and Rutnagherry, at Surat, Broach, Ahmedabad, Halar, and Kurrachee, and Hyderabad, from which is issued a ceaseless series of popular reprints and new publications. There are the *Ramayan*, the *Mahabarat*, the *Bhagwat Purana*, *Pandurang Mahatmya*, or Stories of Vitthoba; *Ganpatche Stokh*, or Praises of Ganpati; *Gopi Gita*, or Praises of Krishna; *Kashi Prakash*, or Pilgrimages to Holy Places; *Tritaveli Abhang*, or Verses on Pilgrimage; *Hindu Dharma Tatwa*, or Principles of Hindu Religion; *Jotish Pratna*, or Divination by Stars; *Samundrika* or Divination by Lines on the Hand; *Palichi Karika*, or Divination by the fall of Lizards on different parts of one's body; *Bhupala*, or Morning Songs; *Palne*, or Lullabies; *Lavania*, or Popular Songs; the *Manas Puja* of Tukaram, or Spiritual Worship of God, and his *Abhang Karunpad*, or Hymns on the Mercies of God; *Pancohpakyan*, or Moral Tales and Fables; *Shuk Bahattari*, or Moral Tales Related by a Parrot; and *Esopji Ekani*, or Æsop's Fables by Sir Barrow Ellis (1854). The Guzerati books are of the same sort; and the Hindustani differ only in the greater number of chronicles, histories, and biographies. Otherwise the Hindustani publications present the same repetition of books on divination, charms, pilgrimages, rules for praying, the lives of the saints, hymns, epics, and love songs, satirical verses, and nursery rhymes. Such publications gives the student a truer insight into the abiding character of a people than it is possible to receive from their newspapers. Even in Europe the ruck of English, French, and German sensation newspapers give you utterly misleading ideas of the English, French, and German people; but go into a bookseller's shop and ascertain the statistics of the books sold, and you know at once what manner of men and women they are, and in the best possible way in which you can know them, except by living among them. The popular literature of the Tamils and Telegus is still more absolutely absorbed in mythology, and legend, and ritual than that of the Mahrattas, and Guzeratis, and Bengalis; while the Mohammedan literature of Hindustan is of a far higher literary and scientific character than the Mohammedan literature of Western India, consisting largely of poetical, doctrinal, and historical works. There are at least a thousand living Hindustani poets of name and fame in India, the number including an Englishman, Alexander Hatherley, who writes under the name of "*Acan*," and an Englishwoman, celebrated for her beauty as well as for her poetry, known amongst the natives by the title "*Malika*," or Queen. But the Hindustani press of the North-West Provinces, Oudh, and the Central Provinces, except for its perpetual discussions on Central Asia, Afghanistan, Russia, and Turkey, as might be expected indeed amongst historical and political populations, is very like the rest of the native Indian press, almost wholly occupied in watching, like famished cats, the goings in and out of obscure Government officials, that haply they may devour them.

But, considering the rapidity with which it has grown, and the distinction and influence which the leading native newspapers have gained, it is evident that the native press of India supplies a real want in native society; and the fact of the transparent honesty, although its unnecessary personalities and violence are admitted, with which it deals with felt local grievances, makes it an admirable handmaid to the Government in the administration of the country. Taken as a whole, and examined for years, as I have examined the files of the last four years for the purpose of this lecture, I scout the charge of its disloyalty as utterly childish and unjust. When there is anything like disloyalty, it has been prompted by the example or provoked by the taunts of the Anglo-Indian press. The Anglo-Indian newspapers, which daily denounce the Viceroy and Provincial Governors as "dolts" and "idiots," directly a native newspaper ventures to repeat their language, will at once cry out in chorus for the peremptory interference of the Government to put a stop to these attacks on its authority. "Yes," an Anglo-Indian editor replied to me the other day, "It's all the difference between calling one's-self a d—d idiot, and being called an idiot by another person." I do not see how the Government is to distingush the difference.

The natives of India are human beings like as we are. They know on which side their bread is buttered. They recognise that our power in India is overwhelming, and practically unassailable, whether from without or from within, and it is accepted with unreserved loyalty by all the industrial and respectable classes. The native princes, instead of desiring to overthrow our empire, are anxious only that its stability should be as clearly recognised in England as it is in India. Speeches like Mr. Lowe's not simply puzzle, but frighten them. The lower Hindu and Mohammedan priests are actively hostile, and the roughs of the great towns, the scum and off-scourings of the old anarchies and despotisms we have for ever superseded, are always an element of danger. But they all know the real fact, that they have to deal with a power that is irresistible. As for the native press, its influence is all on our side —what little influence it has; for all the vernacular papers thoughout India put together do not probably count 100,000 readers, certainly not 100,000 subscribers. We have been placed in India for the political, social, and spiritual regeneration of its 400,000,000 populations, at least we find ourselves there at the head of one of the greatest political, social, moral, and religious revolutions known in history. We could not shrink from this mission—from this position—if we would, and certainly would not if we could, and its greatness and its grandeur are too solidly founded to be shaken by phantoms.

At the same time, it would be injudicious, and might at last become dangerous, to ignore the treasonable character of the articles which sometimes appear in the obscurer native Indian newspapers. We are educating India, and should educate it in the way it should go. The one discordant note in the welcome with which the Prince of Wales was received in India was the sustained outcry from a score or two of the native papers, that the Prince's visit, in almost every incident of its ceremonial details, and in its very conception, indeed, had been a deliberately planned insult to the native princes and chiefs. It is eminently characteristic of a treasonable spirit that they should have unanimously seized the opportunity of the Prince's visit to make this attempt to sow bitter personal hatreds between the British Government in India and the great feudatories of the British Crown. I firmly believe, myself, it was all the work of one or two treacherous wire-pullers in Bombay and Baroda. Papers with a circulation under 300 can be supported only by wire-pullers. But the sinister inclinations and intentions betrayed by such writing manifestly only need the opportunity—supposing always that their writers, or wire-pullers, had the courage of their words—to be put into action. In fact, in persistently dinning into the ears of the native princes and chiefs—who had assembled in Bombay and Calcutta, and elsewhere, to meet the Prince of Wales — that they had been systematically insulted, these native papers struck a well-calculated blow at the British Government, which meant mischief. We must, however, be very careful not to confuse such truculent papers with the native press of India, and still more careful not to confuse their treasonable license with the liberty of the native press. Not even the lowest of native newspapers has yet reached the degrading depths of political and moral infamy of several of our London journals, which we never dream of recognising as even poor and debased relations of the English press. We treat them simply as lepers, and put them altogether out of the camp of journalism. There must be no thought of restriction, direct or indirect, on the liberty of the press in India. There is no danger from the freedom of the native press, although Indian officials, and Anglo-Indians generally, and the English press in India often resent it. The only danger is in allowing incessant and destructive attacks on the British Government, the source of all power and law, and order throughout India, to pass without correction, and in allowing them at all. This is what no Government dare allow unless it courts destruction. Nothing would be more dangerous than to restrict the liberty of discussion, in a country governed as India is, by a narrow and jealous bureaucracy. The absolute freedom to discuss the policy and acts of the Government, and the conduct of its officers, is one of the greatest securities of our rule in India. But it is quite another matter to allow attacks on the British Government of India. Even if not actually dangerous, they should be forbidden on principle, in the interest of orderly Government. In France they have always more or less confused the freedom of the press with revolutionary attacks on the Government; and whilst suppressing the former to prevent the latter, have at once made liberty and all orderly Government impossible in that country. What the Government of India might do is not in any way to discourage public criticism of its policy and its administration, but to make any attacks on itself—on its supremacy, legality, and suzerain rights—a punishable offence, by warning, by suspending, and if necessary, even, at length, confiscating any treasonable or seditious paper; such a law, being of course, as applicable to the English press in India as to the Native, against which the English press has been so lustily demanding something of the sort. But what they want is, that the Native press should wear its rue with a difference. What indeed is most required to keep [the Native press straight, is the example of the English press. It can more naturally and far better than the Government control the spirit and fashion the future of the Native press. It should be watchful to detect and correct every misstatement, and to rebuke with candour and forbearance every misrepresentation of the acts and policy of the Government, and of the conduct of its officers, and no reproof from it would be so profitable to the native press for correction, and for instruction in righteousness, as the example of its own uprightness, ability, and honourable reputation. The French failed in India because of their vanity, and mutual jealousies, and self-seeking; and we succeeded through our loyalty to each other and to the natives, and the surest bond of union between ourselves and with our native fellow-subjects in India will always be the magnanimity which is the distinguishing virtue of Englishmen.

I propose now to let the native newspapers speak for themselves, and I have arranged my extracts from them under four heads, viz., 1st. On the Native Press; 2nd. On Natives and Europeans, and on the relation of Educated Natives to the British Government of India; 3rd. The Queen's new Title and the Delhi Imperial Assemblage; and 4th. "The Eastern Question."

1. In regard to the Native press—

The *Aligarh Institute Gazette* of the 28th April, 1876, writes:—"To be a native even is a great crime."

It is now our opinion that to be a native is a great crime, and though it is such a crime as we have no power over, still it is a great crime. If we are asked how it is that it is a crime, we will answer that the impediments thrown in the way of natives prove that they are not free like other human beings; that the rights which ought to be conceded to a noble race of beings by virtue of their humanity are not granted them; and that all these miseries are merely due to their being natives. It is therefore doubtless a great crime to be a native. Perhaps it is only for the sake of outward consolation we are told that no distinction is made in respect to black and white, but if we consider for a moment, it has no effect. It is also supposed that natives are void of good intentions, fidelity, and good-will towards Government; that natives have not been gifted with intellect and brains, or they would assuredly be entitled to those rights to which other intellectual and sensible people are entitled. For this reason it is incumbent upon natives not to consider themselves in future as altogether human beings, and to hope for those indulgences which by mere virtue of humanity are peculiar to human beings. Though they be subject to a just Government, they ought not to imagine that natives are entitled to the same rights as those to which their other subject races are entitled. In short, it is a great crime to be a native.

The reasons for those proceedings, whereby it was supposed that under British administration natives and Europeans are not alike, were of numerous kinds, on account of which there have been quarrels and disputes for ages, and natives have been complaining and asking why the British Government does not concede those rights to them by which they might be placed on a par with their European fellow-subjects, and thereby make the balance of English justice equal in both scales. Beyond this their complaints have had no effect, except to gladden their hearts by a few consoling words. For instance, though Government, with a view to do justice, has promised to confer those rights which natives have desired of the Indian Government, yet by its acts it has proved in a very small degree that it has actually respected their rights. For this reason the just and sanguine hopes that natives entertained have proved unavailing. Besides this there are a great many other things that prove a great difference to exist in the rights of Europeans and natives. But these tales have grown old; and we will, therefore, draw the attention of our readers to a new argument which will verify all those suppositions,—that it is a great disgrace to be a native, from which we deduce that when it is a disgrace to be a native, what will the result of all those plans be which natives adopt to preserve their honour; for they can devise all other methods, but can never clear themselves from the defect of being natives. . . . .

We have now to see whether the freedom of the native press ought to be suppressed on the grounds advanced by Parliament or not. In our opinion it is very unbecoming the dignity of a wise and foreseeing Government to wish to deprive the native press of its freedom on such unjust grounds. Those who are advocates of freedom, such as Sir Charles Metcalf, have granted freedom to the press merely for these forcible and unprecedented reasons,—that man's mind is like a closed house in which a fire might be kindled, his tongue like a passage through which smoke might keep escaping, and his murmuring thoughts like the flame of a fire. Therefore, if a fire be kindled in a house, and the passage for the smoke be closed up, such a house will assuredly become dark and dismal within, and in the end it will cause much violence. In the same way, if thoughts be engendered in the mind of man, and his tongue be tied, the vapour of his thoughts will assuredly destroy his mind. On this supposition, if the British Government deprive the native press of its liberty, India's tongue will be tied, and the feelings of these poor and timid subjects' hearts will make them very vicious. Therefore, those who would preserve peace in a country will never be averse to the freedom of the press.

It is great weakness to suppose that the articles in native papers can excite the minds of the people at large, and it is very regretful to find that in the British Parliament the expressing of such strange notions is becoming a precedent for *ex-parte* decrees. Perhaps there was not a single friend for natives in Parliament when this was said of them, although natives, apart from all proofs which they could advance to rebut those ideas, could bring forward a divine argument which they have accidentally at hand. It is this:—The Lieutenant-Governor of Bengal has, with much tenderness of heart, most fully admitted all their zeal and loyalty which are exhibited in native papers. When, therefore, a European officer of such high standing has so thoroughly examined natives and their thoughts, and acknowledges them in his administrative report, the doubtful opinion of a single member of Parliament can never carry any weight with it.

We cannot in any way understand the second extraordinary reason advanced for wishing to deprive the native press of its freedom, viz., that English officers do not like themselves to be criticised. On reflection it will be seen that for this very reason, native subjects ought most certainly to be permitted to criticise, in order that the honour of justice might be upheld. But we regret that Parliament should think otherwise. The strangest part of it is that the ventilators of these ideas have not had the opportunity of proving whether native criticims is improper or not. If it be proved that the criticisms are improper, a reason can be given for the just disapproval of the officers concerned; but if it cannot be established, then the just and unjust indulgences afforded to English officers defeat justice, and these reasons for the suppression of freedom can in no way be justified by law. We natives must, therefore, understand that our freedom is to be taken from us merely because we are natives, for we can think of no other reason. . . . .

Lastly, we must observe the fame and honour which Government has acquired by the mere fact of not interfering with the freedom of the press in India, will suffer greatly as soon as interference is shown. Apart from this honour, the benefits and necessary information, the report of native opinion, and the specifying of the same, their ambition and their loyalty, which Government can only know of through the press, and through whose means Government can make various amendments—all will become greatly impaired, and its numerous political designs will suffer greatly.

Perhaps Government has placed greater confidence in the opinions of those editors who are in no way partial to native newspapers, and who heartily wish their freedom upset. But we (natives) depend greatly upon the fact that our British Government is the supporter (defender) of a very civilised and free Government, who consider freedom the foundation of rule. It is not an

Eastern Government, nor the rule of an Indian rájah or nawáb, that it should annihilate the limited and weak freedom of natives, which (itself) cannot even be reckoned as a part of actual freedom. In this matter we are exceedingly thankful to a correspondent of the *Times* who has written in defence of the natives, which we reprint from a Bengali paper that has quoted from the *Times*.

The *Dacca Prakásh*, of the 31st December, 1876, refutes the imputation of disloyalty which is so often cast upon the native press. The exposure of the illegal and arbitrary acts of public officials and low Europeans is made rather in the interests of the Government, which is thus informed thereof, and not from any feeling of disaffection; and the value of this service will be best appreciated by the consideration, that in the opinion of the public, Government is identified with these men, and their acts are regarded as under its guidance.

The *Bhárat Sangskárak*, of the 1st January, makes the following observations, in a highly eulogistic editorial on Lord Lytton:—Though his Lordship has been at the head of the Indian Administration but for a short time, he has already, by a number of liberal acts, made himself popular with the natives. The noble views which he announced in his inaugural address, on assuming the reins of Government, have been carried out in practice, and have thus in the minds of the public begotton a confidence and affection towards the administration. The Fuller Minute alone has entitled him to their respect as a sincere friend of this country; and since its publication we have heard of but few cases of Europeans trampling under foot the life of helpless natives.

The consideration his Lordship has shown to the editors of native newspapers, by inviting them to the Delhi Assemblage has been indeed uncommon. In the absence of any representative institutions, the native papers are the only means of expressing and representing public opinion in this country; and narrow-minded rulers have all along slighted it. The more they increased in number, and the greater the ability with which they were conducted, the attitude of Government became the more hostile towards them; until their frank expression of opinion has been regarded as seditious and libellous, their courage and independence an evil to the country, and their criticism of the acts of the local officials repeatedly censured as impertinence. The agitation made, and the means adopted, during the administrations of Lord Mayo and his successor, for the purpose of subduing and curbing the spirit of the native press, caused some apprehension that its ruin was at hand. The accession of Lord Lytton, therefore has been a most fortunate event, and to him they owe the honour of being invited to Delhi, and regarded as guests of the Viceroy, on the occasion of the Imperial Assemblage.

The short period of his administration has been fraught with natural calamities, and some political mishaps to the country, with famines and storm-waves, and complications in the frontier territories; and the holding of a costly Durbar in face of these disasters was regarded by the public as inopportune and unadvisable. But he had already advanced too far to recede. Still he has reduced the expenditure connected with the affair, and put forth energetic efforts to cope with the visitations that have befallen the country. He personally visited the frontier and settled the disputes to some extent; and has strengthened the tie of friendship with neighbouring States. He visited Bombay, and the scene of distress, and has made arrangements for affording relief. As for the storm-wave in Eastern Bengal, and the misery occasioned by its being but partially relieved, Sir Richard Temple, and not his Lordship, must be held responsible. It is also said that he has himself subscribed liberally in aid of the relief operations, and has met from his own funds much of the expense connected with the Durbar. We are sorry that India has the prospect of retaining so gracious a ruler only for a short time; for his retirement in the ensuing year is already spoken of as probable.

2nd. Under the head of natives and Europeans, and of the relation of educated natives to the British Government, my extracts would fill several numbers of the Society's *Journal*. Scarcely a copy of the native papers—that is, outside the happy Madras Province—is published without some complaint of the discourtesy and harshness of Europeans towards natives; and the frequent complaints against the Government for not employing natives more in the public service are most bitter, and often intolerably unfair. It is only in such articles that anything like an expression of disloyalty occurs; while the tone of many of them is conspicuously loyal.

The *Bombay Samáchár* (42) of the 6th December has a leader, headed, "Who is to be blamed for the Absence of Friendly Intercourse between the Europeans and the Natives of this Country"? This absence of a friendly intercourse, says the *Samáchár*, was noticed by his Royal Highness the Prince of Wales and his noble companions, while on their visit to this country; and they complained of this undesirable fact on their return home. The complaint has become a prominent theme in the leading articles of the Home press; and, among the rest, the London *Times* gave a leader to the notice of the subject. The *Englishman* of Calcutta has recently published an editorial on the subject, the writer of which tries to reply, or, rather, to explain away the charge brought by the London *Times* on the Europeans in this country. The writer in the *Englishman* freely admits the fact, but endeavours to fix the blame of this undesirable state on the natives. The writer here dwells on the advantages which the natives have derived from the English Government; a fact which is gratefully admitted by the natives, but which has no relevancy in the present discussion. But, as the *Englishman* imported the question of the advantages received by the natives from the British rule into this present discussion, the *Samáchár* will only observe that it is these very advantages which are an eyesore to the Europeans of the stamp of the writer in the *Englishman*. They do not wish the natives to have equal rights with themselves, or to enjoy an equality with themselves in the eye of the law. The *Englishman* also asserts that the natives have advanced under the British rule both mentally and physically. The *Samáchár* admits that they have advanced to some extent mentally; but to say that they have advanced physically, is utterly untrue. They have, on the contrary, deteriorated considerably in that matter. They have become more timid and effeminate. Englishmen value and appreciate courage and spirit in their own people, but not in the natives. They wish them to be entirely submissive and devoid of self-respect. If a native is found bold enough to return an abusive word or a blow to a European aggressor, his conduct is interpreted as an insult to the whole European race and an act of disloyalty to the English Government! With these facts patent to all, the *Englishman* boldly asserts that the natives have obtained equal rights and laws and have advanced mentally and physically under the British rule. The *Englishman* then asserts that the present generation of the Anglo-Indians is of a higher standing than their predecessors; that is, they are persons who move in the higher circles of society at home. The *Samáchár* observes that, if this assertion be true, the present generation of the Anglo-Indians should be found to act more generously with the natives than they actually do. For the higher classes at home are well known to act towards the natives very kindly and generously, a fact which has been borne out by the concurrent testimony of numerous natives who have visited England.

The plea advanced by the *Englishman* in support of its views is, that the natives jealously seclude their women, and therefore there cannot be a friendly and social intercourse between them and the Europeans. To this the *Samáchár* replies that this may be true in Bengal, but it is not so in this presidency, and certainly not in regard of the Pársis. But one cannot say that there is any better or closer social friendly intercourse between the Europeans and the Pársis. Thus, the pleas of the *Englishman* are baseless, and it utterly fails in its attempt to exculpate its countrymen from the charge brought against them by the London *Times*. The Calcutta paper may be accused of an attempt to mislead the home public. If the Anglo-Indians sincerely wish to establish a friendly intercourse with the natives, they can most easily do so.

The *Koh-i-Núr* of July, 1876, quoting the discussion that took place lately in the House of Commons about the steady advance of Russia in Central Asia, and referring to the *Indian Statesman*, which contained an article on the unjust treatment of natives by the English rulers, and their consequent dissatisfaction with British rule, observes that no doubt the English have made many improvements in the country, yet they have kept back from it its indubitable rights; instead of seeking the prosperity of India, they have enriched their own nation at its expense. Nothing can be a graver mistake than that committed by some Englishmen in mischievously asserting that natives will not remain quiet and content when Russia has extended its boundaries to the confines of British India. The people of this country, whatever be the severities and cruelties to which they are at present exposed, are naturally averse to revolution and change of government—for fear of making a change for the worse. Let the officers of the Government but conciliate the millions of India, and acquire their good-will by honest and true efforts; and then Russia with all its mighty armies may be despised.

The *Oudh Akhbár* of the 19th July, referring to the letter recently issued by the Government of India to the Government of the North-Western Provinces, conveying its dissatisfaction at the proceedings of the latter in the case of Mr. Fuller and his syce, observes that this act of justice on the part of Lord Lytton is one which has no precedent in the history of India. Lord Lytton deserves the most sincere thanks of natives, and especially of vernacular papers, because their complaints have not only reached his ears, but have had a fair hearing.

The *Akhbár-i-Am* of the 11th October has an article entitled, "What is the cause of the want of unanimity between Europeans and Natives?" The British Government has lasted (and will last) for hundreds of years in this country. During this long interval the Government has been indefatigably engaged in devising means to promote the comfort and welfare of the people. Thousands of men, who were no better than asses and wild brutes, have been converted by it into civilised and enlightened beings. The prevalence of distress and misery under the former administrations contrasts most strongly with the ease and comfort which are enjoyed under the present rule. In the face of these things, it is really a mystery that there is no perfect amity between the governing classes and the governed. This long intercourse, with all its connecting ties, should have led to the union of the two sects of the community, like the commingling of water and milk. But, on the contrary, they are to be seen existing side by side as quite distinct bodies. The acquisition of English by a limited number of natives, the conversion of a few Hindustánis into Christians, and *vice versá*, and the adoption of English dress and manners, do not deserve to be called a union of the two elements of society. The two may be said to be in union when instinctive sympathy comes to exist between them, and one begins to share the sorrow and joy of the other. They pretend to be on excellent terms with each other, but harbour implacable enmity at heart. There are several reasons for this. Different desires and prejudices inspire the two classes of the community. Englishmen hate idolatry. Natives regard the slaughter of kine as abominable. In the second place, the Hindoos consider Europeans in the light of unholy and unkind foreigners, while Englishmen, on their part, charge natives with folly, and contemn them as groping in the dark. Englishmen look upon them as things of sport; nay, matters have assumed a worse shape. Englishmen are becoming the eaters, and Hindustánis the eaten. The partiality of Englishmen towards their countrymen is making the knot of mutual hatred and enmity tighter and tighter every day, and is sure to lead to disastrous consequences. The natives outwardly praise the Europeans, but inwardly are extremely jealous. Likewise, the Europeans cunningly impart to the natives their learning, and so on, but are secretly undermining their power, wealth, and greatness. Thus, on account of the intervening screens of cunning and dissimulation, one native cannot read the heart of the other. There are ten important failings in the Europeans, which greatly go to alienate the hearts of the natives, and they may be enumerated as follows:—

(1) The Europeans contemn the natives and their institutions, manners, and customs, as false and worthless.
(2) They are jealous of the promotion and advancement of natives.
(3) They look upon themselves as victors, and upon the natives as the vanquished tribe.
(4) They subject natives to disgrace even in common trifling matters.
(5) They treat with utter disregard the opinions and feelings of natives.
(6) They act upon the recommendations of others without due consideration and deliberation.
(7) They misbehave with regard to gentleness, politeness, and good manners.
(8) They drain India of her riches to replenish England.
(9) They diffuse their religion in an underhand way.
(10) They show partiality towards men of their own creed and colour.

Full scope is at present given to the last of the above-mentioned faults. A native magistrate is not competent to punish a European, but a European can punish a native. Nothing but partiality can account for this otherwise inexplicable phenomenon. Mr. Fuller killed his syce, and had to pay only a fine of 30 rupees. An official of the Indus Valley State Railway put an end to the life of his menial servant by one blow. Hundreds of instances of this nature may be cited, which are a clear proof of English partiality. There are other causes also at work, though of a minor character, and now and then make their existence felt by prominently coming to view.

No doubt there are certain defects in the natives also, viz.:—

(1) They despise all the institutions of the English.
(2) They hate Englishmen, thinking them to be foreigners or conquerors.
(3) They refuse to learn and adopt the excellencies of Englishmen.
(4) They hide their miseries and misfortunes from Englishmen through reserve and bashfulness.

But, after all, for the existence of the gulf that separates the governing classes and the governed, the former are more to blame than the latter. The editor is in a position to assert freely and frankly, that as long as Englishmen do not become really kind towards the natives, relinquish their pride as a conquering race, and esteem the natives more highly, no useful union can be effected between the two nations. The Hindoos are involved in such intense darkness that it is vain to expect that they will themselves ever make advances towards a reconciliation.

The *Aligarh Institute Gazette* of the 15th September says that Lord Lytton's minute in the Fuller case has as yet not answered to the popular hopes of its efficacy in diminishing the murder of natives by Anglo-Indians. The reports of deaths of natives under the blows of Englishmen have been of late as frequent as those of deer killed in the hunting season. An artilleryman kicked and cuffed a punkha coolie to death at Ságar. An Englishman killed a native boatman not long ago. Some British soldiers, bent on sport, shot a chaukidar at Lucknow. A superintendent of the telegraph department beat a native to death at Karachi. A European *tamashawala* struck a native with a stick in a *sarai* at Gorakhpur, and the man died from the effect of the blow. And a railway servant killed a punkha coolie at Jhelum. Here are six murders perpetrated by Anglo-Indians within a short period of time. It is not yet known how the law has avenged the deaths of the unfortunate natives upon the European murderers in the above instances. It is no doubt a matter of regret that the blood of natives continues to be shed in this ruthless way; no more value attaches to it than to that of wild beasts or to water. There is no one to listen to the grievances of the natives. But the editor is still more grieved to find that the orders of the Governor-General are likewise disregarded in India. If they carried the least weight with them, a temporary, if not a permanent, security of life from the outrages of Anglo-Indians would have fallen to the lot of natives. But, on the contrary, his Excellency's orders have failed to influence the courts of justice at all; and the bloodshed of natives is a thing of almost daily occurrence. Thus, under the English rule, men are killed like beasts of prey. Is it not for this very reason (the insecurity of life) that Asiatic rulers are to this day infamous for their tyranny? All that has been asserted with reference to their despotic rule is that the life and property of the subject were not safe, that their jail administration was not good, and that their officers were oppressive and tyrannical. Do not these very evils exist under the British administration, and will they not hand it down to posterity as a just object of blame? If poor natives continue to lose their lives at the hands of the European masters as at present, the English rule in India will perhaps have to give up all claim to the security of life of its subjects. It is not the personal cruelty of the sovereign, but the wickedness of a few of his officers, that has exposed Asiatic Governments to abhorrence. The same state of things unfortunately prevails under our English rulers. They do not inflict exemplary punishment upon their offending countrymen, so as to deter others from treading in their footsteps. Since the High Court has protested against the reprimand of Lord Lytton, there is no hope that the innocence of European murderers will in future be even nominally questioned. The deaths of natives caused by the blows of Englishmen will now come to be unhesitatingly ascribed by magistrates and medical officers to diseased spleen, or, in other words, to mere accident. The result of this will necessarily be that if any Governor-General will have the boldness to interfere, he will incur the displeasure of the High Court, and his proceedings will be held unconstitutional. Under these circumstances one will not be far from the truth in asserting that the death of a native is a legal proceeding, and that every other proceeding is illegal.

A Bengali correspondent of the *Khair Khwah-i-alam*, 15th September, says that Englishmen, as soon as they land on the Indian soil and come in contact with their countrymen resident in the country, change their temper. In a short time the natives appear to them to be no larger than gnats. It does not take them long to learn the habits of a kicking and biting horse; abusing, beating, and kicking become quite habitual to them. The sudden change which takes place in the behaviour of the generality of Englishmen in India is ascribed, by the advocates of Anglo-Indians, to the impure atmosphere or climate of this country. But, in reality, the chief agency at work in bringing about this change is no other than the weakness and helplessness of the natives, and the independence and arbitrary temper of Englishmen. The violent passions of a man are often kept under check by a fear of public opinion or the penalty of the law. But in India there is no check to restrain the violence of Anglo-Indians. Any censure of their conduct by their countrymen is out of the question; nor have they any reason to fear anything on the score of retaliation from the natives. Looking at the outrageous conduct of the Anglo-Indians, the British Government in India deserves to be classed with the most tyrannical governments that ever existed. The oppressed natives are not much better off than the Israelites of old. Ravana exacted life tribute from certain Hindustanis but once; but under the British Government, anxieties, cares, and disappointments constantly prey upon the mind of the natives, sucking their life-blood like leeches and snakes, without the least intermission. But when the laws and institutions introduced by the British Government for the good of the people are taken into consideration, the native mind seems disposed to imagine that the administration of even-handed justice (to subject nations) has fallen to the English nation alone, and that the oppression and tyranny which once prevailed throughout India have vanished under the just rule of the English, and that learning has begun to flourish in this country. Moreover, the native mind exults to think how eagerly intent are the English people at home on recognising the rights, privileges and liberty of the Indian people. But the writer regrets to say that the unjust dealings of Anglo-Indians towards the natives have threatened to destroy the splendid halo of light that surrounds the bright face of English justice, and thus to doom that to ignominy, which is so well worthy of renown. Let the Anglo-Indians look for a moment at their conduct, laying aside all prejudice and pride, and they will be satisfied that their habitual outrages are calculated to do a great mischief to the good of their own nation, and that their antipathy threatens to undermine the foundation of their rule in this country. It is no secret how the ill-treatment of the Hindoos by the Mussulmans through national feelings and prejudices accelerated the downfall of their rule in India since the time of Aurungzib, in whose reign it attained its culminating point. Do not the violent proceedings of Anglo-Indians tend to alienate the hearts of the oppressed natives from the Government? Are not these oppressions likely to produce a kind of sympathy for the poor people of India in the minds of other kings? Under these circumstances, will not the natives be induced to think that all the rules and regulations that are passed by the Government, and the stir that is made at home to promote their welfare, are nothing but a deception, nothing but a mirage to tantalise them? The writer then goes on to argue how the Anglo-Indians, through jealousy and mean interested motives, keep the Government and the Empress in the dark with respect to the actual condition of the people. It is also remarked that Eurasians are much more to blame than Englishmen. Thousands of innocent natives have perished at the hands of the former alone; and their deaths have been invariably ascribed to accident in shooting, or to the previous existence of some disease in themselves.

The *Aligarh Institute Gazette* of the 21st July, 1876, in an article headed "The Justice of Lord Lytton," observes that Mr. Fuller, who killed his syce, was sentenced to pay a fine of only 30 rupees by the magistrate at Agra, a punishment which a native would have received for killing a dog belonging to an Englishman. The natives have now not a shadow of doubt that English murderers are allowed to escape, and that killing a native by an Englishman is not an illegal act. They cannot think of a single instance in which an Englishman has been convicted under the charge of murder. There is always some trumped up excuse ready at hand to cover his crime. Lunacy and insanity are the first pleas thought of, or he is represented to be in a state of uncontrollable mental excitement, a term which has a very vague and comprehensive meaning. Or perhaps the doctor tries to find the previous existence of disease in the deceased,—an enlarged spleen, an ulcer in the stomach, &c. An Englishman has thus come to be regarded as the angel of death by natives. The punishment inflicted by the magistrate of Agra on Mr. Fuller being merely nominal did not satisfy Lord Lytton. A reference is here made to the contents of the letter which the Government of India lately issued on this case showing its displeasure and dissatisfaction. The editor then proceeds to call upon natives to acknowledge their sincere gratitude to his Lordship for his impartial justice, and assures them that his rule will not be that of a rájah or a nawáb, but that of a wise, just, and conscientious Viceroy, who holds himself amenable for his actions both to man and God. He has clearly given his countrymen to understand that he heartily disapproves of the light esteem in which they have been wont to hold the lives of the native population. It may be now reasonably expected that Englishmen will refrain from murderous acts, if not from fear of Heaven, at least for fear of receiving severe rebuke and punishment from the Viceroy. After making a few more remarks in the same strain, and commenting on the unjust acquittal of Private McGrath by the jury when such unequivocal evidence stared them in the face, the article closes with an appeal to natives to acknowledge the rare merits of the new Governor-General.

The *Akhbàr-i-Alam* of the 20th July, republishing *in extenso* an Urdu version of the recent letter of the Supreme Government on Mr. Fuller's case, expresses the gratitude and obligation of the native population to Lord Lytton for his justice. The editor remarks that it does not appear from the letter that increased punishment has been inflicted upon Mr. Fuller. Mr. Leeds, who has been greatly to blame, also has escaped with a very slight punishment—mere loss of promotion for one year. He should have been at once dismissed, and never again permitted to enter the service of the Government. The Judge of the High Court, who, in spite of the clear evidence against the murderer, regarded his crime as a very light one, has shown that he lacks the requisite qualifications for his high office. The censure that has been passed by the Government of India upon the Lieutenant-Governor of the North-Western Provinces, who is remarkable for ability and shrewdness, is one of no little moment. The editor then alludes to the partiality shown by English officials towards their own race, by which the name of British justice is greatly lowered. Hundreds of unoffending natives are barbarously killed by Englishmen, but not a single European has hitherto lost his life in this manner at the hands of natives. Isolated cases, such as the murder of Lord Mayo, or of Chief Justice Norman, are entirely beside the question, as they were perpetrated, not by natives of Hindustan, but by men belonging to frontier tribes.

The *Oudh Akhbar* of the 15th October publishes an article, communicated by a correspondent, in praise of Lord Lytton for his minute on the Fuller case. His Lordship's action forms an epoch in the Indian annals, and is the first of its kind during the long rule of the English Government in the country. His memorable minute is not a reprimand to the Local Government and the High Court alone, but a warning to the whole European community resident in India. He may justly be called the Núshírwán of India. His resolution is based on the effacement of all distinction of colour and creed. It shows his Lordship's anxiety to view with an equal eye his European and native subjects; and on this impartial administration of justice the popularity and the stability of the Government depend. It is to be deeply regretted that natives cannot obtain common justice against Englishmen at the hands of Englishmen —a civilised, enlightened, merciful, and pious tribe, professing a revealed religion. Mr. Fuller's case is a typical example of the English administration of justice in India. Lord Lytton has endeavoured to uproot this long-standing evil. But the censure which his noble action has elicited from his European officers and the Anglo-Indian press, appears to be worse than their injustice. Thus it is apparent they do not value the native subjects of the Empress of India more than the commonest vegetables. They are so fond of their evil habits that they never try to get rid of them. Are not the people of India the subjects of their Empress? Do they not possess the rights and privileges of a free people? Are they not the creatures of the Almighty Creator? The tenderness of heart of the English Government may be fairly estimated from its putting a stop to the cruel practices of *Suti*, human sacrifices, and the slave trade, simply because they involved the loss of human life. The rule of the East India Company came to an end in 1858; and the year 1876 has seen the close of the reign of the Queen and the commencement of that of the Empress. Will not even this change free India from her wretched bondage? Will not the Europeans and the natives, the governors and the governed, even now be held equal before the law? Rájah Vikramaditya offered himself to a demon to save his people from destruction. But in these days several human sacrifices are offered to gentlemen, and with them justice is also made a victim. Are these the works of the vaunted light of knowledge? Is this what is meant by enlightenment and civilisation, that seven murders can be perpetrated in one year, and justice dispensed as in the notorious Fuller case? In time of war, passion and excitement get the better of reason and the sense of justice, savage and barbarous acts are accordingly committed, and men are murdered on both sides without pity, as has lately been done at Belgrade. This has thrown the whole of Europe in a blaze, and provoked expressions of strong sympathy. A general hue and-cry has been raised by the people of Europe to expel the Turks from Asia [apparently Europe is meant], to divide their country among themselves, and to secure freedom for the insurgents from the yoke of the Porte. But in the mutiny the people of several cities in India were cruelly plundered and massacred; and not only did not the love of humanity of Christendom avail to excite any sympathy for the sufferers, but no sympathy was expressed even by the Mohammedan powers. On this the English papers maintain strict silence. But let the dead lie buried. The murders committed by some blood-thirsty European gentlemen, and the partial decisions of the courts of justice in these cases deserve a stonger condemnation than the Bulgarian atrocities, because the latter were perpetrated under the influence of hostile feelings, while the former occur in a state of perfect peace and obedience on the part of the people. The honourable task of putting a stop to these atrocious crimes fell to the lot of Lord Lytton. His action should be regarded, not in the light of an expression of sympathy with natives, but in that of a noble effort to free the Government of her Imperial Majesty and the English nation from a grave charge that threatened to impair their reputation. He thus deserves praise and gratitude at the hands of his countrymen, and not censure. The writer then proceeds to express his astonishment at the circumstance that the Viceroy possesses no control over the High Court. This law surely needs amendment. It is a very serious fault in the administration, if the Viceroy can exercise no jurisdiction over the High Court. We are now under the absolute reign of the Empress. It is not well to have a dual government. Two kings cannot rule in one country. The Government would do well to associate a jury of respectable natives with the magistrate, the sessions judge, and the High Court in cases of this kind. At the *post-mortem* examination one native hakim and four other natives of respectability should also be present. And an abstract of the whole case after decision should be ultimately sent to the Viceroy for information. These things will greatly help to check crime and violence.

There is one more important duty which awaits Lord Lytton. A review of all the murder cases that have hitherto happened during the British rule, at least of those seven cases that have occurred since his Lordship's arrival, should be made, with special reference to the medical evidence in each. The medical evidence will be found to have discovered in almost every case the existence of an enlarged spleen in the deceased. This review, when complete, should be sent to the various journalists for remarks. These murders, as at present committed, only satiate the fury of the individual murderers concerned. The best way to dispose of the unfortunate victims would be to sacrifice them, eight or ten together, in time of pestilence, scarcity, or famine. Thus a double object would be attained,—the gratification of the murderer and the averting of a public calamity.

The editor then argues that men (viz., sawárs, soldiers, police constables, syces, grass-cutters, coolies, &c.), who have hard laborious work to do, cannot be subject to a disease such as a morbid enlargement of the spleen. They are, as a rule, strong, robust, able to run, and eat a good quantity of food. The enlargement of the spleen is marked by the unusual swelling of the stomach, the thinness of the body, and the paleness of the complexion. Granted that natives are weak, and Europeans strong and powerful; and that the former die from slight blows: yet as those blows, slight as they are, suffice to cause death, the offender should suffer capital punishment. However, natives are not so weak as Europeans have supposed them to be. After commenting on the love of justice of Sháhjahan, Shír Sháh, and Jehangir, by way of examples, the editor extols Lord Lytton for his justice, and hopes that Englishmen will abstain from violence in future.

A correspondent of the *Agra Akhbár*, dated 20th October, says that the speech of Lord Salisbury at Cooper's-hill College, denouncing the conduct of the Anglo-Indians, has aggravated the condition of the natives. His Lordship's public denunciation of the want of sympathy on the part of the European officers towards the natives stung the Anglo-Indians to the heart, who, though perfectly aware of the fact, had hitherto studiously concealed it. Moreover, his Lordship's recognition of the claims of the natives for admission into the Civil Service, and his framing rules and regulations for that purpose, only served to sprinkle salt over the wound. Since then the Anglo-Indians, who form a very strong and influential part of the community, have set themselves to work, and to publish all sorts of articles in the public papers with a view to convince the Secretary of State that the impression which he has come to form about their conduct rests on no solid foundation. It has been asserted by an Anglo-Indian paper that Lord Salisbury, in order to arrive at a true knowledge of the state of affairs in India, should have gained his information from the civil officers, and that he was not justified in allowing much weight to the information conveyed to him by the Prince of Wales and his retinue, who came here only for sport, and performed a rapid perambulation of the country, and who only excelled in shooting. But nothing can be a greater mistake, says the writer, than to suppose that the Prince of Wales and his companions came to India for sport and amusement. What really prevailed on them to undertake such a long journey was not the love of hunting or of amusement, but the worthier object of ascertaining the actnal condition of her Imperial Majesty's subjects in the far east. It is in the highest degree creditable to their shrewdness and penetrating observation, that what another would have discovered in a much larger period of time, they found out in a remarkably limited time. The Anglo-Indians who, through the organ of the press, are under-rating their experience, are strenuously exerting themselves, from sordid interested, motives, to depreciate that valuable information which Lord Salisbury has obtained from them. The Anglo-Indians, in referring the Secretary of State to themselves for accurate information on the subject, wished to play themselves the parts both of the plaintiff and witness. Is there any European officer in India who has not long been acquainted with the want of sympathy between Anglo-Indians and natives? Hitherto all have wilfully shut their eyes to it. Now that the matter has transpired, strenuous efforts are made to suppress it. The Anglo-Indians have all conspired to turn truth into falsehood. Since the publication of Lord Salisbury's speech above referred to, natives have still more fallen in their estimation. Those instances of European violence which have of late occurred fully corroborate this statement. There are men who deny the prevalence of any instinctive dislike between the children of the soil and their foreign masters. Europeans are in the habit of killing natives like dogs and cats. The courts of justice look on the payment of a trifling fine—no more than the hire paid to labourers for the removal of the corpse of a dog or cat—a sufficient atonement for their atrocious crimes. There are Europeans more kind than the ordinary run of their fellows, who allay their feelings of anger by merely subjecting natives to indignities. But to a native the loss of honour is much more dreadful than the loss of life. A magistrate orders a municipal commissioner into custody. An assistant magistrate causes a mukhtár to place a shoe on his head in the open court. A joint magistrate kick and cuffs an amlah in the court. A European officer sometimes sends for a sweeper to strike a mukhtár with his broom. On the 19th September last an assistant magistrate had ten strokes of the shoe inflicted on a patwari. These are, to be sure, the unmistakeable signs of a perfect amity between the two sects of the community. These tyrannical proceedings of the European officers, like those of Nadirshah, can surely command the love and good-will of natives. The Secretary of State is as yet only aware of the existence of a want of sympathy between Englishmen and natives, but what will he say when he comes to know of these highhanded proceedings of the Government officers?

The *Dnyán Prakásh* (3) of the 28th of August, 1876, has a long article, headed "The Administration of the English Government." Great English statesmen now and then express wonder, why the British Indian Government, which is so civilised and just, is not as popular as it ought to be. The fact appears to them the more unaccountable, as they know that the native Governments which preceded the English rule were notorious for their extreme tyranny and oppression. To the writer in the *Dnyán Prakásh* the question does not seem so very difficult of solution. He thinks that the thing can be accounted for to some extent, by the simple fact that the English are foreigners differing from the people in several essential things—as religion, race, manners, customs, &c. The old native Governments were, no doubt, very oppressive; yet, being indigenous, their defects were tolerated. The unpopularity arising from this cause can, however, be greatly mitigated if Englishmen really wish to endear their rule to the people of this country. But the English rulers seem to wish that they should be regarded by the people as foreigners. For their treatment of both these races strengthens the above belief in every impartial observer. There is no doubt that the natives enjoy many rights and immunities of which they did not even dream under the native rule. But the rights and privileges enjoyed by the Europeans are greater than those conceded to the natives; and therefore the liberality of Government in this matter, instead of creating a sense of gratitude in the hearts of the natives, makes them feel the invidious distinction Government makes between them and the more favoured race. Another cause of the unpopularity of the English Government in this country, is the notorious partiality of its English officers in dealing out justice between Europeans and Natives. The writer is aware that Englishmen have come not simply to benefit India. They are no more free from self-interest than any other human beings, and it is quite absurd to expect them to rise superior to human nature. No reasonable man ought to find fault with them for adopting such measures as are necessary to keep up the political superiority of their race in this country. But there ought to be some limit to this allowable exercise of self-interest. The *Dnyán Prakásh* freely and cheerfully admits that the English Government has done much to benefit India. It has given her peace, security of person and property, the blessing of education, a taste for liberty, and many other boons, and its services ought to be gratefully admitted and duly paid. But all this does not justify the excessive greed which our Government sometimes evinces. Again, the dealings of Government with the native princes and chiefs supply even greater grounds for complaints than its dealings with the common ryots. The bad instances of its foreign policy are too well known to need any remarks on that subject here. The article closes with an extract from the *Calcutta Indian Statesman* newspaper, relating the tyrannical mode in which the Indian Government under Lord Hastings compelled the Nizam's Government to give to it as a gift, an enormous sum of 16,000,000 of rupees to beautify the city of Calcutta.

The *Benares Akhbár*, of the 26th October, regrets to say that the favours of the Government are thrown away upon the natives. The Mussulmans to this day do not hold the English Government in the same estimation as they did the former Mohammedan rulers of the country. When his Royal Highness the Prince of Wales came to India last year, the Nizám feigned sickness when he should have gone to Bombay; and he resorted to the same excuse in order to avoid appearing at the Delhi durbar. What does the Nizám think of himself? His ancestor was only the governor of a province and a commander of forces under the emperors of Delhi, and belonged to the second class of honour. Surely he does not wish to be placed on the head of the Viceroy. The Viceroy, being the representative of her Imperial Majesty the Queen in this country, is entitled to the same honour and respect at our hands as the Queen herself. The Nizám should be present at the approaching Imperial Assemblage at Delhi, and show the same respect towards the Viceroy as his ancestors did towards the emperors of Delhi. He should present the Viceroy with the usual nazaráná like other chiefs, and occupy the seat in the durbar allotted to him according to his rank. Did not his ancestors pay nazaráná to the emperors of Delhi? It is not easy to see why he should feel ashamed to make the usual presents to the Viceroy. The Nizám was never an independent chief like the Maháráná of Odeypur and other Rájás. The second seat was assigned to the Maháráná of Odeypur at the durbar held in Bombay by his Royal Highness the Prince of Wales, although, looking at his high birth, he stands highest among the feudatory chiefs. He might have been fully persuaded, before his departure for Bombay, that he would not get the first seat at the durbar, yet this consideration did not weigh sufficiently with him to keep him back from attendance at the durbar. The Nizám is entitled to the honours which were due to the ex-Nawab of Oudh, while the latter was on the throne. Nasir-ud-din Haidar and Wagid Ali Sháh received the Company's Governor-General at Cawnpore with due honours; then all this hesitation on the part of the Nizam to meet her Majesty's Viceroy, and make his Excellency the usual presents, is very unbecoming. The Nizam's absence from the Delhi durbar should be taken to be an unmistakeable sign of his hostile disposition towards the Government, which, in the end, will turn out injurious to himself. The object of Sir Richard Meade's visit to the Viceroy at Simla has not yet transpired; but the secrecy with which such unimportant matters are conducted causes unnecessary apprehensions in the minds of the ignorant people.

The *Indu Prakásh* (of February 1, 1876) has a leader headed "The Continuous Degradation of the Native Princes." At one time several of them were as independant as the British Goverment itself, and enjoyed even a higher dignity and political status. But gradually they have been suffering degradation, and at present have fallen into a very low condition. The English Government has assumed paramount power in the country. But its officers are not content with this; they still continue their efforts to lower the political status of these feudatories. We see every time a fresh artifice is contrived to bring about the above object. In the late Baroda question, the English Goverment assumed the power of deposing from and putting up on the gâdi of a native State any person it pleases. The legality of this course being questioned at the time, His Royal Highness the Prince of Wales was invited to visit this country, and the native princes and chiefs were made to do him homage as to their superior. Soon after this a Bill was introduced into the English Parliament for conferring on Her Majesty the high title of the Empress of India. About this time another step was taken to take away from the native princes one more mark of their princely dignity, namely, the power of issuing separate coins for their own States. Here the writer refers to the new law on the subject, namely, Act IX of 1876, and quoting sections 2, 4 and 7 of that Act, makes remarks on them. Some time since, continues the writer in the *Indu Prakásh*, some native States were deprived of their jurisdiction over the Europeans residing in their territories, and now an attempt is being made to invade their right of trying their native subjects also. Here he alludes to the Bill brought forward before the House of Lords by the Marquis of Salisbury, to empower the Indian High Courts to try the subjects of the Indian princes charged with participating in the forbidden slave trade. After giving the substance of the speech of the noble Lord while introducing this Bill, the writer alludes to the suggestion made by Lord Stanley, that as the Bill proposes to empower the English Courts to punish the subjects of the native princes, it is but right that the consent of those princes should be obtained before this law is passed. But no attention was paid to this reasonable and proper suggestion, and the Bill passed the first reading. Cannot the object of this provision, namely the punishment of those subjects of the native princes who are engaged in the wicked trade, be as well attained by having these persons punished by their own rulers? Why should the power be assumed by the English High Courts? It is not at all likely that the native princes will go against the wishes of the mighty British Government in this matter. It is very surprising that the Parliament should consent to take away this important right of the native princes without their consent, in spite of the treaties which have never been cancelled formally, and, therefore, must be considered to be in force. The proceeding does not seem to be quite fair even in the paramount English Government. It can be justified only by the principle that "might is right."

The *Native Opinion* (2) of the 9th July, 1876, has an editorial, headed "Employment of Natives during the

Mohammedan Rule." In our last issue, says the *Opinion*, we have shown that though our English rulers have passed laws and rules from time to time, declaring the eligibility of the natives for high posts, those laws and rules have never been brought into operation, and the natives have received no benefit whatever from them. The English are believed to be a civilised, far-sighted, wise, just, and liberal people. The Mohammedan rulers of India, it is said, did not possess any of these high virtues. Yet one is obliged to say that they were a hundred times more generous and considerate towards their Hindoo subjects than are the present English rulers. They were foreigners, as the English are, and not being as enlightened as the English are, if they had excluded the natives entirely from the public service no one could have blamed them for so doing. But the conduct of the Mohammedan emperors was entirely the reverse of that of the present English rulers. They conquered the country, but made it their home, and admitted the natives to equal rights with themselves. Every branch of the administration was open to the children of the soil, and, therefore, the natives were soon reconciled to their foreign rulers. Under the present rule the country, no doubt, enjoys infinitely more conveniences; but as the people are getting more and more of these conveniences, they lose much of their value and attraction. The writer then quotes from the *Hindu Patriot*, and shows to what high and important posts the natives were elevated under the Mohammedan kings. They were often made governors of provinces, great ministers, and such other high functionaries. The natives never abused the trust so generously reposed in them by their Mahommedan masters. The writer also quotes the English authors Orme and Mill in support of the generous and considerate treatment of the natives by the old Mohammedan rulers of this country. Can even one instance of a native being raised to a great post of dignity and trust by the English Government be produced? Several natives have shown that, by their education and other high qualifications, they are as fit as any Europeans to be entrusted with high posts under Government, but are their talents made use of? The great English authorities think only of providing for their own needy relations whenever any valuable vacancy occurs. The English are very liberal in empty promises, but in practice they are extremely partial to their own race in distributing patronage.

The *Native Opinion* (2) of the 3rd September, 1876, has an article, headed "Prospects of the Natives to the Covenanted and other High Posts," in which it observes that the time of the natives obtaining high posts appears to have come near. In Bengal a discussion is going on for conferring the district judgeships on the natives. Sir Richard Garth, the Chief Justice of Calcutta High Court, is said to have reported to Government that the native subordinate judges perform their duties much better than European district judges do theirs. The latter, in disposing of the appeal cases made from the decisions of the former, often spoil the cases, and, therefore, their decisions, instead of helping, frequently obstruct the course of justice. The Chief Justice, therefore, recommends that the present district courts, presided over by single judges should be done away with, and replaced by courts having three judges, one of whom should be a native, one barrister, and one civilian; and this recommendation is said to have met with the approval of Sir Richard Temple, the Lieutenant-Governor of Bengal. It is also stated that the Government of India has sent round a circular letter to the subordinate governments, calling upon them to give their opinions as to what high posts they think can be bestowed on the natives. It is also said in the newspapers, that the authorities are contemplating putting natives on the Revenue boards, and that this news has caused an agitation among the European civilians. Possibly, the Government of India means to commemorate the grand event of the next new year by inaugurating, on that auspicious occasion the new liberal policy of admitting the natives to a share of the honourable and lucrative administrative work. The writer also refers to an order, said to have been recently issued by Lord Salisbury to the Government of India, instructing it to make no distinction between the European and the native civilians under it, and to treat them alike; and ordering that when the rules of the service require it, the former should be put under the latter, and that those of the latter who decline or show unwillingness to abide by these arrangements, should have their promotion stopped and their names reported to the Home Government. Lord Salisbury seems determined to carry out the above liberal policy. He has indicated this determination in his celebrated speech at the Cooper's-hill College. The *Native Opinion* is only afraid of one thing. It thinks that the natives will, no doubt, get high places under the arrangement, but they will get them only through favour, not by right, as the European covenanted civilians do. The right way of obtaining these honourable appointments is only through the Civil Service examinations. But by reducing the limit of the qualifying age of the candidates from 21 to 19 years, the Secretary of State for India has closed this straightforward path to the natives of this country. Those natives who will get high posts through favour of the great authorities, will not act with as independent a spirit as incumbents of those posts ought to act. So if Lord Salisbury will get the Civil Service examination held in India for Indian candidates, as they are held in England for the English, he will confer a much solider benefit on this country than by admitting its natives to high posts through only favour and recommendations.

Dnyán Prakásh (3) of the 4th September devotes a long leader to the notice of Mr. William Wordsworth's able and scholarly letter to the editor of the *Bombay Gazette*, on the Fuller controversy. This controversy, says the *Dnyán Prakásh*, has served to bring to light the sentiments of the different classes of Englishmen regarding the relation between the two races. Many Englishmen consider it as their right to cuff and kick their native servants, and talk of many silly and wicked things. But it is a matter for much consolation and joy to find that there are also other Englishmen who love and honour justice and truth, and openly advocate these virtues. Mr. Wordsworth's letter is a very rare specimen of very great and stern impartiality and philosophical liberality of thought both in politics and religion, and does great honour to his head and heart.

The *Sâdharani*, of the 9th July, on the "Causes of the Dissatisfaction of the Natives"—The increasing dissatisfaction towards the British Government is, by many, supposed to be due to the spread of English education, and the wide circulation of newspapers. This may be true to some extent; but it is not the whole truth; for the unhappy feeling was in existence long before, and was steadily increasing, at the time the Honourable Mr. F. Shore, the then Judge of Furrukabad, published, in 1837, his "Notes on Indian Affairs." That the native press alone is responsible for creating and fostering this discontent is a charge which is dictated solely by the malice of the Anglo-Indians. Mr. Shore clearly points out that the corruption of the Sahibs and the vicious system of British administration had then produced extreme dissatisfaction in the minds of the natives. The faults noticed by him fifty years ago have at the present day assumed formidable dimensions. It is, however, needless to refer to them here. We proceed to others.

1. The inordinate self-conceit of the Sahibs. No matter whether it is the raw assistant magistrate, biting his nails, while his sheristadar explains him a petition, or the retired Governor, addressing empty benches in Parliament at a late hour, the same feeling is noticeable in almost all of them; the Governor only

became conspicuous because he was in possession of great power. Otherwise, with the exception of Mr. Skrine and a few others, the large majority are of this description. Pride of one's own race may be overlooked; but in a foreigner, possessing a different creed, and who belongs to the conquering race, it is never forgotten.

2. The sahibs, perhaps to keep up their dignity, consider themselves a totally distinct people from the natives. It is a common saying, that "Frequent intercourse alone makes friends." With the natives, the sahib holds no intercourse. One may go to him every week and make his *salaams*, but he will not return your visits. There can never be true intimacy under these circumstances; and where there is no intimacy, though not an entire severance of relation, differences will gradually arise.

3. This alienation accounts for the almost utter ignorance, on the part of Europeans, of the manners, customs, and religion of the natives. They are as ignorant in these respects now as they were fifty years ago; with this difference, however, that the Europeans of the present day have learnt a few book words of our language. What wonder that we should be dissatisfied, when all our weal and woe is entrusted in the hands of men who cannot comprehend our real feelings? On reading the article of the *Hindu Patriot*, on the Mahesh Car, Sir W. Herschel is said to have remarked, "I am sorry for what I have done." He may be pardoned; but the Government, which enabled him to act so arbitrarily, does not escape unpopularity. Would it not be better to rule that, "in dealing with the manners, customs, or the religion of the native subjects, the English magistrates should always consult some competent native officers?" Or is it that Government is not willing to remove the dissatisfaction of the people?

4. Whatever faults may disfigure the British character, the chief defect is a party-spirit, which becomes more striking when contrasted with the rule of the Mohammedans, who never carried it to such an extent; and though there was no toleration under some of the Mogul Emperors, still there was not, as now, such an intense display of race partiality. Their feeling has warped their sense of justice, which is administered in one way to the British and in another to the native. What became of Mr. Levien; and what of Surendranath? What of MacGarth of Allahabad; and what of Koylash Mahanta of Cassim Bazar? The black and the white are tried by different judges and in different ways. Then, again, in the matter of punishment. A native of India works at the oil-mill, while there is "penal servitude" for a white man. An English soldier, fighting for the good of his own people, draws Rs. 16 a month; while a poor native, who is every moment ready to give his life for another, is allowed only half the sum. He remains on that pay for ever, while his European brother-in-arms meets with rapid promotion. While a miserable hut, in the midst of out-lying marshes, is assigned to the native sepoy for his residence, a thousand square feet, in a two-storied barrack at Berhampore, is placed at the disposal of each European soldier. There are fever hospitals for the sick; but while a European patient lies at his ease on the third story, on a clean bed, under the punkha, the unlucky native languishes on the first floor on his miserable charpoy, and lives on rice, the food most wanting in nutrition.

The deputy magistrates and the subordinate judges work themselves to death, but have no credit given them; while the magistrate or the judge, whose time is taken up in hunting excursions and decreeing appeals, enjoys twice or even thrice the pay of the former; and will not such a state of things breed discontent?

5. As a consequence of this selfish policy of the rulers, India is impoverished. She has no power. The native princes are effete; while industry and commerce are ruined by British competition. This is a fruitful source of popular discontent.

6. The British Government has destroyed the respect and honour hitherto enjoyed by the respectable middle classes of the Hindoo society. A common constable now arrests a respectable zemindar. Such a state of things would have been impossible if the doors of the Civil Service were open to educated natives of respectable parentage.

7. Justice is sold, and denied to the poor. The expenses of litigation are heavy. What with the stamp fees and the pleaders' fees, and the peons' fees, and numerous other items of expense, a suitor is ruined. Justice is also tardily administered.

8. Government is fond of constant and needless changes. Popular and worthy officers are causelessly transferred from one station to another. Thus it has been with Mr. Skrine, the able Magistrate of Chooadanga. Government will only reap curses as the result of transferring this officer.

3rd. Under the head of "The Queen's New Title and the Delhi Assemblage," none of the native papers, so far as I have examined them, have raised any objection to the translation of the title of Empress of India by *Kaisar-i-Hind*.

The *Oudh Akhbār* of 30th August says that India is ringing with joy at the welcome news of the assumption of the title of Empress of India by her Majesty. It is confidently hoped that prosperity will now spread over the whole country. The administration of the country has hitherto been conducted on such intricate and strange principles as were not only unintelligible to the people, but quite opposed to their thoughts and habits; and hence the necessary consequence has been that measures designed to advance their own good have been ignorantly ascribed by them to the interested motives of Government, and popular complaints have not been unfrequent. The English Government adopted this line of conduct towards its Indian subjects in pursuance of the usual policy of a conquering nation in its early dealings with the conquered. The rights of the conquered people are not fully recognised till their ability and loyalty have been subjected to a strict ordeal. The British policy in India has been no exception to the rule. As the children of the soil proceeded to give stronger proofs of their attachment to the Government, their foreign rulers admitted them to the advantages of their just and benevolent rule. They have received better treatment since her Majesty assumed the reins of the Government of India than fell to their lot under the East India Company. The Queen has only consulted their good in making an addition to her titles, which was further warranted by the enormous extent of India, and the splendour and magnificence of her feudatory chiefs in no way inferior to those of kings. Strong hopes are entertained in every quarter that after the termination of the proclaimed durbar at Delhi nothing will will be wanting on the part of the Government to gratify the native mind in every way; every cause of complaint that at present exists shall be removed. If the condition of the native population is not ameliorated on the present occasion, they must be supposed to be doomed to distress for ever.

The people of England have long cherished three sanguine wishes—(1) The person to whom the government of this country is entrusted by England should assume the title of *Shahanshah*, and at the same time make it his permanent abode. They would thus be enabled to represent their just claims without difficulty, and would be saved the trouble and expense of going to England in search of their advantage. The control of the English Parliament also, whose complicated way of working is quite mysterious to the native, would also be done away with. (2) The English officers of Government should also permanently settle down in the country, so that the wide gulf that separates them from their subjects may be bridged over, and intimate familiarity and sympathy firmly established between the two. (3) The natives should be nominated to posts of trust and responsibility. The assumption of the new title by her Majesty has been the first step in this direction. The feudatory chiefs of India, distinguished for their devoted loyalty to the British Crown, may now clap their hands with joy. They will now be exalted in rank, and their treaties with the supreme power will be weeded of their strict stipulations and conditions. The common people should also not be neglected on this occasion. They should also partake of the bread and fish of the Government, and be generously dwelt with in every way.

The *Shola-i-Túr*, of 29th August, says that it is unable to understand the stir that is at present made in every quarter for the welfare of India. Is it the real world, it says, that it appears to walk in, or do its ears and eyes deceive it? Wherever it turns, nothing but good news for India greet its ears. See Lord Lytton's resolution on the Fuller case, Mr. Justice Turner's wholesome speech to a recent Allahabad jury, the jealous exertions of his Royal Highness the Prince of Wales in behalf of this country on his return home, and the favourable remarks of wise and learned Englishmen, as Professor Monier Williams, &c. Above all we must mention the recent proclamation of his Excellency the Viceroy to hold a grand durbar at Delhi in honour of the assumption of the new title by her Majesty. The editor, after indulging in the high hopes entertained by the people at large from the growing interest taken in Indian affairs by her Majesty, as unequivocally manifested by the addition of the new title, remarks that the contemplated nomination of natives to the Civil Service, and other measures to improve the material and moral condition of India, are no doubt good as far as they go; but their benefits fail to reach the mass of people at large. In no way will their distresses be mitigated by elevating few scores of their fellow-countrymen to lucrative posts. What they look forward to is some tangible good which they have been accustomed to value from time immemorial. Abolish some of the taxes, diminish the rate of land revenue, do away with some of the obstacles to admission into the public service, and they will be gratified and will be ready to die for their Empress.

The *Akhbár Anjuman Hind* of 15th April, writes:—"God be praised that this important matter has been settled. It has given much joy, but the people of India will only have real joy after all the essential matters dependent upon the title have been settled. We hope to see from telegrams what powers have been vested in the Empress of Hindustan, and to what extent India will benefit. If in the eyes of all European rulers of this country the honour of natives is thereby increased, and they receive employment of every nature unconditional on a knowledge of English; also if the Government demand upon land is reduced somewhat, and justice and free land tenures are given to the learned, to dervishes, poets, physicians, and penmen, &c., then the people of India will have as much joy as the Mohammedans enjoyed during the reign of the Mogul emperors, and the Hindoos during the reign of rájahs. At any rate there will be some satisfaction in knowing that the title of our sovereign has been changed, and that it has been restricted to our country."

The *Akhbár-i-Am* of 19th April, writes:—"We wondered much at one time why Englishmen objected to the Queen assuming the title of Empress, for how could it possibly harm them? But now we understand perfectly well that they do not like her Majesty to be styled Empress of Hindustan; they are jealous. The country formerly belonged to Englishmen, now the Queen has stepped in and taken it over, and in future her name will appear in all regal documents. England objects to the audacity of India wishing to be styled a separate empire, and her queen to become ours also. We wonder how such jealous people can sit in Parliament and benefit India. If we were to do as Englismen do, we would soon be disloyal to her Majesty."

The *Vakil-i-Hindustan*, 25th March, 1876:—"Mr. Disraeli, the Prime Minister, said in Parliament that her Majesty would get the title 'Empress of Hindustan.' This is such cheering news, that all the joy of the natives would not be ample enough, and the glory of the Queen on receiving the title would be insufficient. We natives are delighted that the Queen should receive a title from our country, which is now the most honoured of all her colonies. This honour will be the boast of our people. We are sorry that Mr. Gladstone objected to this title, but as his objections were unfounded and weak, they were not admitted. We hope that the Prime Minister's proposals will not be checked by such objections. Mr. Gladstone says that if the Queen receives this title it will affect the status of native princes. We consider no change of native titles necessary. It would have been necessary if our princes were not honoured as those of other countries. The Queen has a right to this title, and it ought to be conferred upon her. Since the Nawab of Haidarabad, Maharaja of Baroda, and the Maharaja of Mysore, &c., receive royal salutes, is it advisable to object to the proposal, even were it to affect the status of native princes? It would be well if by the change their titles were affected. We are exceedingly delighted and obliged to the Prime Minister. We exhort all our native contemporaries to join in thanking Mr. Disraeli.

"It is proposed to confer the title of 'King of Delhi on the Prince of Wales."

This is very frequent.

The *Oudh Akhbár*, of March 31st, writes:—"The *Hindu Prakásh* says, as her Majesty is about to assume the title of Empress, it is proper that the titles of the chieftains of India should be raised. If this is not done, the policy which prompts this transaction will not be prosperous. English ministers are bound to reflect upon this matter."

The *Rohilkhand Akhbár*, 29th March, 1876:—"Certain wags say that 'indigestion is the result of excessive learning;' and this appears to apply to certain Englishmen. Those who have accustomed themselves to much talking, by constantly discussing and arguing, of necessity discourse so much on a subject that both hearers and speakers are disgusted. Now, was a title such an important matter as to form the subject of a discussion? Poor Queen Victoria must be thinking that she needlessly put this matter before Parliament, and that these people have pulled to pieces that excellent suggestion by discussing this trifling matter to such an extent. In truth, what glory is there in that title, if she receive it now? What, alas! was not the Queen fit for and entitled to the rank of Empress, that so much endless talk was brought up? But this is the rule with Englishmen, that they make a pole out of a skewer. In Europe, petty kings are styled emperors. The King of India was also thus styled. Then why is it that the Queen, who owns India and England—two empires—is not considered fit to be styled Empress? What are we to call this except insanity? If it is that the titles of Indian noblemen are to be raised—and this prevents the title of Empress being conferred—then we say, first give her Majesty the title, and we will see about the poor natives hereafter."

The *Najm-ul-Akhbár* of March 24th quotes from the *Spectator*, that Englishmen in England will never style her Majesty "Empress," and adds the marginal remark,—"Sir, why do you lie?"

The *Koh-i-Nur* of 11th March, 1876, writes:—"Her Majesty the Queen will do honour to the title of Empress by affixing it to her name on the 24th of next May. This day will give birth to the said title, and then may be seen the fortunate stars of many honoured people acquiring prosperity and glory, and increasing twofold the light of that bright day by their refulgence."

The same paper of March 18th writes:—"When the Sovereign of England is in reality Empress of India, what harm can any one see in conferring this title?"

The *Sayad-ul-Akhbár* of 20th March, 1876:—"The scent of independence perfumes the title of Empress."

The *Marwar Gazette* of March 13th notices without comment a telegram to the effect that "Mr. Gladstone had said that by changing her title the dignity of independent Indian chieftains would be affected."

The *Sadarsha* has the following article (in English):—"The direct Government of India was transferred to the Crown on 1st November, 1858, by a statue passed on 2nd August of that year; but on that occasion no formal addition was made to the style and titles of the Sovereign of the United Kingdom. From the date of this transfer her Gracious Majesty has been popularly styled the Empress of India; but this title does not rest on any legal basis. A happy thought has now struck Mr. Disraeli, who, it is well known, entertains the view that England is now an Asiatic Power; and she is undoubtedly the greatest of Asiatic Powers. It appears to us that no better title can be chosen than that of 'Empress of India,' which has been popularly applied to her Gracious Majesty since the assumption of the direct government of this country by the Crown. It will be in the recollection of our readers that while Dr. George Smith was editor of the *Friend of India* he raised this important question, which was then thoroughly discussed. If we remember aright, the title of 'Padishah' was the best that was suggested; and it was also shown that there could be no objection to the assumption of that title by a female sovereign. Mr. Lowe and Mr. Forster, from their places in the House of Commons, have objected to the title of 'Empress,' on the ground that it is despotic. We cannot admit the force of this objection. The Government of India is doubtless a despotism, although it is a despotism of a mild type. Some of our contemporaries have expressed apprehensions that the assumption of the title of 'Empress of India' by the Sovereign of the United Kingdom means a change in the policy of governing this country. We for one do not share in these apprehensions. The principles of Indian administration have been clearly and unmistakably laid down in the proclamation issued on the 1st of November, 1858, and any addition to the title and style of the sovereign cannot make any alteration in those principles. The addition of a title is merely a matter of form. Even without any formal legislation on the subject, her Gracious Majesty is popularly termed the 'Empress of India;' and what Mr. Disraeli proposes to do is nothing more than to place it on the basis of a legislative enactment. It is for those who object to the title of 'Empress' to suggest a better one. We believe they will not succeed in doing so. Let Mr. Lowe and Mr. Forster carefully consider the nature of Indian rule, and they will then see reasons to withdraw the objection advanced by them. The Government of India is a despotism, although our rulers are, to a certain extent and on some occasions, influenced by public opinion. The wishes, feelings, and wants of the teeming millions of this country are not always consulted in determining the measure to be adopted. In fact, there is no obligation on the part of our rulers to do so. Very often they carry out measures without the slightest regard to the wishes and views of the native community. The Bombay Revenue Jurisdiction Bill, now pending before the Legislative Council, shows what we mean. The whole country has unanimously declared its opinion against the Bill, and still the Government is resolved to proceed with it. The people are not consulted in the matter of taxation. The Government decides what contributions they shall make to the public exchequer, and how the money so raised is to be spent. The two principles which are the very back-bone of a constitutional Government, viz., that the people shall not be taxed except with their consent, and that they shall determine how the money raised by taxation shall be applied—are wholly unknown in this country. The people may cry loudly against the imposition of income-tax or the repeal of the cotton duties, but Government does not listen to their cries. It carries out its own resolutions. The whole country may condemn the construction of costly palatial barracks, or of works of irrigation which will never earn enough to pay even their working expenditure, to say nothing of interest on the capital outlay; but who pays any heed to their representations? If the Government of India is not a despotism, we do not know what that word means. The fact that two or three natives sit in the Supreme and local Legislative Councils does not alter the despotic character of the Indian rule. The presence of these members does not signify anything. It does not prevent the Government from having its own way. The views of the Executive Government are always carried out by the official majority. Now, do Mr. Lowe and Mr. Forster contend that the Government of India is conducted on constitutional principles? We are surprised that two such able Liberal statesmen should have displayed so much ignorance as to the actual nature of British rule in India. The Government of India may be a mild despotism—a benevolent despotism; but, nevertheless, it is a despotism. If so, what better new title could be chosen for her Gracious Majesty than that of "Empress of India?" As we have already said, it is for those who object to this title to suggest a better and a less objectionable one; but we have no hesitation in saying that they will fail to do so. Without any legislative enactment on the subject, the Queen has been always styled the 'Empress of India,' and the best thing that could be done is to adopt the title that has been approved by popular opinion."

The *Almorah Akhbár* of the 15th March says:—"The natives of India are asking each other whether India will derive any benefit from the visit of his Royal Highness the Prince of Wales or not." The editor says that in his estimation better days are again in store for Hindustan, and that the days are not far for India to become rich and populous like the countries of Europe. That if the Prince of Wales had not come out to India, he would never have had the opportunity of knowing that the respectable class of natives had no hand in the mutiny of 1857, but that it was the instigation of the lowest and meanest class of the natives, who got a bad name for the respectable class, who are suspected even up to this day; for an English paper writes that it is not good for Scindia to have so many regiments, and that the Europeans should keep a watchful eye on him. The editor concludes by saying that these are the very people who try their best to keep the British Government and native chiefs at enmity with each other, and are also jealous of the natives doing well and prospering. That if the Prince of Wales had not come out to India he would never have known what the natives feel from their hearts, and that it is gladdening to know that his Royal Highness the Prince of Wales has seen everything for himself, and will never forget the natives of India.

The *Oude Akbár*, of March 1st, 1876, writes that "all the newspapers are writing that Her Majesty the Queen ought to get the title of 'Sháh-in-Sháh of Hindustán,' and that it also occurs in the view taken by them, and that it has been a great mistake that this title was not conferred on her long ago, which every power in Europe should acknowledge, and the people of England should lose no time in circulating it." The editor concludes by saying "that when this title is conferred on Her Majesty the Queen, all her first-class ráis should also have conferred on them the title of Bádsháh."

The *Native Opinion* (2) of the 10th September has a long article, headed "The Imperial Assemblage at Delhi." "The approaching Darbár at Delhi," says the *Opinion*, "in honour of the new title which her Gracious

Majesty has been pleased to assume in connection with this country, and to which all the great officers of the Government and all the nobilities from the Himalayas to Cape Comorin will be invited, will be the grandest affair that has ever been witnessed in India. The English Government has enjoyed the virtual imperial power in this country for the last fifty years; but the supremacy, which was quietly enjoyed and exercised up to this time, is to be formally and publicly proclaimed to the world on the 1st January next. The thing is thoroughly natural, and as it ought to be. The 1st of January, of the year 1877, must be the happiest and proudest day to Englishmen, who, from the smallest beginning as common traders, have succeeded in rearing up a most powerful and imposing empire, and have become the supreme rulers in this, one of the oldest and largest countries in the world, by their prowess, sagacity, and wisdom. The natives also have very good reasons to rejoice on this memorable day. The English supremacy has conferred on India several most valuable blessings. We are indebted to it for the profound peace we now enjoy, and have been enjoying for so many years. Had it not been for the strong British Government, there would be anarchy and bloodshed from one end of the country to the other. We did not know the true art of government, and, therefore, were easily subjugated, first by the Mohammedans and then by the English. We are now learning that important art from our English rulers, and they are also generously and kindly teaching it to us. Wo love and respect the English rulers, because they govern us not only justly, but even generously, and wish to promote our welfare and prosperity. Every wise and patriotic native ought to join cordially with Englishmen in the joy of this great event. The writer then, in common with several other native papers, requests Government to augment this joy of the natives by commemorating this great and glorious event, by making some liberal concessions to the princes and people of this conntry. For instance, though the grasping annexation policy has been definitely abandoned, and the paramount Government sincerely wishes the permanence and prosperity of the feudal native States, yet the native princes suffer much annoyance, and are put to much painful anxiety from the high-handed and arbitrary conduct of the political officers entrusted with the supervision of their states. In order to remove this old complaint, a diet of the native princes and chiefs may be created, and to it all questions and disputes arising between them and the paramount power, or among themselves, may be referred for decision. Again, a sort of representative assembly like a parliament may also be established, which may not be invested with the supreme power in the State, as is the case in England, but may be well entrusted with certain powers, and which should be consulted by the executive Government in adopting great administrative measures. Again, that this great day may be made to live perpetually in tha grateful memory of the country, the old and unjustly annexed native States of Satara, Nagpore, and Oudh may be resuscitated, not in their old dimensions and powers, but in some humble forms, as mementoes of the great generosity and self-sacrificing love of justice of the great British power. The third suggestion of the *Opinion* is, that in inviting the native princes and chiefs to the great Darbâr at Delhi, no great pressure should be exercised on such of them as are unable to comply with the invitation, either from pecuniary difficulties, or from sickness or such other valid cause. The Government need not bo told that these Darbârs have of late occurred rather too frequently; and, considering the costliness of the trips, some princes and chiefs may be naturally unwilling to be again so soon put to a great expenditure. Almost all these suggestions have already appeared in the papers and also in these summaries. . . .

Tho *Arunodaya* (7), of the 14th January opens with a leader, "The New Title and India," in which the writer regrets that the recent *tamasha* at Delhi, for which such grand and great preparations were made, has passed off, but India has received no substantial benefit whatever, High-sounding but empty titles, medals, and banners, have been liberally bestowed. Certificates of honour have been given by hundreds or by thousands. But this is all empty bustle. It can do no good to anybody. What good can a title do to a man who has no means to support it? It can bring no food into his plate if he is hungry. If he be in want, he must forget his big title and submit to any work he can get to earn a livelihood. Our Sovereign has assumed a grander title, and we, as loyal and dutiful subjects, congratulated her, and made public rejoicings to celebrate the event. We have done our duty. But we may be permitted to ask most humbly and respectfully, What has our gracious Sovereign done for us on this auspicious occasion? Has anything been done to curb the insolence and high-handedness of the ruling race towards the subject races? Have any measures been adopted to enable the natives to regain their former commercial prosperity? Has Government abolished invidious race distinctions and recognised equality between the European and the native subjects? Many more questions of a similar nature may be asked; and they all can be answered only in the negative. We know we will be told that the good Empress has been gracious enough to confirm her old assurances given to us in 1858 in her great proclamation, and we must look upon this confirmation and renewal as a great boon. The *Arunodaya* reserves its remarks on this point to some future issue.

The *Indu Prakásh* (1) of the 1st January, in a leader, headed, "The Accomplishment of the Wish of England, and the Foundation of the Prosperity of India," referring to the great proclamation ceremony at Delhi, observes that this day Victoria, the great Queen of England, becomes the Empress of India, and the long-cherished wish of the English people has been completely fulfilled. What this wish was, can be gathered from an article which recently appeared in the London *Times.* The *Indu Prakásh* then gives, at some length, a substance of that article, and observes that, by the great and solemn ceremony of this day, the English power has attained its highest point in this country. The English Government has become formally what it was virtually for years together—the supreme or paramount power in the land. The political independence of native States, which was nominal, has even vanished. The *Indu Prakásh* hopes that this ebb will prove a beginning of the coming rise and prosperity of this old nation. Tho new honours and distinctions conferred on the great native princes will, it is hoped, not prove mere empty sounds, but will lead to some good result, beneficial to those on whom they have been bestowed as well as to the Empire. It is also fervently hoped that this great day will be the era from which the real unification of this vast empire, and its advance in all things which constitute progress, and the indissoluble and cordial union of England and India, will be dated by future historians. The *Nyaya Sindhu* (13), of the same date, also takes the same hopeful view of the event, and expresses the same prayer for the future prosperity of this great and ancient country

The *Indu Prakásh*, of Jan. 8 (1), the *Dnyan Prakásh* (2), and several other papers of this week are full of the notices of the great Delhi Darbâr and of the local darbârs in the different cities and zillah towns of this Presidency. They all express deep loyalty, and offer hearty congratulations to her Imperial Majesty on this great and memorable event. Many of them give the substance of the great and eloquent speech made by his Excellency the Viceroy on this occasion. The speech has given a general satisfaction, but has fallen somewhat short of the very great expectations which were formed by the native public, about the concessions which it was thought her Gracious Majesty would grant to her native subjects on this auspicious occasion. Several titles and honours were liberally bestowed, but nothing substantial has been vouchsafed. The writers, however, are sanguine and hope much good from the new régime by-and-bye.

The *Dnyan Prakásh* (3), of the 11th January, devotes a long leader to the notice of the gracious acceptance by his Excellency the Viceroy of the address sent to him, with permission, through a deputation by the Poona Sárwajanik Sabhá, and of that presented to him by the Native Press Association recently organised. The *Dnyan Prakásh* is extremely glad and grateful for the very kind and encouraging terms in which his Excellency spoke of the Sarwajanik Sabha and of the Native Press of India, and has thereby recognised the utility of these popular institutions both to the Government and the people, institutions which some evil-minded and envious officials thought it wise to misrepresent as seditious, disloyal, wicked, &c. But these false calumnies have been falsified by the recognition mentioned above. The Viceroy has, in recognising these useful institutions, acted not only generously but wisely also.

4th. Under the Eastern Question I include everything connected with our Indian foreign relations, from Constantinople to Pekin. The Mahratti and Guzerati press is generally silent on these questions, as having little interest for the exceedingly practical people of Western India. The Tamil and and Telegu press is absolutely ignorant of their existence—wrapt in the the oblivion of the deep content of the Madras Province. The Bengali press also seldom indulges in foreign politics. On the other hand, the Hindustani press throughout India, and especially in the North-West Provinces is always occupied with them. Rumours of the advance of Russia fill every paper.

The Eastern Question.

The *Oudh Akhbár* of 12th April, 1876, accounts for the belief of natives generally in the rumours of Russian advancement by the timidity of the British and the daring of the Russians, and cites a correspondent lately arrived from Giljhat;—"Rumours of Russian enterprise, and perseverance became rife, and Russian power was in high estimation. She wishes to remove British rule from Hindustan. British officers have been killed on the frontier, and the people of those parts were aware of it, believing that Government would avenge itself, but such did not take place and murderers roamed about freely. When troops have been sent to the frontier, the natives there have become convinced that the soldiers (British) so sent have gone unwillingly, and in fear, and have wished to return as soon as possible. Besides, when these frontier marauders have been punished, the infliction has been very light, and they have soon forgotten it. They say that the action of the British Government is the reverse of that of Russia. In truth the Russians are powerful, their Government is like unto thunder, and their approach unto a storm. When their forces advance they resemble an encircling cloud, and who dare oppose them?"

The *Benares Akhbár*, of the 10th February, considers the ruler of Cábul a worthless and useless fellow, who continues on his throne because England is against taking Persia and Afghanistán. Notwithstanding the enormities perpetrated in the Khyber Pass, England will not take the latter country for fear Cábul should join Russia and turn round upon her. The editor does not believe that the country will be ruled by any of the Afghán family after Shere Ali's death.

Several papers notice that while Europeans travelling in Central Asia have every obstruction thrown in their way by the Russians—Russian visitors to India have every facility for taking notes afforded them by the authorities.

The *Rahnuma-i-Hind*, of 14th March, sees its predictions fulfilled in the gradual advance of the Russians (upon India), and advocates prompt measures for the obstruction of Russian progress, and hails the expected reorganisation of the native army.

The *Koh-i-Nur*, of the 11th March, writes an exhaustive article on the safety enjoyed by visitors to India, and strongly advises the Government to demand the same rights and protection for his subjects who visit Cábul, Persia, and Turkey. The Government is asked to take example by the Russians who always demand an explanation from the oppressors of their subjects.

The *Albert Gazette* of 11th February says:—"Prince Sikandar Beg, a relative of the Amir of Cabul, who is now in London, and who was formerly in the service of Russia, uttered these unpropitious words at the meeting of the East Indian Association—viz., 'Anyone who has served in the Russian army, and knows what it is, believes that Russia will advance upon India sooner or later.' England ought to try and prevent Russian progress, otherwise when the Russians enter Afghanistan, India will at once be lost. Although what Sikandar Beg says may be true about Russia's coming into India, still the idea of India being lost on her entering Afghanistan is erroneous. Reflecting upon the ideas of natives, we fully believe that they do not prefer any government to that of England, on account of the independence, peace, and justice which they enjoy. Probably, if any such thing happens, the Mohammedans, inspired with religious fervour, will come forward to protect their country and maintain peace. To act in anticipation is wise, and it would be well for the British Government to appoint an agent to the frontier of India, and place no reliance upon Cabul: in fact, it is necessary to have an agent at Cabul."

The *Anand Lahori*, of the 30th June, writes that the rapid progress of the Russians in Central Asia has filled the minds of the well-wishers and lovers of English government with great anxiety. Two entirely opposite views are held by persons able to judge of political affairs on this point. There are men who assure Government that the Russians have no intention of taking India, and that there is no reason to be at all afraid. There is another party who advise Government not to put any faith in the fair speeches of Russia, and to be prepared beforehand for all contingencies. The editor considers the former party to be in error, and sides with the latter. The Russians may have no hostile inclinations at present, but they will have strong inducements to take India on extending their dominions to the frontier of Hindustán. The sight of means to do a thing, makes it often done even against our will. Instances are not wanting in history of conquests being made which were never anticipated. The English themselves came first to India as merchants, and never dreamt of acquiring the sovereignty of the country.

The editor suggests that the Government should be on the alert, and in order to check the advance of Russia should garrison Herat. It should lose no time in making warlike preparations for the maintenance of its power in Hindustán; and above all in striving to acquire the good will of its vast population.

A similar correspondent of the *Lohi-Mahfúz* of the 11th August, quoting a recent communication made by some one on the frontier to the Commander-in-Chief as his authority, writes that a Russian Ambassador lately came to the Amír of Cabul and made several tenders on on behalf of the Czar; that the Amír should enter into a friendly treaty with the Russian Emperor; that he should agree to the permanent residence of a Russian consul in Cabul; and that he should also expel the British Consul accredited to his court from his dominions. Moreover he should allow a free passage to Russian forces through his territories. The Amír is said to have ostensibly declined their proposals; but it is not known for certain if he has entered into any secret engagements.

The correspondent further reports that a bloody battle is likely to ensue between the Amír of Kâshgarh and the Russians on the confines of Yárkand.

The *Lawrence Gazette* of 15th August remarks that the Amír of Cabul stands at present in a very critical position. The Emperor of Russia requested him to consent to the residence of his agent at Cabul, and the Government of India also made some proposals to increase their influence at his court; but political considerations induced the Amír not to comply with the requests of either. The Amír is greatly indebted to the Government of India, inasmuch as the latter presented him once with a large quantity of arms, and give him annually the immense sum of 24 lakhs of rupees. It is this pecuniary aid which enables him to pay his forces regularly, and thus peace and order are maintained in his dominions. At the same time it is to his own interest that the English should strengthen their position in Cabul, because their presence would never fail to check the Russians from extending their encroachments.

On the Turkish question the *Rahbar-i-Hind* of the 11th November expresses its deep regret and astonishment at the circumstance that no European power has yet thought of taking Russia to account for her gross misconduct. She is always intriguing to provoke quarrels and disturbances, her secret object being to establish her authority over the whole world. It is high time that the European powers should join together to curb her ambition and cripple her strength. This bold measure will solve the so-called complicated Eastern question once for all. If Russia persists in working on the religious feelings of the Christian powers of Europe, and the latter continue to yield to her evil influence, Turkey will be obliged to have the question of her miseries and misfortunes decided permanently. Weak as Turkey is, her national strength is yet unimpaired. It must be borne in mind that the Sultan is regarded as the Khalifa and protector of the great Mussulman sanctuaries—Mecca and Medina. If he despair of aid from the Christian powers, he will naturally feel inclined to appeal to all the Mussulmans in the world, and there will be nothing to prevent them responding to his call. In the event of an outbreak of war with Russia, it may be strongly hoped that England and France will espouse the cause of Turkey. Russia has been openly assisting the refractory tributary states of Turkey with men and money, and therefore, properly speaking, the Turks have been hitherto fighting not with the Servians but with the Russians. If the Christians will patiently consider the late proceedings, they will at once be convinced that the real guilty party who should be held responsible for the late war is Russia, not Turkey. The war owed its origin simply to the instigation of Russia, and its evils have afflicted not Turkey alone but Servia and Bulgaria as well, so that the Christians must condemn Russia as their enemy, and punish her accordingly. Russia is never tired of scheming for her own aggrandisement, whether by fair or unfair means. Her policy is always directed by self-interest. There is no doubt that she will ultimately try to seize the Christian powers also.

The *Anjuman-i-Paunjab* of the 10th November says that Russia has cherished implacable enmity towards Turkey for centuries past, but everyone knows with what success. The Russians would not hesitate for one moment to devour the Turks raw if they could. It is obviously impossible for Russia to wrest the dominions of Turkey from the Turks. But, supposing that Russia succeeds in effecting the conquest of Turkey, it behoves us to consider how this revolution would tell upon the interests of Europe in general and of England in particular. The immediate result will be that the supremacy of the Mediterranean will be transferred from the hands of the English and the Turks to the Russians, and the possession of a strong navy will greatly augment the power and influence of Russia in Europe. Russians will be enabled to become the rivals of Englishmen in all Asiatic trade and commerce. The monopoly of commerce which England has so long enjoyed will thus come to an end. The insatiable desire of Russia for the extension of her dominions can only be explained on the supposition of her greediness for money, which nothing but commerce can gratify. Russia has already begun to play the same game in Central Asia that England did in India from the time of Furrakhsiyar to that of Shah Alam II. She has opened trading factories at several places in Central Asia, and strictly prohibited all foreign merchants from carrying on trade in that quarter. No one can deny that the present prosperity, affluence, and power of England have all sprung up from her extensive commerce. It is not easy to fancy how she will be able to sit with her hands folded when a rival country threatens to injure the means which have raised her to her present elevated position. It is too much to expect of the Russians that, after the conquest of Turkey, they will resist the overwhelming temptation of entering into competition with the English in commerce. The maintenance of peace in Europe, and specially the English interests, demand the avoidance of hostile outbreak between Russia and Turkey. It is very creditable to Turkey that, in spite of her poverty and the frequent changes in her administration, she has been able to put down the insurrections of her refractory subjects and tributary states. The ministers of England are fully acquainted with the ultimate designs of Russia, and the editor trusts that they will never allow Russian intrigues to succeed.

The *Oudh Akhbâr* of the 10th September says that the rebellion of the five subject Christian states against their liege lord, the Sultan of Turkey, is commonly attributed to the oppression and tyranny of the latter. This may be said to apply with greater or less force to all countries and all times; but, in reality, it is Russia that has stimulated the revolt. It is beyond the shadow of a doubt that Russia cherishes an implacable enmity towards Turkey and England alike, whether it be from motives of jealousy or covetousness. A Russian general is the commander of the insurgent Christian forces, and Russian volunteers are also lending their aid. This may be owing to national or religious prejudices, but it is quite opposed to the accepted principles of international law. But Russia, under the influence of malicious notions, pays no heed to all this. How fearlessly she broke the Black Sea Treaty the other day! Her inward wishes concentrate in this, that England should abandon her alliance with the Ottoman Empire, so that she may be enabled to swallow Turkey as a morsel of bread. The Crimean War having failed to serve her evil purpose, she has resorted to the makeshift of fomenting internal commotions in Turkey; but, on account of the timely interference of England there is again no better success in store for Russia. It is time that England should call upon Russia to render an explanation of its gross violation of international law. No power at present is justified in assisting the rebellious subjects of another power on mere national or religious considerations. Had this been thought a sufficient cause for interference in foreign affairs, China, Nipal, Burma, and Assam would have boldly extended their support to the Hindu section of the mutineers in 1857, and the Mohammeden mutineers would have received aid from Persia, Turkey, Cabul, &c. Now that Russia has openly come forward to the aid of the Christian insurgents, England should also stick to her alliance with Turkey. If England falls off at this critical moment, it will be thought weak and pusillanimous. The time has not yet come that she should actually take up arms on behalf of her ally, and enter the field against Russia. It will suffice for the present if she makes known to the Indian

Mussulmans that they are at liberty to render pecuniary aid to Turkey if they please, and that by so doing they will not displease their Government. The editor then proceeds to exhort them to assist their co-religionists, with whom they are connected by several ties, in their present distressed circumstances, according to their means.

The *Shubha Suchak* of the 5th January, but received on the 7th, has a long leader, headed, "The Secret Plan, and the Time for Verifying the Promises given by Her Majesty to the Natives." The writer begins by alluding to the grave situation of the Eastern question, and its bearing on the British Indian Empire. It is the connection between England and India which renders the Turkish question so very vitally important to both these countries. Singly, neither England nor India could have much interest as to who rules Turkey, the Sultan or the Czar. But as England wishes to keep her Indian possessions, and as India wishes the continuation of the British rule, which has done so much for her, and from the continuation of which she expects a great deal more, both these countries are very much interested in the proper settlement of the above question. The continuation of the rule of the Sultan in Turkey appears to the *Shubha Suchak* extremely difficult, if not impossible; and if Russia succeeds in absorbing Turkey, the event must be a source of great anxiety to the British statesmen. Russia is an aggressive power. Though possessed of very extensive territories, her greed for conquering and adding to her already very vast dominions new kingdoms and countries appears to be insatiable. Her recent conquests in Central Asia prove the above assertion. Her Asiatic frontier is not very far from Cabul. No doubt the Czar repeatedly disclaims any design on British India, and points out the impracticability of such an enterprise on his part. But his past conduct shows us the value of his disclaimers. How are we to reconcile his aggressive successive conquests in Central Asia with his professed moderation? If any occasion comes, continues the writer, the people of India are ready and willing to help their Empress in the defence of her Indian Empire. They think it their duty and privilege to render such help to their good sovereign. But, unfortunately, the British Indian authorities think it wisdom to render her Imperial Majesty's native subjects as unfit as possible to render this help. They have disarmed the country. They exclude the natives from all the higher appointments in the army, and thus check any development of martial virtues in them, and the nation is being emasculated. The sad result is to be attributed to the ungenerous and selfish suspicion of the English authorities. No honest Englishman can deny that the natives possess martial talents; for England is mainly indebted to her native army for establishing and extending ther Indian Empire. The fact is universally admitted. It is acknowledged by the English historians of British India, as well as by several eminent English statesmen. The claims of respectable and competent natives to high posts in the army and the civil service have been repeatedly admitted by the great authorities both in England and India; but, unfortunately, the admission is not yet carried into practice. The present time, when her gracious Majesty assumes the title of the Empress of India, is the most appropriate occasion for fulfilling this old and often-repeated promise to the people of this country, and for showing the natives that their good and great Empress makes no distinction between them and her British subjects, but is ready to reward loyalty and merit in both alike.

The *Native Opinion* (2) of the 7th January, in an article, headed "The Settlement of the Turkish Question, involving the Question of the Greatness of the Mussulman and of the English Nations," referring to the present grave situation of the Eastern difficulty observes that though nothing positive can yet be predicted, still it appears very probable that Russia will gain her long-cherished object, and add European Turkey to her already too vast dominions. And if this success be achieved, it would render Russia the greatest power in the world. It would immensely add to her commerce and wealth, and produce a great change in the political state of Europe. This will also determine the future greatness ond power of the Mohammedan and English nations. The writer in the *Native Opinion* does not think it possible for Turkey to cope with success with Russia. Nor is it likely that other Mohammedan nations will give any material help to Turkey in her crisis. The days of the Mohammedan glory have passed. The Mohammedan nations have been hopelessly enervated by luxury and indulgence. The religion of the Prophet, which once filled its followers with an indomitable energy and courage, and led them to the conquest of the greater part of the civilised world, has ceased to produce that great result. The Mohammedans are now hardly able to retain the little power they possess among the nations of the earth. They are losing it fast. Russia has conquered the greater part of Mohammedan Asia, and is increasing her influence on the remaining powers, namely, Persia, Cabul, Kasgar, and even China. The English are extending and increasing their influence in Egypt, Abyssinia, and other parts of Africa. The only important Mohammedan kingdom that exists at present is that of Turkey; and when that is conquered by Russia, the Mohammedan power will disappear from the earth. The fate of Turkey is sealed; and the only question now is whether the Turks will submit to this fate as helpless creatures, or fall as brave men. The people of India are not much concerned in the fate of Turkey. But they cannot afford to be equally indifferent to an indirect issue of this great struggle between Turkey and Russia. The downfall of Turkey will injuriously affect the fame of the English nation. This makes India deeply interested in the issue of this struggle. The English ministers, only a few days ago, pledged themselves to maintain the integrity and independence of Turkey, and told the world that England is prepared to maintain this pledge even by force of arms. And the same English ministers advise the Sultan to submit to the proposals of the European powers—proposals which destroy the integrity and independence of Turkey—and use threats to induce Turkey to submit. This conduct of England is too unbecoming, censurable, and mean to be sufficiently condemned. The conduct fully verifies the insolent prediction of the Russian paper, the *Golos*. All this does not redound to the credit of the great English nation.

The *Rajah-i-Am* concludes, "Should there be war, the spectacle will be magnificent; but as long as Hindustan is disunited, no profit can thereby accrue to it." And the *Akbar-i-Am*, alluding to the occurrence at Debra Ismail Khan, of a dog having pined away and died, in consequence of a sheep which had been its companion being killed, regrets, in view of possible contingencies, that this feeling of mutual sympathy does not inspire the natives of India.

There can be no mistake indeed as to the interest really felt by the Indian Mohammedans in the fate of the Sultan of Turkey. They accept him as the Caliph, and it is quite beside the point to argue that there is no canonical authority for it. The last of the Abbassides was the last of the canonical Caliphs; but on the fall of Bagdad, A.D. 1258, a pretender to the lineage of Abbas fled to Egypt, and was there proclaimed Caliph, and he and his successors were accepted as Caliphs by the Mamelukes and the Sultans of Brusa. But the Arabs would never accept them, nor would they ever accept the Turkish Sultans, who from Selim the First succeeded to the false Caliphate, that is, not until the last few months, since these troubles of Turkey began. In fact, the spiritual pretensions of the Sultans were lost sight of while Turkey was a growing and prosperous worldly power, and it is only since the dissolution of the Imperial Ottoman dominion of the Turks has become imminent, since 1856, that the spiritual theory of their office has been revived, with almost universal acceptance, until now at last the tribes of Irak Arabi have sent in their submission to the present Sultan as Caliph, and I am told that the Shias of Persia—in face of the common danger of Islam—are doing the same. It is quite true, also, that there is little solidarity amongst the Indian Mohammedans. But the spread of English education, and, still more rapidly, of English ideas, is fast breaking down all those barriers of ignorance, and selfishness, and of race and religious hatreds which separate between man and man in a semi-civilised and imperfectly educated condition of society. An intense excitement has been recently observed amongst the Mohammedans in the north-west, and a few weeks ago two large cases full of Enfield caps, with a copy of the Koran on the top of each case, were seized at the Jhelum railway station, where the discovery was made only through the accident of the wagon in which they were packed having caught fire. In such a state of things, the daily prayer offered up in every mosque in India for the peace and prosperity of the Sultan, by his proper name, as the Asylum of Islam, and the Guardian of the Holy Places of Mecca and Medina, cannot be, or will scarcely long remain, an empty form. The Sultans of Turkey are but pretenders to the Caliphate, but their pretension may yet shake the world from the Danube to the Ganges in a last "war for religion," and final overthrow of Islam. The Hindoo generally is a social being, simply, but every Mohammedan in India is an active political force. Sir Richard Temple and Sir W. Muir understand the Mohammedans of India better than any living Indian statesman, and Sir W. Muir has very recently, at Edinburgh, expressed his opinion as to the sympathy of the Indian Mohammedans with the Turks. The following is Sir Richard Temple's opinion of them:—"Not more fiercely does the tiger hunger for his prey than does the Mussulman fanatic throughout India thirst for the blood of the white infidel. . . . There is no use disguising a fact which is inevitable." This is the sort of mined ground on which we stand in Mohammedan India, and trains are laid to it in every direction from Cabul and Bobhara, and from Mecca and Constantinople.

It has been said that the petitions sent to this country from India on behalf of the Sultan are spurious, because no native could write such good English. I do not see what the language in which the petitions are written has to do with their being the genuine expressions of native feeling. But the fact is, that educated natives, and certainly the native University graduates of Bombay, can very generally speak and write English almost as freely as Englishmen, and very often more grammatically, and with greater literary ability and tact. It is in fact laughable to me that anyone should have suggested that these petitions were written by Englishmen because "no native could write such good English." Few Englishmen could speak, and still fewer write, so well as the late Dr. Bhau Daji, of Bombay. Whatever he said or wrote was done with the ease of all natural effort, and always sparkling with the play of sentiment and literary allusion. He was never taken by surprise, and always had full command of himself, of his arguments, of his words, and his temper. He would in fact have made a thoroughly acceptable Parliamentary debater. Not many Englishmen could write with greater simplicity and clearness of expression and argument than one of the present native members of the Bombay Legislative Council. I only know of one Englishman, a distinguished naturalist, who can express himself with such self-evident accuracy. One of the most distinguished of the native University graduates is a perfect master of the style of "a slashing leader writer." I constantly receive letters from native gentlemen, and even those written by gentlemen who have picked up their English practically, and not at school or college, seldom trip in grammar, while their freshness and go, and sort of Pepysian comicality, is all their own; as might be expected of men, the natural vigour of whose generous souls has not been self-consumed in book learning, and competitive examinations, and overflows in those acts of noble munificence for the good of others, for which the native merchants of Bombay—to whom "Young Bombay" owes so much—have always been notable. One of the best of these merchants of the "Old Bombay" type, and the first to set the example of that public spirit which has renewed the city of Bombay in a generation, knew, indeed, but little English beyond our celebrated "God-damn." If such native gentlemen still—as was always done before English was publicly taught in Bombay, thirty and forty years ago—call in any English friend to help them with their petitions, it is as we, in similar cases, seek the help of some lawyer, or experienced adviser, or ready writer, and not necessarily because they cannot write perfectly good English themselves. And I need scarcely say that in India a good Englishman is everywhere a rallying point for all natives—a true "helper of men." Indeed, a sympathetic English barrister, or solicitor, soon comes to possess the greatest and most intimate influence in native society, reminding one of the relations of a Roman lawyer [patron] to his clients, "*cunctis janua patebat.*" These petitions were, no doubt, submitted to some English friend "for correction or approval;" but, even if so, they are not for that a whit less genuine and spontaneous acts, and certainly they might very well have been written by any of the learned Mohammedans of Bombay, one of whom acted, on a recent occasion, as the special correspondent of a leading London newspaper. The extracts which I have read from the Anglo-vernacular newspapers of India are of themselves a complete refutation of this objection.

The extracts prove most painfully the serious discontent of the native educated classes in India with their position—and their numbers, and their discontent are every year increasing; and although of little consequence at present, it may at some future time call for the attention of the Government. The evil would not be materially abated even were every appointment under the Government of India thrown open to natives, for the appointments would not suffice for more than a fraction of the competitors for them. The evil may cure itself in time—for India is growing rich, and the means of livelihood for the educated will assuredly grow up with its wealth.

But the bitterest complaining of the native press is of the exclusiveness and discourtesy of Englishmen towards natives; and here the remedy is entirely in the hands of individual Englishmen. It is very true that the inveterate caste prejudices of the natives themselves are highy provocative by the coldness and social exclusiveness of which they complain. In a learned and scholarly translation of one of our standard histories of India, the word "English" wherever it occurs in the original, is rendered in the translation by a native word which signifies "the defiled," and in a sense which the English word is far too weak to express. A distinguished native statesman, whose family has been honoured for generations by our Government, and who himself owes everything to his sound English education, has been known to speak of us when alone amongst his countrymen by a word or rather phrase, which means "the low caste fellows," the fact being that we are ethnologically the only pure-blooded Brahmins in India. But it is only the imperfectly cultivated who could resent such solecisms. *Noblesse oblige*, and in India we have to overcome evil with good. We have, everyone of us, great opportunities for promoting good fellowship with our native fellow subjects of all classes. Not at all by conforming to native ways. We should always, in all things, strictly uphold our English-hood; not in any spirit of race exclusiveness, but because our manners and habits are the practical expression of the truths which quicken our lives, and are, in fact, far more efficacious for religious teaching in India than what is taught in controversial mission schools and mission books. It is not possible for many of our Government officers, and our chaplains, priests, and ministers, and missionaries of all sects, on the pay they receive, to exert all the influence in India of which they are each one capable; and I only wish that rich and cultivated Englishmen would go out and settle in India as missionaries, of any sect they please—provided they go to set forth their doctrine by their works, which can be read of all men, rather than by words, which are often hard to be understood by any of us. Such a missionary's house should be a model of English refinement and amenity. It should be a museum of the natural history and productions of the district, and in the garden should be grown every plant belonging to the neighbourhood. It should be at all times open to every one, and, however bored, the missionary house master should never fail in patient listening to every one, and never leave a stone unturned to help the helpless. He should be the confidant of all local discontent, gradually transmuting it, by his helpfulness and his counsel, into loyalty. He should dig wells, and plant roads, and build leper hospitals and schools. And if we only had a few score such missionaries in India, each one would be worth a company of European troops to the Government. But we are every one of us, small and great, missionaries in India. The Government of India is not a great system of statecraft simply, but essentially a religion, the highest expression which Englishmen can give to the convictions and aspirations which animate the national civilisation; and each of us, in his ordered place, serves the end to which our whole administration in India is surely and irresistibly moving.

Principal Bombay papers and their circulation.

	Names of Newspapers.	Place of Publication.	Edition.	Number of copies issued.
	Anglo-Marathi.			
1.	The Indu Prakásh	Bombay	Weekly	1,200
*2.	,, Native Opinion	Do.	Do.	400
3.	,, Dnyán Prakásh	Poona	Bi-weekly	700
4.	,, Suryodaya	Tanna	Weekly	375
*5.	,, Maharastra Mitra	Satara	Do.	250
6.	,, Bodha Sudhakar	Do.	Do.	275
7.	,, Dnyan Chakshu	Poona	Do.	1,000
8.	,, Dnyanodaya	Bombay	Do.	325
	Marathi.			
9.	,, Arunodaya	Tanna	Weekly	410
10.	,, Jagàn Mitra	Ratnagiri	Do.	175
11.	,, Belgaum Samachar	Belgaum	Do.	300
12.	,, Wartaman Dipika	Bombay	Do.	200
13.	,, Nyaya Sindhu	Ahmednagar	Do.	185
14.	,, Shubha Suchak	Satara	Do.	85
*15.	,, Parashu	Jamkhindi	Do.	50
*16.	,, Kalpataru	Sholapur	Do.	150
17.	,, Khandesh Waibhaw	Dhulia	Do.	125
18.	,, Satya Sadan	Alibag	Do.	400
*19.	,, Nasik Writt	Nasik	Do.	100
20.	,, Hitechchhu	Kaladgi	Do.	125
21.	,, Dnyan Bodhak	Dharwar	Do.	175
22.	,, Satya Shodhak	Ratnagiri	Do.	150
23.	,, Hindu Punch	Tanna	Do.	340
24	,, Subodha Patrika	Bombay	Do.	1,600
25.	,, Dharwar Writt	Dharwar	Do.	350
26.	,, Nagar Samachar	Ahmednagar	Do.	200
27.	,, Shiwaji	Poona	Do.	200
28.	,, Kashta Wilasini	Do.	Do.	125
29.	,, Swadesh Mitra	Bombay	Daily	500
30.	,, Sanmarga Darshak	Mudhol	Weekly	120
31.	,, Dnyan Sagar	Kolhapur	Do.	125
32.	,, Pandhari Writt	Pandharpur	Do.	150
33.	,, Kartnatak Wartika	Belgaum	Do.	150
34.	,, Malwan Samachar	Malwan	Do.	210
*35.	,, A'rya Warta	Dhulia	Do.	100
36.	,, Hubli Waibhaw	Hubli	Do.	75
37.	,, Hindu Mitra	Bombay	Daily	150
	Anglo-Guzarati.			
38.	,, Guzerat Mitra	Surat	Weekly	400
*39.	,, Surya Prakash	Do.	Do.	200
40.	,, Hitechchhu	Ahmedabad	Do.	450
	Guzarati.			
41.	,, Bombay Samachar	Bombay	Daily	700
42.	,, Jame Jamsed	Do.	Do.	525
43.	,, Akhbare Sowdagar	Do.	Do.	615
44.	,, Rast Goftar	Do.	Weekly	1,550
45.	,, Parsi Punch	Do.	Do.	225
46.	,, Yajdan Parast	Do.	Do.	500
47.	,, A'rya Mitra	Do.	Do.	250
48.	,, Deshi Mitra	Surat	Do.	900
49.	,, Sind Samachar	Kurrachee	Do.	50
50	,, Samsher Bahadur	Ahmedabad	Do.	200
51.	,, Ahmedabad Samachar	Do.	Do.	60
52	,, Kira Wartaman	Kaira	Do.	153
53	,, Kattwar Samachar	Rajkot	Do.	45
54	,, Broach Wartaman	Broach	Do.	50
55	,, Niti Prakash	Kaira	Do.	115
56	,, Duniadad	Nadiad	Do.	125
57	,, Panch Dand	Bombay	Do.	700
58	,, Adal Insaf	Mahudha	Do.	51
59	,, Satya Mitra	Bombay	Do.	400
60	,, Datardum	Do.	Do.	1,000
	Hindustani.			
61	,, Kushful Akhbar	Bombay	Do.	175
	Persian.			
62	,, Mofurrahul Kolub	Kurrachee	Do.	300

The proprietors of the newspapers marked * have not given information as to the number of copies issued. In these cases an estimate has been made.

Principal Newspapers of North-West Provinces, Oudh, and Central Provinces.

Names of Newspapers.	Language.	Locality.
1. Lam-i-Nur	Urdu	Jaunpur.
2. Taj-ul-Akhbar	,,	Lucknow.
3. Maksud-ul-Akhbar	,,	Gurgaon.
4. Mufid-i-Am	,,	Agra.
5. Lauh-i-Mahfuz	,,	Moradabad.
6. Atalik-i-Hind	,,	Lahore.
7. Anjuman Akhbar	,,	Shahjahanpur.
8. Karnamah	,,	Lucknow.
9. Dabdaba-i-Sikandri	,,	Rampur.
10. Lawrence Gazette	,,	Meerut.
11. Shola-i-Tur	,,	Cawnpore.
12. Rohilkhand Akhbar	,,	Moradabad.
13. Agra Akhbar	,,	Agra.
14. Anwar-ul-Akhbar	,,	Lucknow.
15. Akmal-ul-Akhbar	,,	Dehli.
16. Gwalior Gazette	Urdu and Hindi	Gwaloir.
17. Patiala Akhbar	Urdu	Patiala.
18. Matla i-Nur	,,	Cawnpore.
19. Mangal Samachar	,,	Beswan.
20. Roznamcha	,,	Lucknow.
21. Vidya Vilas	,,	Jammu.
22. Sadik-ul-Akhbar	,,	Behawalpur.
23. Naf ul-Azim	Arabic	Lahore.
24. Nasim-i-Jaunpur	Urdu	Jaunpur.
25. Urdu Akhbar	,,	Dehli.
26. Najm-ul-Akhbar	,,	Meerut.
27. Nur Afshan	,,	Ludhiana.
28. Oudh Akhbar	,,	Lucknow.
29. Nur-ul-Anwar	,,	Cawnpore.
30. Urdu Delhi Gazette	,,	Agra
31. Hadi-i-Hakikat	,,	Lahore.
32. Saiyid-ul-Akhbar	,,	Dehli.
33. Marwar Gazette	Urdu and Hindi	Jodhpur.
34. Muhibb-i-Hind	Urdu	Meerut.
35. Vakil-i-Hindustan	,,	Amritsar.
36. Akhbar-i-Am	,,	Lahore.
37. Malwa Akhbar	Marathi	Indaur.
38. Benares Akhbar	Hindi	Benares.
39. Akhbar-i-Alam	Urdu	Meerut.
40. Jalwa-i-Tur	,,	,,
41. Khair Khwah-i-Alam	,,	Dehli.
42. Safir-i-Hind	,,	,,
43. Tahzib-ul-Akhlaq	,,	Aligarh.
44. Aligarh Institute Gazette	Urdu & English	,,
45. Meerut Gazette	Urdu	Meerut.
46. Asar-ul-Amsar	,,	Lucknow.
47. Khair Khwah-i-Panjab	,,	Gujranwala.
48. Rifah-i-Am	,,	Sialkot.
49. Mayo Memorial Gazette	,,	Dehli.
50. Hindu Prakash	,,	Amritsar.
51. Koh-i-Nur	,,	Lahore.
52. Kurshid-i-Jahantab	,,	Agra.
53. Maksud-ui-Akhbar	,,	Gurgaon.
54. Rajputana Social Science Congress Gazette	,,	Jaipur.
55. Akhbar-i-Anjuman-i-Panjab	,,	Lahore.
56. Panjabi Akhbar	,,	,,
57. Akhbar-i-Anjuman-i-Hind	,,	Lucknow.
58. Atalik-i-Hind	,,	Lahore.
59. Muir Gazette	,,	Meerut.
60. Vritt Dhara	Marathi	Dhar.

Principal Madras Newspapers.

English.

Native Public Opinion.

Tamil.

Amirtavasani.
Dinavartamani.
Vettrikodiyon.
Sathyavartamani.

Telegu.

Vivekavarthani.
Andhrabhasha Sanjivani.
Brahmanda Ranjani.
Lokaranjani.
Sudhi Ranjani.
Purusharthapradayini.

Malayalam.

Paschima Taraka.

Hindustani.

Shams-ul-Akhbar.
Tilism-i-Heirat.
Mazhar-ul-Akhbar.
Shahi Omdat-ul-Akhbar.
Mirat-ul-Ara.
Safir-i-Madras.
Sayyid-ul-Akbar.

Principal Bengal Newspapers, and their Circulation.

1. Burdwan Pracharika	
2. Bhárat Shramjibi	650
3. Bishwa Suhrid	450
4. Hindu Patriot (English)	
5. Rungpore Dik Prakash	
6. Dacca Prakash	400
7. Hindu Ranjika	
8. Amrita Bazaar Patrika	2,217
9. Bharat Mihir	650
10. Education Gazette	1,168
11. Moorshedabad Prathinidi	
12. Moorshedabad Patrika	
13. Pratikar	235
14. Somaj Darpan	460
15. Grambarta Prakashika	200
16. Hindu Hitoishini	300
17. Howrah Hitarkari	300
18. Sadharani	516
19. Soma Prakash	700
20. Sulabha Samarchar	3,000
21. Sambad Bhaskar	
22. Samarchar Chandrika	625
23. Sumbad Pralhakar	
24. Sambad Purnachandrodaya	
25. Behar Banhu (Hindi)	
26. Jam Jahan Numa (Persian)	250
27. Urdu Guide (Urdu)	400
28. Qazid (Urdu)	

DISCUSSION.

The Rev. Mr. Long said he had listened with deep attention to the very excellent account given of the native press in India. The population Dr. Birdwood had stated at 400,000,000, whereas the highest estimate had been 250,000,000.

Dr. Birdwood—British India.

Mr. Long would like to know which was the correct estimate. With regard to there being no restriction on the native press, he thought liberty was good to a certain extent; but liberty and license were not equivalent terms. A man was at perfect liberty to smoke a cigar along the streets, but it would not be allowed in the neighbourhood of a gunpowder magazine. The same rule necessarily applied to the liberty of the native press. As to the discussion in the native press relating to the Queen's title, the word Kaiser had nothing to do with the term Cæsar, or Czar, but was an old Assyrian word, which was found in such names as Beltashazzer, Nebuchadnezzar. He believed the first native newspaper was established in Bengal, under the auspices of Dr. Carey, in 1818, in the vernacular; and it was liberally encouraged by tho Government, who reduced the postage, allowing it to pass at one-fourth the usual rate. In the Marquis of Hastings' opinion, it was very important that the native press should be brought directly in contact with the Government. Shortly after that period, a crop of native newspapers had started up, and in which the stirring question was discussed of the abolition of the practice of widow burning. This led to a gentleman starting another paper defending the practice, opinions as to which had not even now entirely died out among natives. Numbers still looked upon it as the quickest road to heaven. Things thus went on with regard to the native press without any notice being taken till the time of the Indian Mutiny, when the mixture of the European with the native was as oil and water, and then the Government was aroused to the fact of its existence. Indications as to the existence of the feeling which led to the Indian Mutiny were then discovered, and if attention had sooner been drawn to the utterances of the native press, much valuable information on the subject would have been received. At that time he had an interview with Lord Canning, who said the Government knew the feeling of the native chiefs on the question of the mutiny, but what they desired to know was the feeling of the people on the subject. He (Mr. Long) said to his Lordship, he thought it was most important the Government should be fully acquainted with the views of the native press, by having reports of their contents made to the Government. Having said this to Lord Canning, he well remembered his Lordship taking out his pencil and saying "That is the very thing." He told Lord Canning that his suggestion had gone up to the Government a year ago, but his Lordship had never heard of it, and it was discovered it had been stopped by the Financial Secretary on the ground that it involved an expenditure of 300 rupees a month! The idea of a reportership of the native press was adopted then, but at present there was a hitch in the matter. The Government used to issue every week an account of the chief points in the native press, but this had been stopped; and Sir George Campbell in a pamphlet recently issued called "The Blue-books, and What is to Come Next," directed attention to this important question, and said, "A few years ago the native press in Bengal was a good deal excited, but then it was the converse of the things which we read now—it was not the Mohammedans vowing terrible things against us if we do not support the Turks, but the educated Hindoos, who were annoyed because we had done some things for the Mohammedans in the way of education, and otherwise which trenched on a monopoly of Government employment. Some very strong things were said in the native papers. It was the practice to cull the flowers of the native press in an English abstract for official and general information. In this one day appeared an article going beyond even the usual limits. We were held up to execration as favouring the Mohammedans, merely from fear of the assassin's knife which had lately been used; and we were told that if we followed such courses the Hindoos, whose ancestors had brought us in because they were dissatisfied with Mohammedan rule, would know how to turn us out, and to bring in our place the Russians, now rapidly advancing to contest India with us. I thought this rather strong, but I knew the difficulty of dealing with these things without more stringent measures than we were yet prepared for. The Viceroy had also noticed it, and called my attention to it. We made inquiries, and found that the paper from which this precious extract was taken, was a small lithographed sheet lately started by two plucked students of the Catholic University, and most insignificant. A solemn State prosecution of such people was impossible, and we were obliged to content ourselves with a private warning, and a resolve to give less publicity to such obscure prints in future. But such things go on." In his opinion there were two points to be observed with regard to the native press. In this day of hasty travelling, when India had become more and more the scene of our tourists, who often returned only to speak of Indian progress in a disparaging way, it was refreshing to examine the native press, and to find the great change in native opinion contrasted with 30 or 40 years ago. It supported the Government in all its leading views on moral and material improvements. With regard to their circulation, these papers represented the opinion of the middle classes and a certain number of the upper, but the ryots of Indian were not at all represented, nor was the condition of the agricultural classes.

Mr. Sen, having examined the newspapers of his own presidency, Bengal, thought they were more prone to express a kind of dissatisfaction than the Bombay and Madras people, and the reason was that Bengal had been under British government for more than 100 years. Education had made gigantic strides; great schools and colleges were founded, and when the students were sent out, after having passed in such difficult subjects as Sanskrit, mathematics, philosophy, &c., there were no places open for them. True there was the law, and it was the great ambition of Hindoos to be lawyers, but the field was so overrun that when they went to the court they could find little or no employment, and these people must write something against the Government. They had been brought up in schools which promised to support them, and when they were educated there was nothing to offer them. It was next to impossible for an Indian to become a district magistrate in competition with the Indian Civil servant educated here, and starting under different auspices. Their's was really one of the poorest countries in the world, and they could not afford to pay such large sums as were being required for the government of the country, and they would be bankrupt. People had said it was a rich country, but they would find it a very difficult question to deal with, to pay their debts, for the state of the peasantry was really very bad. One fact had struck him, that there was not that intimacy between the governors and the governed which there ought to be. Unless that were altered there would be no chance of reconciliation. They wanted to be friends with the English, but as long as they had in their hearts that burning feeling that they were the conquerors and the people the conquered, and not equal to them, reconciliation never could take place. Another great reason why the Hindoos and the English could not agree, was that there was not an equality of law. Five years ago the Criminal Law was passed, showing that if an Englishman was prosecuted for some crime he was never to be tried by a native magistrate. Another important matter was that the Anglo-Indian press were endeavouring to get the Government to stop the liberty which the native press enjoyed. Only the other day the Government was asked to pass a Bill to put a stop to what were called seditious articles, but if these articles were written in England they would have been termed quite mild.

Mr. Campbell, as an old resident in Bengal, and one who had had much to do with the press, had heard the paper with very great pleasure, and, in his opinion, there had never before been a paper on the native press so complete. He thought, however, Dr. Birdwood had travelled a little out of the round in discussing the Queen's title. He thought the animadversions on the demerits of the Indian press were utterly unjust. The advantages greatly counterbalanced any supposed disadvantage. A free press in India was an exotic, and at present its influence was exceedingly limited and superficial. The Government did not make the least attempt to influence it; in fact, they rather liked to hear things said against it. It was mostly loyal, and the Government reaped much benefit from it. When he was in India, the remarks of the Indian press were particularly attended to. He had seen many kinds of malpractice and maladministration brought to light by the native press. The officials were generally fairly treated. As to its tone, it must be remembered the writers were Oriental, and prone to use exaggerated rhetoric, and what to Western minds seemed the quintessence of disloyalty was no such thing, although it might appear so. Whence arose this vituperative style? From the local English press, which was very rabid, and no term of abuse was sufficient to paint us with. The native press grew up in this state of things. It took its lessons from, and its guide and exemplar was the local English press. Government might do much through the administrators of the country to influence the native press for good. When he was in Calcutta six years ago, he had an interview with one of the most rabid of the

Indian press alluded to by Dr. Birdwood. The man had come to him on some matter of business, and he took the opportunity of speaking to him about his paper, and showed him how much influence and power he lost by such writing; he took a number of the *Englishman*, and told him to read that. The difference to a native mind between such a paper and his own was simply homœopathic. In his opinion, the great and crying want of India at present was the want of a cheap vernacular paper, published under the supervision of the Government, circulated almost gratis, drawn up by some competent person, knowing the wishes of the Government, and explaining the object of the taxes, the means adopted for the improvement and elevation of the people, and discussing everything of importance and interest. Nothing would keep the natives of India *en rapport* with the governing classes better. And the head man of each village should be asked to circulate it. It would thus be a means of the very greatest good, and counterbalance any evil which might arise from the freedom of the press.

Mr. Caldwell said as Dr. Birdwood had alluded in his admirable paper to the letter he had addressed to the *Times*, he desired to say a few words. His experience was somewhat large on the subject, as some years ago he had been editor of the *Madras Athenæum* and *Daily News*, which was started in 1837. That was the earliest daily newspaper in India, and he thus came across a great many of the Indian papers. About a year after he returned to London, the *Indu Prakásh*, which meant "the bright effulgence of the moon," and circulated to the number of almost a thousand, had an article which stated we were not the paramount power in India, and he wrote a short letter calling attention to that. Dr. Birdwood had charged him with having indulged in sensationalism. To a certain extent it was, but he considered some restraint ought to be placed on such writing. There were two kinds of sensationalism and exaggeration—one minimising, and the other maximising. As far as we were concerned with India till the Prince of Wales's visit, we had been greatly given to minimising the facts as to India. We judged India too much from our own standpoints. In our school books we used to talk of 180 millions of population, then it become 280 millions, and now it was 400 millions, and this proved that we were now only gradually becoming acquainted with the country. Now amongst this enormous population there was only a very small press, circulating 100,000 copies a week altogether. But this did not represent the real influence which thus was permeating the people. Perhaps the largest circulation of any one was actually not more than 3,00, but each copy would be read by numbers, and, therefore, to judge of its influence and power, it must be taken side by side with the circle under which it was circulated and read. Most men in India did not read, but were read to. Take for instance the *Indu Prakásh.* One copy of that would represent far more in India than one copy of any paper in this country. It was taken to the Temple-tank and read at night by moonlight after the people came from their work. Every word of it was read as few papers were here. In 1857 the most potent newspaper in India was a very small paper indeed, with a very limited circulation indeed. He did not say exercise tyranny over the native press, but he did say its liberty had been very suddenly bought, and we ought to exercise a more scrutinising eye over it. That letter of his in the *Times* was written at the time of the Baroda trial, and he could well imagine the effect such a statement in a Mahratta paper that we were not the leading power was likely to have, and he asked why should such a subject be brought up at all? He did not mean to say that the press of India was disloyal as a whole. On the contrary, it was perfectly wonderful how loyal it was, but it was needful there should be very great care exercised over it. Mr. Long had alluded to the practice of Anglo-Indians having been informed what the native press in all parts of India contained, but that had been dropped. That was a matter of real importance. They must also remember the great difference there was between the Anglo-Indian and Native press. The Anglo-Indian editor criticised personally, but the Native press could not distinguish between doing that and seeing how far we go, but they began at once to talk about our not being the paramount power. If we criticised the action of the individual, they went much further. In conclusion, Mr. Caldwell alluded to Dr. Birdwood's observations on the translation of the Queen's title, which, as it stood now, was a masculine, not feminine title.

Mr. Freeland felt they were all much indebted to Dr. Birdwood for the highly interesting and exhaustive paper he had read on a most important subject. It was impossible for us in England to know much of the native press in India and its operations. The whole secret of the solution of the problem of the Government of a majority by a minority, lies to a very considerable extent in a careful study of the utterances of that majority, as shown in its native organs. He was very glad to find that the tone of the Indian press was loyal. They would all he trusted cordially echo the expression of the hope that the Anglo-Indian press would set them a good example in their writing. If we boasted of our superior civilisation, it was to the utterances of the Anglo-Indian press we must look as the exponents of that superior civilisation; and he hoped that the tone taken by the Native press in asking that employment might be opened up for these young men who were being educated to a higher degree, and were qualifying themselves for higher positions, would result in their participation of the government of the country to which they aspired. As to the views of Mohammedans, he knew from many letters he had received from Mohammedan gentlemen, that they had no sympathy with the abuses of the Turkish Government. They hated mis-government as much as we did. But what they felt sensitive about was the violent utterances made use of in this country, that the cure of mis-government in Turkey was to be sought in the expulsion from their homes of a large Mohammedan population. He did not say the speakers meant it, but that was tendency of their addresses, and he was informed it had produced considerable sensation in India. Dr. Birdwood had said that one of the bitterest complaints made by the native press was as to the bearing of Europeans towards the natives. The young men who went there should endeavour to consolidate the power of this country, not by any suggestion as to its military force, but by the example of high culture and general high personal bearing. The individual Englishman who went there should never think he went there as a mere unit, but remember that he was looked upon as a representative, as far as influence and example could represent it, of what was called the superior civilisation.

Mr. Fitzgerald asked Dr. Birdwood if he could inform them whether these native newspapers paid, because it seemed to him that they were conducted on a scale so small that it was quite impossible.

Dr. Birdwood replied that no paper under a circulation of 300 could possibly pay.

Mr. Hale thought anything like a restriction of the press would be unfair and injudicious. The press was the best mode of discussing the affairs of the nation, and letting the Government know what they thought ought to be done. The press of India ought to have every reasonable liberty. If the Government would take the pains to educate it, and get it into a proper channel, nothing need be feared from it. He said, give them all the freedom and advantage possible.

Mr. Hyde Clarke said they were deeply indebted to Dr. Birdwood for the valuable information he had given them on the subject of his paper, and especially wit regard to the different position of the Native and the English press in India. A distinction had well been drawn by Mr. Long with regard to the proper function of the press. Liberty of the press was one thing, and license was another. Many never drew a distinct line between liberty and license in a general view of the subject. But when you came practically, as governor of the country, to do so, you must arrive at some result, because it then became your business to apply the institutions of the country to the people to whom they were to be adapted, and it would be a very great mistake to suppose that they could establish a newspaper under tho same conditions in England, India, and South America. All your institutions must be adapted to the political education of the country for whom they were proposed. In this country it was by long experience, and centuries of liberty, that we had now the means of availing ourselves of an absolutely free press; but even as to that we were accustomed to the application of legal safeguards, which we, as members of the public, and which editors of papers were always familiar with. In India, as Dr. Birdwood had pointed out, they had two classes to deal with—one was the English press addressing itself to a certain extent to men who had been brought up in habits of political freedom; the other, the Native press, addressed to men at the present moment undergoing their political education, and it was of the utmost importance that the native press should exercise its functions under proper restrictions.

The Chairman said:—I think we must all feel that we have derived both information and instruction from the valuable paper read to us to-night by Dr. Birdwood. At any rate I can answer for myself to that effect, for I must acknowledge that hitherto my acquaintance with the state of the native press of India has chiefly, if not altogether , been derived from perusing from time to time the exracts from native newspapers which come before me in the course of my official life, and from studying the reviews that are published periodically by the French *literateur*, M. Garcin de Tassy; consequently I almost feel that I owe an apology to a meeting like this for taking the chair when such a subject is discussed. The deep interest I take in everything Indian must be my excuse. I confess that if I had been asked what I thought of the native press of India five minutes before eight o'clock to-night, I should not have given it so good a character as I should do at this moment, after hearing what my friend Dr. Birdwood has to say for it. It is possible, and very probable, that my attention has chiefly been drawn to extracts from those papers which are not given to saying smooth things of the Government of India. It is, of course, to be regretted that any paper which finds readers in India should be characterised by disloyalty, but I do not think that much harm can be done by papers whose circulation, as given by Dr. Birdwood, is so small. It may be that Government ought to deal with seditious writings, otherwise than by treating them with silent contempt. But I am disposed to agree with Mr. Campbell in thinking that the best way of teaching the people of India what is politically right and what is wrong, would be by the publication, under Government auspices, of a carefully-edited newspaper in the vernacular. I am not surprised that there has been some general discussion on Indian matters to night, for it must be admitted that our friend, Dr. Birdwood, in the course of his enthusiastic paper, has touched upon some burning subjects; such for instance, as the social position of the educated classes of the people of India in their intercourse with ourselves. When I look back to my early days in India—now, I am sorry to say, upwards of thirty years back—when, by-the-bye, you might have counted the native newspapers on your ten fingers, and then think of the state of education and literature in that country now, I see clearly that there has been a great awakening of the mind and intellect of the people throughout the length and breadth of the land in the interval. That education may progress more and more rapidly among them is my sincere wish. Indeed I think I may venture to say that the wish of us all is that the educated classes of the people of India may more and more be associated with Englishmen in official work as they advance in knowledge, and prove themselves to be deserving of confidence. I hope and believe that better days will come for those among them who are steadily and earnestly preparing themselves for public life.

Dr. Birdwood thanked the meeting, and in reply said that Mr. Caldwell in his remarks had not addressed himself to the points on which he spoke in his paper, a- to the letter to the *Times*. The circulation of the native press was not larger than he had stated, and he had never heard of the papers being used by such numbers as Mr. Caldwell had spoken of. The circulation was limited to the subscribers, and he believed he might say with truth that the readers were fewer than the subscribers; many of the papers were simply got up by one man who took the whole, and distributed them among his friends. It was mere romance to say they were read by moonlight, and at the Temple-tanks. Such was not his experience. He would not renew the discussion on the title of Kaiser-i-Hind, because he thought, on further consideration, he would omit altogether that portion of his paper when printed.

A vote of thanks to the Chairman concluded the proceedings.

SIXTEENTH ORDINARY MEETING.

Wednesday, March 21st, 1877, Lord Alfred S. Churchill, Chairman of Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Adam, Robert Smith, Leith.
Anderson, John Andrew, jun., J.P. (Mayor of Faversham), Hillside-house, Faversham, Kent.
Ashby, Henry T., 8, Bartholomew-road, N.W.
Barnett, Frederic, 4, Cambridge-gardens, Kilburn, N.W.
Birkbeck, George Henry, 34, Southampton-buildings, Chancery-lane, W.C., and Rock Ferry, Birkenhead.
Blenkinsop, William Edmund Brandford, 29, Royal-avenue, Chelsea, S.W.
Corfield, William Henry, M.A., M.D., 10, Bolton-row, Mayfair, W.
Couper, James, St. Rollox Chemical Works, Glasgow.
Darling, William Howarth, 126, Oxford-street, Manchester.
Hart, George Henry, 54, Wych-street, Strand, W.C.
Pagan, John, Wakefield.

The following candidates were balloted for, and duly elected members of the Society:—

Clark, Mrs., 24, Upper Woburn-place, Tavistock-square, W. C.
Farmer, John S., Kilburn-house, Kilburn, N.W.
Hall, Admiral Sir William, K.C.B., F.R.S., F.R.G.S., 48, Phillimore-gardens, W.
Hamilton, George, F.C.S., F.R.A.S., Queen's College, Liverpool.
Hart, James, 18 and 19, Fenchurch-street, E.C.
Isaacs, Lewis H., 3, Verulam-buildings, Gray's-inn, W.C.
McAlpin, Kenneth, Llanion-terrace, Pembroke Dock.
Mudie, John, Burton-on-Trent.
Niven, John, Osbourn-house, Clayton, near Bradford, Yorkshire.
Perrett, Edward, 23, Abingdon-street, Westminster, S.W.

A lecture was delivered on—

VITAL AIR.

By Benj. W. Richardson, M.D., LL.D., F.R.S.

Dr. Richardson commenced by stating that he took the term "vital air" from the words of the discoverer of it, the illustrious Joseph Priestley, who applied the words to indicate that part of the atmospheric sea, which is the great supporter of ordinary combustion and of animal heat and life. After the discovery of Priestley, the term "oxygen" had been applied to this gaseous substance, and by that name it was now familiarly known; but, for his present object, the lecturer thought that "vital air" was still the most distinctive expression, because he was going to treat of the gas, on the present occasion, simply in respect to its vital properties. He should conclude that his audience were all conversant with the primary facts relating to vital air; that it formed 20·90 parts of the atmosphere, mixed with 79·10 parts of nitrogen; that these two gases were mechanically commingled; that combustible bodies burned in the atmosphere, because of the presence in it of the diluted vital air; that animal bodies burned in it for the same reason; that many bodies combined with it without active combustion; and that through the processes of combustion and combination it entered into the construction of most of the solid substances which constitute the materials of the earth, organic and inorganic, living and dead.

In the present lecture Dr. Richardson undertook to consider the vital relationships of this gaseous body, or air, to the human organisation. For such purpose, he might conveniently divide his subject into three parts.

1. In the first part, he would, in a simple manner, follow vital air in its course through the body, and trace briefly the natural changes which took place under its influence during that course.
2. He would notice some of the modifications of function which occur from changes of conditions in the circumstances under which the air is received into the body, or in the vital air itself, or in the body.
3. In the third place, if time permitted, he would touch on the practical applications, to affairs of daily life, of the knowledge of the relationships which exist between vital air and animal function and health.

In treating on the first of these heads, the lecturer explained that the greater part of the vital air which enters the body is taken in by the lungs, in the act of inspiration in breathing. To illustrate this section he placed on the screen, by means of the oxy-hydrogen apparatus, a beautiful representation, after Jules Sarazin, of the lungs and heart in position. The full capacity of the lungs for air when they are inflated varies considerably in different individuals, but it has been computed that in an average adult man, in the prime of life, it is about 300 cubic inches. Under ordinary conditions, that is to say, without excessive inflation, the quantity of atmospheric air, viz., of vital air, and oxygen in the lungs, might be taken at 260 cubic inches. It has been computed, from measuring the quantities of air taken in at each inspiration, and given out at each expiration, under varying states, that a mean of 30 cubic inches may be accepted as a fair average of the volume of gases received and given off in each act of breathing. This would give as nearly as possible six and a quarter cubic inches of vital air taken in by the lungs at each inspiration. Of this a considerable part comes back in expiration; but about five per cent. (4·90) of it does not come back; it is replaced, however, by a rather smaller proportion (4·25 cubic inches) of a new gas, in which it is combined with carbon, viz., carbonic acid gas. The nitrogen with which the vital air is intermixed on entering the lungs returns practically unchanged. Thus the first step in respiration consists in the absorption by the lungs of close upon five cubic inches of vital air for every hundred cubic inches of common air breathed. It is important, next, to consider how this absorption is effected.

In illustration of this subject, Dr. Richardson placed on the screen a view of the interior of the lungs, showing the bronchial passages, commencing with the trachea, by which the air is primarily received, and having described these and the ciliary apparatus with which they are provided, he proceeded to delineate in the same manner the minuter structure of the pulmonary organs, namely, the lobules, the minute bronchial passages, and the ultimate termination of the bronchial surface in the air vesicles, the structures and characters of which minute bodies were also depicted on the screen.

From the bronchial surface of the respiratory organs, the lecturer passed to the pulmonary vascular surface. He showed, by the same means of demonstration, the course of the blood from the right side of the heart over the lungs, and the capillary system of vessels through which the blood is brought to play, in infinitely refined ramifications, over the minute air vesicles which had already been described, the minute receptacles of the vital air. Here the process of absorption of the vital air takes; the part of it which is lost in inspiration is given over from the vesicles into the blood, while from the blood which has been brought up from all parts of the body by the action of the right side of the heart, the carbonic acid, which appears in expiration, is diffused into the vesicles, replacing the vital air that has been absorbed. In this change the blood assumes a different colour and different qualities. It came up into the lungs of dark colour, and is called venous blood; it passes on in its course from the lungs after this red in colour, and is called arterial blood. The process of change occurring in respect to colour, was first clearly demonstrated by the distinguished philosopher Dr. Hooke.

From these illustrations the lecturer proceeded to discuss the question of the mode in which the vital air is condensed in the blood. He showed that the condensation takes place in the minute bodies called the red corpuscles. The character of these corpuscles, and their construction, he demonstrated from three specimen views, and described at some length the experiments which he and others had conducted, in order to discover how the vital air is condensed in them. He considered the subject advanced towards solution, although still incomplete, and proceeded by tracing the blood, charged with the vital air, through its arterial course, into the extreme or capillary system of vessels at the terminations of the arterial system. A view of the double circulation of the blood was given in representation of this part of the subject, and it was explained that in the capillary net-work of the general system, the vital air which is absorbed and fixed in the pulmonary respiratory capillaries is given up, and applied to the support of the animal combustion. Here the animal fire is kept up during life; here the vital air combines, in combustion, with carbon; here the carbonic acid is produced; here the corpuscles, which in the lung are the condensing agents of the vital air, become the condensing agents of the carbonic acid; here the venous blood takes its origin, the capillaries terminating alternately in the veins. The course of the blood through the veins to the right side of the heart was next traced, as well as its entrance into the lungs to receive a new supply of vital air. One or two simple experiments were now performed, to illustrate the change which vital air produces on venous blood. Into a glass vessel with a long stem of glass attached, shaped so as to resemble somewhat a large tobacco-pipe, a strong solution of soap was poured. Upon the soap was next poured a little venous blood, then through the stem of the pipe oxygen gas was driven from a bladder into the solution of soap; the soap was thereupon raised in the bowl of the glass in multitudes of small bubbles, the films of the bubbles carrying the blood with them. In this manner the soap bubbles became so many little cells containing vital air, while the blood represented the capillary current in the lung. The whole of the cellular structure in this way produced soon became brightly arterialised, contrasting remarkably with the lower layer of blood, which remained unchanged. This, Dr. Richardson said, was a very fair representation of a lobule of a lung, and its ultimate vesicular structure during inspiration. He explained that by more refined arrangement he could extract the air from these soap vesicles, and maintain an imitation of the respiratory process. He added that, in his opinion, the original construction of animal vesicular structure, and probably even of vessels, was by diffusion of gases through colloidal fluids in a similar manner.

Before leaving the subject of absorption and application of vital air in the body, one other matter of great importance had to be understood. The whole of the processes which had been explained were under the control of the nervous system, a compensating action by which supplies of blood for reception of vital air and for distribution of it were kept under what might be called automatic control. By another illustration on the screen the lecturer showed the two nervous systems of the body, the cerebrospinal system and the sympathetic or organic system of nerves. From the centres of the organic system nervous filaments accompany the arteries, and by the influence they exert on the muscular coats of the minute arteries, they regulate the supply of blood that is to be admitted into the capillary network. This arrangement applies to the pulmonary breathing circulation as well as to that of the general system, and the more elaborate the vascular system of organs, so, as a rule, is the accompanying nervous system. Two views on the screen were made to represent these facts; the one gave an illustration of the vascular supplies of the stomach, the other an illustration—from a photograph of an actual dissection by Rüdinger—of the nervous supply of the same organ.

The object of all these elaborate processes is the production of animal vital heat, which, as far as we know as yet, is the main spring of vital action, physically considered. How far this object is attained was indicated from an elaborate table by Lardner, in which was shown the total quantity of common air respired in twenty-four hours (450 cubic feet), the vital air contained in this, the vital air absorbed, the carbon consumed in the body, the carbonic air produced, and the heat developed by the combustion of the carbon. Some consideration of the mode of application of the force developed, and of the elimination of the products of combustion by the various processes of secretion and excretion, brought this part of the lecture to a close.

In considering the modifying influences which affect vital air in its application to the wants of life. Dr. Richardson showed that such modifications would be induced (*a*) by pressure of carbonic acid in the blood in excess; (*b*) by presence of vital air in excess; (*c*) by excessive chemical combination of vital air with carbon in the tissues; (*d*) by excess or deficiency of water in combination with the vital air; (*e*) by modification of condition of vital air itself, as when it is transformed into ozone; (*f*) by reduction of its active properties as a supporter of animal combustion; (*g*) by the presence in it, or in the blood, of certain foreign substances which interfere with its combining properties; (*h*) by derangement of the nervous compensating balance which regulates supply. A variety of illustrations were given of a practical kind bearing on these points, and the lecture was concluded with the observation that sanitary science and sanitary principles would never stand on a sound and satisfactory basis until these elementary truths were fully understood by the masses of the people.

MISCELLANEOUS.

THE NEW EDUCATION CODE.

In the House of Commons on Tuesday,

Viscount Sandon, in reply to Mr. Stopford Sackville, said:—"A few representations have been made to the Education Department objecting to the new Schedule in the Code respecting needlework, but, as was to be expected, they have principally come from towns, as the rural schools in many cases excel in needlework. My hon. friend will remember that while needlework has always been necessary in State-aided schools, we inserted in the Code for the first time two years ago a special money grant for it, if it was taught systematically, with a view to secure greater attention being paid to this important subject, and a very general approval of this provision was expressed on both sides of the House. We have been strongly urged by many of our best inspectors to lay down a schedule for needlework, and the present one has been prepared by ladies of practical experience in both town and country schools. We are quite prepared for some opposition to it on the part of a considerable number of teachers, as we are aware that the subject has in many cases been too much neglected. As it is the first time that a schedule has been made on this subject, we are anxious to have the advantage of knowing the opinions of experienced critics regarding it, and we have therefore arranged that the children should not be obliged to be taught in accordance with this schedule before March, 1878, in order that we may consider suggestions on the matter during the coming year, and, if necessary, make modifications or alterations in the schedule in the Code of 1878. I wish, however, to assure my hon. friend that we intend to do all we can to secure that this subject shall be thoroughly well taught in all our shools, as we believe that a thorough knowledge of plain needlework is more conducive to the welfare of the girls who must attend them, than an acquaintance with some of the more ambitious subjects which are sometimes urged upon us."

LOCAL SCHOOLS OF COOKERY.

The following correspondence has taken place between a gentleman who has a school of cookery in his parish, and a parishioner interested in the movement:—

"I do not see how cookery could be carried out in ordinary country schools, where, as much as managers can do, is to make both ends meet. To teach girls to cook you must have a proper grate—I do not mean a close range—that is, such a grate as is to be found in cottages. This is not generally the kind of grate found in schools. Secondly, you cannot teach cooking in the school itself, for the lesson in cookery would of course be given in the two hours of secular instruction. In many cases there is not a house attached to the school, and where there is I much question whether the teacher would give up the privacy of her house. Thirdly, the instructress is a great difficulty; most teachers's wives, or mistresses themselves, can cook after a fashion, but I much doubt their ability to teach cookery on system to children, even supposing place and material to be found them. Of course, if an additional room could be built on to schools, with a proper range or grate in it, or an adjacent cottage could be rented, difficulties would be removed." The answer of the promoter of cookery is to the following effect:—

"No doubt we are fortunate in being near London, and in having to do with a population intelligent in all its grades. But I fancy that all its difficulties could be overcome in less fortunate districts. As to the grate, one might be easily hired for a cost not exceeding £2, or an American stove might be used. As to a room, the teacher's house would often be available, and if not, a vestry-hall, reading-room (little used in the day-time), or even a widow's cottage might be hired for one or two days in the week. The chief difficulty is to get a teacher, but in time this difficulty might be overcome. Would not a temporary school of cookery answer one year (say) at Hereford, next in Worcester, &c.? I believe they could be made self-supporting, if furnished and freed from rent. Thus many teachers and pupil-teachers could learn, without going to Kensington. Then, again, all female students in training colleges might be required to take out a certificate in cooking, and grants might be made to Kensington and other schools of cookery for all teachers and pupil-teachers trained to pass an examination before an inspector (I should think about four special inspectors in this and kindred subjects would do the whole country by centres). Teachers of cooking can be manufactured more rapidly than is commonly supposed or (by ladies) admitted. Our first teacher began with us not two years ago in complete ignorance. She is now teacher of cooking with the London School Board, and was favourably mentioned in an article in the *Times* the other day." He adds, "Our expenses for the last year are under £13 (not including extra furniture). By a turn of the screw I am satisfied the kitchen could be made self-supporting, but here we need not do that. Besides our ordinary dinners we get great practice, without loss, on Bank holidays, for the workmen's club, and once a quarter for the youths' guild, the girls cooking for their fathers, brothers, and themselves. The sick, also, get their good help without cost to the kitchen."

"There is no question on which more enthusiasm may be raised. With some it proceeds from a love of good living, with others from a desire to cheer the lives and purify the tastes of those who spend day after day in a dreary round of monotonous (when in excess), debasing labour."

"There is no doubt that if the Education Department would recognise the instruction of teachers as a national work, local schools of cookery would soon be established throughout the kingdom. Private efforts have proved the necessity, but they are insufficient for national work."

CORRESPONDENCE.

MR. DANVERS' PAPER ON INDIAN RAILWAYS.

I agree mainly with Mr. Hyde Clarke's letter in the *Journal* of 23rd February. I should have been glad if we could have had an adjourned meeting on a subject so important, and which it was impossible properly to ventilate in a couple of hours. I have, so far, the advantage of Mr. Hyde Clarke, that I was able to say, personally, part of what I wanted to say; but we were all so desirous to hear Lord Northbrook, that I was unable to refer to one of the most important questions of all—the present position of "railway extension" in India; or, as unhappily we may nearly say, "the stop put on railway extension."

I dare say we shall agree with Lord Northbrook, that if the Indian railways could have been made by private capital, as English railways were, it would have been the best thing of all; but Lord Dalhousie saw, twenty years ago, and Lord Northbrook fully admits, that this was not possible, and the system of guaranteed railways was inaugurated, Lord Dalhousie stating, in his celebrated "Railway Minute" of 1853, that no other system was then practicable, as the Government could not make them themselves. I am sure we shall all also agree with Lord Northbrook, that "there was one matter which signified more than all, the soundness of Indian finance."

But the question arises, "Has not the Indian Government undertaken more than it can perform efficiently, and with sufficient promptitude, looking to the admitted value of railways, and generally of improved means of communication to a country like India?" It would be overstating the case to speak of the Government attempting to make these works entirely out of its surplus revenue, because we know that part of the proceeds of its loans has gone this way; but it is not, I think, overstating to say extensions are made mainly dependent on the state of its finances generally, and are now, have been before, and may be again, and yet again, complicated and impeded by these unhappy famines.

The "guarantee system" had much to be said in its favour, and it was well and fully said by Mr. W. P. Andrew, at one of our Society's meetings, on 11th May, 1870. Mr. Danvers' paper shows that under this, about 94 millions were spent on the railways now open, and that with all the disadvantages of want of experience, and the unusual expenses attendant on new and vast undertakings, there is reason to believe that the accounts for 1876 will show the general net revenue only half million short of the guaranteed interest, while several of the roads (notably the "East Indian") were already dividing with the Governments a surplus reserve. We may well say with Lord Northbrook, that "he did not think any one who had any knowledge of India could doubt that that was one of the most profitable investments that was ever made by a great nation."

But the old system is at an end, and a new one was commenced, and announced on 23rd July, 1869, by the Duke of Argyll in the House of Lords—the Government would now make the railroads themselves. I heard the Duke's speech; the weight justly attached to his opinion was supported by the advice of Lord Lawrence. The new system received the adhesion of Lord Salisbury from the front Opposition bench, and the thing was done. It was stated that it was contemplated to spend about three and a-half millions on an average of years (about half of what the companies had spent), but I fear it will be found that the actual result falls considerably short of even this half to the end of 1875. We might have expected to see 21 millions "spent," or rather "invested," and I think Mr. Danvers' annual report, June, 1876, shows the amount to be little over 12 millions. To my mind the wonder is that they have been able to do so much, and it is satisfactory to find Mr. Danvers stating in his paper (page 271) that in the case of the "Rajpootana" State Line, 400 miles had been nearly completed, and would be finished at a cost of three millions, or about £7,200 per mile, whilst it had earned in the half-year to 30th June, 1876, at the rate of 2·27 per cent., though only opened in 1875.

At present, there is very nearly a complete "block," and a stop to the extension from the strain on finances consequent on the famine, and the most praiseworthy determination of the Government before all things to save life. Just before going to Delhi, Lord Lytton, when in Bombay, was strongly urged by a deputation of the Chamber of Commerce to press on the works of the "Western Rajpootana" Line, a line of which the great commercial and political importance was—as Mr. Danvers tells us—recognised by Lord Dalhousie twenty years ago. It was urged that this line would itself, if it had been made, have lessened the effects of the famine in Rajpootana, and while fully admitting all this, and promising that no unnecessary delay should take place, the Viceroy could not say when the Government would be able to proceed with this important work. Take the case of another important railway, the "Northern of Bengal," connecting with the "Eastern of Bengal" line, &c., to go to Darjeeling; this line would be of great value to the rapidly growing tea-gardens of Darjeeling, would open up a "Sanatorium" to Calcutta, and would aid the development of a trade with Thibet, which we may fairly hope—after what Sir Rutherford Alcock said the other night—to see soon. In Mr. Danvers' report of June, 1876, it is said that it was expected to open this railroad in June, 1877, while we now learn that only about twenty-five miles are about to be opened, and for the remainder "no time can be named for its completion." Other cases of the same kind could be cited, but I will refer to one more only. By the last accounts, we learn that in the Madras Presidency the Government had authorised the commencement of the earthworks of a line of railway as "relief works," and were employing in this way the famished population; but, when the first part was finished, they could not say if the works could be gone on with.

Now, is there no way of improving on this state of things? Among his other merits, we all know that the present Secretary of State for India has the advantage of being a good "man of business." Witness his successful management as chairman of the "Great Eastern Railway." The Duke of Argyll commenced the system of the State-making railways. Cannot Lord Salisbury improve on this by coming forward, declaring that they shall be made where wanted, and made at once? Do what the Colonial Governments of South Australia and the Cape of Good Hope have done in London in the last month, and other Colonial Governments have done, and will do—open railway loans in London. Loans for the purpose of making railways, and for no other purpose. In the case of the two Governments I have named, the amounts they wanted were applied for three or four times over, and at prices above the minimum fixed; 97½ is paid for a 4 per cent. loan, and 102 for one of 4½ per cent. The credit of India stands at least as high as that of these two flourishing, but new colonies. A great Government cannot do what a railway company does—give its railway as security, so that debenture holders could take possession in case of defaulting, but tenders to the Indian Government for its railway loans, would know that, in addition to the general revenue of India, they would have the security of the railways which their money had made. "Prevention is better than cure." Railways would go far to mitigate, even if they cannot prevent, the effects of famines. We know what Lord Northbrook said of this; the Indian railways have increased, and will still further increase, the wealth and promote the prosperity of India, in different ways, and largely so by increasing the extent and value of its exports. When the question of their cost to the Indian Government is considered, let us ask how much has that Government lost lately by what it enters as "loss by exchange?" If exchange was down to 1s. 6d., and is now at 1s. 10d., nearly its normal state of late years, is it not the case that a large part of this recovery is attributable to the great increase in the exports of India, which we know of generally, above all in wheat and seeds, and which we shall know much more about when we see the returns of trade from 1875 to 1877, and how much have the railways done to aid this, and how much have they thus, indirectly, saved the Government.

William Maitland.

Oriental Club, March 7, 1877.

THE PATENTS FOR INVENTIONS BILL.

In your report of the meeting on the above subject, some discrepancies have occurred in the remarks I made when moving an amendment to the third resolution, and as I am made to say the very opposite of what I did say, I shall feel much obliged if you will kindly allow me space to correct the same.

According to your report I said:—"The granting of compulsory licenses was obstructing industry and progress, whereas the compulsory working was to compel the patentee to take definite active measures," &c. Instead of this I said:—"The compulsory granting of licenses is intended to prevent a patentee acting the dog in the manger, and thus obstructing industrial progress, whereas compulsory working is intended to compel the patentee to take undefined active measures, and just because these measures are undefined, the clause is liable to give a great deal of trouble, and cause much litigation."

Lewis Olrick, Memb. Inst. M.E.

27, Leadenhall-street, 21st March, 1877.

TRADE WITH CENTRAL ASIA.

In the most valuable paper by Mr. Douglas Forsyth, I notice that carpet weaving, as in many Turkish countries, is an industry of Turkestan.

Is cochineal supplied from India for this work? It is much esteemed in Turkey. H. C.

A special exhibition of arrangements and apparatus for heating and ventilation, under the management of the Committee of the Trade Museum of Cassel, Germany, will be opened on the 1st April, and will remain open till the end of August, 1877. The reception of objects began from the middle of February.

GENERAL NOTES.

South African International Exhibition.—The official catalogue of the British exhibits comprises particulars of all that has been transmitted from this country during the past few weeks, as well as what is now in course of transmission to Cape Town for exhibition there. The British exhibits, which are much more numerous than the contributions from France, Germany, Austria, Italy, Sweden, Belgium, and Switzerland, will occupy the greater portion of the main building. The comparative fewness of the Continental exhibits is no doubt due to the fact of the Cape being a British colony, as well as to the difficulty of organising within the short period between the announcement of the exhibition and its opening, a plan of action that would ensure a complete European representation. Collections of products from Natal, the Transvaal, and Griqualand, are to be exhibited in the main building, while in the grounds will be shown agricultural implements by British manufacturers, a full-size life-boat by Forrest and Sons, of Limehouse, and other interesting objects. The opening of the exhibition will take place immediately upon the arrival out of Sir Bartle Frere, the new Governor, who is now on his way to the Cape.

NOTICES.

PROCEEDINGS OF THE SOCIETY.

African Section.

Tuesday evenings, at 8 o'clock. The following arrangements have been made:—

March 27.—"The Best Trade Route to the Lake Regions of Central Africa," by Edward Hutchinson, Esq., Lay Secretary of the Church Missionary Society. The chair will be taken by Sir Samuel Baker, F.R.S.

April 10.—"The Social State and Prospects of the South African Communities," by Robert Richards, Esq., of Grahamstown.

April 24.—"The Trade and Resources of Morocco," by Dr. Arthur Leared.

Indian Section.

Friday evenings, at 8 o'clock. The following arrangements have been made:—

April 20.—"The Existing and Possible Commercial Communications between Persia and India," by Major-General Sir Frederick John Goldsmid, C.B., K.C.S.I.

May 4.—"Thaumato-dendra, or the Wonders of Trees," with illustrations from life, by Wm. Tayler, Esq.

Chemical Section.

Thursday evenings, at 8 o'clock. The following arrangements have been made:—

April 12.—"The Cinchona Alkaloids; their Sources, Production, and Use," by Dr. B. H. Paul.

April 19.—"Spontaneous Combustion in Factories and Ships," by C. W. Vincent, Esq., F.C.S.

April 26.—"Phosphor-Bronze and its Applications," by Alexander Dick, Esq.

May 10.—"A New Process for the Production of Carbonate and Caustic Soap, without the Formation of any Noxious Waste and the Recovery of the Sulphur," by George E. Davis, Esq.

Science Lectures.

These will be given on the following Wednesday evenings, in place of the usual paper and discussion. The rules for admission will be the same as for the Cantor Lectures. Each member can admit one friend by giving the usual order from the book supplied at the commencement of the Session:—

April 18.—E. J. Reed, Esq. C.B., M.P., F.R.S., "The Modifications which Ships of War have Undergone during the last 20 Years."

May 2.—J. Baillie Hamilton, Esq., "New Musical Instruments."

Cantor Lectures.

Monday evenings, at eight o'clock. Second Course, "On the Chemistry of the Manufacture of Coal Gas," by A. Vernon Harcourt, Esq., F.R.S.

Lecture IV.—March 26.

Principal constituents. Hydrogen, carbonic oxide, marsh gas, olefiant gas. Value for heating and for illumination. Luminous flames. Development of the illuminating power of coal gas. Burners. Gas compared with other illuminants. Different qualities of gas. Photometry. Standard burner. Unit of light.

Each member can admit one friend to these lectures. No special tickets are now required for the purpose; the tickets issued to members at the commencement of the session are available for the Cantor Lectures, as well as for the Ordinary and Sectional Meetings.

MEETINGS FOR THE ENSUING WEEK.

Mon. ...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. A. Vernon Harcourt, "The Chemistry of Gas Manufacture." (Lecture IV.)

Society of Engineers, 6, Westminster-chambers, 7½ p.m. Adjourned Discussion on Mr. J. Lucas' Paper, "Hydrogeology: One of the Developments of Modern Practical Geology."

Royal United Service Institution, Whitehall-yard, 8½ p.m. Captain Hamilton Geary, "The Combustion of Fuel in Steam Boilers."

Royal Geographical, University of London, Burlington-gardens, W., 8½ p.m. Captain Sir George S. Nares, "The Navigation of Smith Sound, as a Route towards the Pole."

Institute of Actuaries, The Quadrangle, King's College, W.C., 7 p.m.

Medical, 11, Chandos-street, W., 8.30 p.m.

London Institution, Finsbury-circus, E.C., 5 p.m. Mr. W. T. Thistleton-Dyer, "Plant-Growth and its Present Problems."

Tues. ..**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (African Section.) Mr. Edward Hutchinson, "The Best Trade Route to the Lake Regions of Central Africa."

Medical and Chirurgical, 53, Berners-street, Oxford street, W., 8½ p.m.

Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Mr. J. B. Redman, "The River Thames."

Anthropological Institute, 4, St. Martin's-place, W.C., 8 p.m. 1. Mr. Hodder M. Westropp, "A Kitchen Midden, near Ventnor, Isle of Wight." 2. Messrs. W. Power and E. Laws. "A Kitchen Midden Found in a Cave near Tenby, Pembrokeshire." 3. Dr. Crockley Clapham, "Brain-weight of Chinese and Pelew Islanders."

Wed....Working Mens' Club and Institute Union (at the House of the Society of Arts), 8 p.m.

Royal Society of Literature, 4, St. Martin's-place, W.C., 8 p.m.

Thur....Chemical, Burlington House, W., 8 p.m. Annual Meeting.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,271. Vol. XXV.

FRIDAY, MARCH 30, 1877.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

HEALTH AND SEWAGE OF TOWNS.

The Annual Conference on Health and Sewage of Towns will be held on the 3rd May next, the Right Hon. JAMES STANSFELD, M.P., in the chair.

PATENTS FOR INVENTIONS BILL.

On Friday last a deputation from the Society had an interview with the Attorney-General, to bring under his notice the resolutions passed at the recent Conference for the discussion of this Bill.[*] The deputation was composed of the following:—Major Beaumont, M.P. (Chairman of the Conference), A. Cassels, Lord Alfred Churchill (Chairman of the Council), E. A. Cowper, James Heywood, F.R.S., A. J. Mundella, M.P., J. Hinde Palmer, Q.C., H. Danby Seymour, W. Lloyd Wise, J. A. Youl, with P. Le Neve Foster, Secretary, and H. T. Wood, Assistant-Secretary.

The deputation was introduced by Major Beaumont, and a discussion of some length ensued, in which the various points aimed at in the resolutions were explained and commented on. The Attorney-General undertook to give the views brought before him his consideration, and added that it would be well for those interested in the adoption of the suggested amendments to impress them on individual members of Parliament.

RAILWAY LAMP COMPETITION.

COMMITTEE.

F. A. Abel, F.R.S.
A. Beattie.
A. Cassels.
Lord Alfred Churchill, *Chairman of Council.*
Major-Gen. Eardley-Wilmot, R.A., F.R.S.
Myles Fenton.
J. Tomlinson.

REPORT.

The Committee to whom this matter has been referred report as follows:—

1. The offer of the prize stands thus:—

"IMPROVED RAILWAY LAMP.

"The Society's Gold Medal, or Twenty Guineas, is offered for an improved Lamp or means of illumination, suitable for Railway Passenger Carriages, that shall produce a good, clear, steady, durable, and safe light.

"It must be simple in construction, and capable of being readily cleaned and repaired.

"In judging the merits, cost will be taken into consideration.

"The Council reserve to themselves the right of withholding the Medal or Premium offered, if, in the opinion of the Judges, none of the articles sent in competition are deserving of reward."

2. Twelve competitors sent in lamps for the consideration of the Committee; some were for mineral oil, some for vegetable oil, and some for gas.

3. Each competitor had the opportunity afforded him of explaining to the Committee the nature and action of his lamp. Certain lamps were at once excluded as not being suitable, and the remainder were placed in the hands of Professor Barff, to test them with regard to light afforded, amount and cost of material consumed, whether mineral or vegetable oil, or gas, regard being had, also, to the lasting powers of the lamp; through the courtesy of several of the principal railway companies, by loan of the lamps ordinarily in use on their lines, an opportunity was afforded of making comparative tests. The testing occupied two days.

4. After carefully examining the results, as reported by Professor Barff, the Committee came to the conclusion that none of the vegetable oil lamps submitted, except Silber's, competed satisfactorily with existing lamps, as furnished by the railway companies for experiment, in regard to light furnished, even with an increased and excessive consumption of oil, and great want of uniformity in illuminating power within short periods. They thereupon resolved that a practical trial be made of the mineral oil lamps of the Railway Lighting Company, one with a three-inch wick and the other with a two-inch wick, and, further, that the Silber oil and gas lamps and Pintsch's gas lamp be also practically tried, Mr. Tomlinson, of the Metropolitan Railway, having placed at the disposal of the Committee a carriage on the St. John's-wood branch of that line. The lamps having been duly fitted by the respective competitors, a trial was made, lasting nearly three hours. The result of the trial was as follows:—

Large Silber (vegetable oil)	Light strong, but a double glass was used.
Flat wick Silber, ditto	Wick holder too heavy; casting shadow.
Gas, Silber	Flame unsteady.
Railway Light Company, small (mineral oil)	Smoked, and when tended went out.
Do. large..........	Light good in corners, but deep shadow in middle of carriage.
Pintsch's gas	Somewhat less light, but the illumination was equally diffused, and quite sufficient to read small print in any part of the carriage.

5. The Committee came to the conclusion that the

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[*] See *Journal*, March 16, page 878.

light shown by the Silber lamp and the Railway Light Company's lamp is greatly superior to that of the existing oil lamps, but that Silber's lamp is not suitable for railway work, and the Light Company's lamp requires that delicate treatment needed by all mineral oil lamps which renders it unfit for railway work. With regard to Pintsch's gas system, the Committee reserved its final decision until they could have further practical trial of it and test its actual performance and cost, Mr. Tomlinson having informed the Committee that they would have an opportunity of so doing, as it was the intention of the directors of his line of railway to test the working over a period of some months, arrangements having been made for the erection of works for making the gas, and for attaching the lamps and apparatus to the carriages.

6. It appears that the gas is produced by a simple and not costly apparatus for distilling shale oil; it is then compressed to the extent of ten or twelve atmospheres and stored in metal cylinders. A supply sufficient for use during thirty or thirty-five hours is, as required, taken into light wrought-iron holders, at about six atmospheres pressure, fixed beneath the carriages. The cylinders are provided with an ingenious arrangement, by means of which the pressure is regulated and equalised, and the gas allowed to issue and supply the burners. The gas is burnt through a small fish-tail burner placed beneath and close to a convex reflecting surface, in which a small slot is made to admit of the passage of the heated air to the chimney.

7. The result of the trial made by the Metropolitan Railway Company, extending over a period of three weeks' working, shows that the gas can be produced at the rate of 16s. 5¾d. per 1,000 feet, and that the consumption per light per hour is 0·5983 of a cubic foot.

8. Coal gas for lighting, and not compressed, as in use at present on the Metropolitan and District Railway companies, costs only 3s. 9d. per 1,000 feet; but its consumption is, in round numbers, at the rate of 4 ft. per hour instead of ·6 ft.. That is to say, it takes 6,500 feet of coal gas to do the work which 1,000 feet of the Pintsch gas accomplish, at a cost of 24s. 4½d. for the former, as compared with 16s. 6d. for the latter. There is also, with Pintsch's lamps, a saving in the number of men employed, including those occupied in manufacturing the gas, and this may be taken in the proportion of five men in the one case as against eighteen in the other.

9. The Committee had before them evidence that carriages had run, and were still running, to Glasgow and back, with lamps having only one supply of gas. The Committee, in addition to the information thus collected by themselves, received from the manager of the Silesian Railway in Berlin strong testimony in favour of the Pintsch system, it having been in use throughout that line with great success for a very considerable period of time.

10. Under these circumstances, your Committee recommend that the Gold Medal be awarded to Mr. Pintsch for his system of lighting railway carriages.

By order of the Committee.
P. Le Neve Foster,
Secretary.

In pursuance of the above report, the Council have awarded the Gold Medal to Messrs. Pintsch.

AFRICAN SECTION.

Tuesday, March 27th; Sir Samuel Baker, F.R.S., in the chair.

The Chairman, in introducing Mr. Hutchinson, said that in looking forward to the future of such a country as Africa, it was necessary to look also to the past. It was an old saying that history repeated itself, but Africa was a country devoid of history, being prehistoric. They knew that parts of that vast continent were, geologically speaking, some of the oldest formations, whilst other parts which had been most civilised, such as Egypt, belonged to the more recent formations. And considering that the earliest civilisation of the globe took place in Egypt, it was very remarkable how dark and mysterious had been all other parts of that vast country until within the last few years. On looking back for a few centuries one could not but be struck with the immense progress which had been made in the civilisation of the globe, especially as exemplified in America, Australia, and other British colonies. The history of these countries showed the prodigious power of England, not only to populate, but to civilise the globe. Turning to Africa it was at once seen that this country had been very much behindhand, and the question suggested itself that if other countries had prospered so marvellously, even within the recollection of living men, how was it that Africa had remained such a mysterious desert, though it had been known to the ancients for thousands of years. Unfortunately the few rivers which were navigable were of immense size, and being fed by the rains in the tropics came down at certain seasons in such tremendous floods, that they brought with them a vast amount of alluvial soil, and formed a bar at the mouth, which thus destroyed the facilities the rivers would otherwise afford. There was also a great want of harbours. Even Table Bay had not a practical harbour, and had been the constant scene of disaster, though Simon's Bay was a little better. Therefore, although Africa was a country of magnificent resources, they lay in the interior so far distant from the coast, and so difficult of access, that practically they had been useless. The consequence was, as necessity was the mother of invention, in a country where there was no means of transport, where there was neither government or law, the law had been simply that of material force, and so Africa had been from time immemorial the scene of slavery. It was only natural that merchants having force on their side should kidnap the inhabitants of the interior, and make them beasts of burden, so as to transport the ivory—the only article of sufficient value to bear the expense—to the coast, where both ivory and carrier were sold for the profit of the merchant. This being the case, it was needless to ask why Africa had not improved as other countries had. Of late years England had set the example of suppressing slavery on the Western Coast, the people had to some extent improved, and the trade in palm oil had become of great importance. On the East Coast, Zanzibar had always been the point from which the interior was most successfully reached. In the time of Ptolemy, when he made those maps on which he laid down two great lakes as the source of the Nile, there was no doubt a trade carried on by the Arabs through Zanzibar, and from them probably Ptolemy obtained his information. They had now suppressed the slave trade, and great success had attended the English expeditions into the interior of Africa, Stanley having just reported a successful navigation of the great Lake Tanganyika. Such being the present condition of Africa, we had to consider how best to develop the resources which were proved beyond all doubt to exist in the interior. Having suppressed the slave trade, they had lost the beasts of burden; but, having once got hold of the plough, and struck a furrow, they could not, as Englishmen, abandon it, and the question was what was the beast which would draw it. This was a question of intense interest to all who had a practical knowledge of Africa, and to many besides, and he should, therefore, listen with great pleasure to the paper which was about to be read, and to the discussion which would follow. One thing to be remembered was that the differences of climate and soil were so great in different parts, that those who had only visited portions were no more fitted to pronounce on the country generally, than a foreigner, who had only lived in the Orkney Isles and Devonshire, would be to describe the climatic peculiarities of England. In some parts of Africa, the country was so fearfully unhealthy as to be quite unendurable by Europeans; but in other parts it was salubrious, and the soil fertile. In the interior, opened up by Captain Cameron, they heard that nutmegs, palm-oil trees, and coffee plants grew wild, and gold had also been found. The question was how to reach them. In the south there were bullocks and bullock waggons, but even there some routes were closed by the *tsetse* fly. In the middle of Africa, no doubt, bullock waggons could travel, but, unfortunately, the cattle of one district invariably died when transferred to another; so that the result was much the same as if, in the old coaching days, the horses which took you a few stages out of London, would die when they got to Oxfordshire, and those from that district would die when they got to Gloucestershire. This appeared to him one of the great difficulties they had to contend with, and he should be very glad to hear any suggestions for overcoming it.

The paper read was—

THE BEST TRADE ROUTE TO THE LAKE REGIONS OF CENTRAL AFRICA.

By **Edward Hutchinson, F.R.G.S.,**
Lay Secretary of the Church Missionary Society.

Our subject this evening is "The best route and plan for the introduction into Central Africa of civilisation, and the development of legitimate traffic."

I had the honour of reading a paper before this Section on the 2nd of June last, on the development and civilisation of Central Africa. By Central Africa I meant and mean the countries adjacent to the great chain of lakes, which by right of discovery belong to England.

I sought to show that, whether viewed geographically, commercially, or politically, the best hopes of success would attend efforts made by way of the East Coast, and through and in concert with the sovereign of Zanzibar; that the approach from the East Coast to the lakes was comparatively short, and through countries presenting no great obstacle to the traveller; but in the main cultivable and cultivated, and therefore capable of receiving and facilitating the passage of considerable traffic, no large extent of desert has to be traversed, no formidable mountain passes to be scaled, nor is the way barred by any large rivers.

I must not be understood as denying to the Khedive of Egypt any prospect of a return for those operations which Sir S. Baker and Colonel Gordon undertook, and have carried on in the Nile valley. On the contrary, a fairly moderate outlay on his part, and a wise and beneficent policy, will bring no doubt a rich reward, in developing, acquiring, and holding so much of the Lake traffic as the Nile route can fairly serve.

But I hold that with England will rest the real utilisation and development of Central Africa, and that through Zanzibar. Let me shortly re-state the conditions which should be kept in view in any attempt of this kind under the three heads—Geographical, Commercial, and Political.

The geographical and physical features of this part of Africa have been fully discussed in papers read to this Section, and I need not enlarge upon them; suffice it to recall Speke's simile of the pie-dish upside down. The coast region is the lip, the Eastern hills represent the ascent, and the upturned bottom the vast plateau.

The chief rivers which flow from the hills, through the Mrima to the coast, run parallel to and not athwart the ordinary course of travel. But in certain parts, especially where the route is at all entangled with the collecting areas of the rivers, the streams and marshes, especially during and after the rains, are serious obstacles to free passage. The rapid tropical growth of jungle, underwood, and grass, is also a serious obstacle in the way, and another formidable difficulty in some parts is the dreaded *tsetse* fly, whose bite is fatal to horses, oxen, and dogs. But these difficulties do not, it is believed, attach to those routes which keep along the ridges separating the river systems. They also cease when the lip of the pie-dish is passed, the hills ascended, and the level plateau reached.

Commercially, the advantage of approach from the East Coast lies in this, that many streams of traffic pass between the coast and the interior; they mostly converge on the island of Zanzibar. The various routes which these caravans take are tolerably well known, and the amount of traffic they carry and bring is, of course, varied.

In connection with these routes certain centres of trade have been established, and these are very important items, and must be taken into account and allowed for in any plan for the development of East Central Africa. These centres discharge towards Zanzibar.

Thirdly, I sought to show that politically it was of much importance that the stream of effort should pass through and benefit in passing the dominion of Zanzibar. For I venture to think that no benefit can accrue to a country desolated by the ravages of a foreign or export in addition to local slave trade, from any scheme for its civilisation that does not keep steadily in view and actually attack this political gangrene. In this matter Zanzibar is at one with us, and by co-operating with her we strengthen her hands and the action of her rules, and materially improve the prospects of the ultimate suppression of the trade. Unlike her neighbour, Portugal, Zanzibar offers no hindrance to the free passage through her mainland territories of English produce or native merchandise; and I may say in passing, that if the obstructive policy of Portugal is maintained, it would be useless to contemplate the improvement of any route through her dominions.

Another reason why politically it is important to act through Zanzibar will be dealt with more at length when I come to consider the plans to be followed for the development and civilisation of Central Africa. I would therefore lay it down as a starting point that to hit upon the best route and plan for the development and civilisation of Central Africa attention must be given to each of these three points:—(1), That absence of geographical and physical obstacles; (2), development of existing commerce; (3), direct bearing on the slave trade and the consolidation of the power of Zanzibar.

As a further preliminary, let us remark that our plan must provide for improved means of communication. The present rude, nay barbarous, system of porterage must be removed, and, as was suggested in my paper of the 2nd of last June, roads good enough for rough bullock carts must be provided.

Keeping in mind these preliminary conditions, let us proceed to examine the chief routes which have been taken by travellers.

Commencing from the South, we find the first route for travel starting from either Mikindany Bay, or the mouth of the Rovuma, just to the north of Portuguese territory, and making along the valley of the Rovuma towards Lake Nyassa. This is the route taken by Dr. Livingstone in 1862 and 1866, and, following the line of the Rovuma, and skirting the Nyesa Mountains, which run down the eastern shores of Lake Nyassa, it took Livingstone to the south end of the lake, passing Mataka. Livingstone speaks of another route, of which he heard at Mataka, running thither to Kilwa.

By this route the Sepoys seem to have gone, who left him in 1866, and brought home the news of his supposed murder.

The expedition of Livingstone in 1866 brings out strongly the importance of the conditions laid down. This expedition was more than a mere journey of discovery; it was in continuation of his attempts to introduce better means of transport and travel into Africa. He had already tried the River Rovuma, and had, apparently, concluded that that river could not afford a water-way, and accordingly he sought, by introducing camels and oxen, to provide means of transport for his goods. Every precaution seems to have been taken, but the expedition proved lamentably deficient in the character of many of its members.

The way lay through a country full of physical and geographical difficulties. The dreaded *tsetse* attacked the animals, which all died, and, after much difficulty and trouble, Livingstone only succeeded in reaching the south end of Lake Nyassa after five months' marching; this direction of his journey was caused partly by the nature of the country, partly by the dread of the Mazita, who inhabited the regions somewhat to the north of the Rovuma. A perusal of Livingstone's journal will, I think, satisfy us that no available route lies near the track of his journey.

Previous, however, to Livingstone's journey, two other travellers had attempted a more northerly route, viz., Roscher and Van der Decken. These had started from Kilwa, and the former seems to have reached Lake Nyassa a little more to the north at Unseewa. Van der Decken gives some information as to Kilwa, which it is necessary to notice here.

The port of Kilwa lies in 9 S lat. There are two Kilwas, about 14 miles apart. The younger Kilwa became the chief emporium for the slave trade, and to this place the various slave caravan routes converge, but the older Kilwa Kisiwani is a better harbour. Somewhat like Mombasa, the town is on an island lying in a bay, which receives two river creeks draining the adjoining country, The harbour is protected against the winds, and gives security to vessels at all seasons of the year. Landing, however, is difficult, as the water shallows very gradually, and large vessels cannot approach the town. This port seems to be the nearest outlet for the countries lying around the southernmost of the Lake Nyassa, and caravan routes do exist, connecting the points.

Van der Decken supplies us with a map, showing the country as far as Mesule, distance about 180 miles. The route of Livingstone is too far to the south, and too confined in the area it serves, to meet our commercial or political requirements, while, together with that of Roscher and Van der Decken, it is too involved in the collecting areas of the Rovuma and its affluents, to satisfy the geographical requirements of the route we need.

Much attention, however, has been given to the idea of a new route, starting from Kilwa and following for some little distance the line laid down by Van der Decken. In a paper read before the British Association at Glasgow, in 1876, by Mr. Stevenson, this plan is discussed, and a supposed section of an available road is given. A second pamphlet has been put out by Mr. Stevenson. It may therefore be interesting to give a few particulars, as furnished by Van der Decken, of some part of this route.

Towards the end of September, 1860, Baron Van der Decken arrived at Zanzibar. Before landing, he learned already that a friend, Mr. Albrecht Roscher, from Hamburg, an excellently qualified traveller, who had preceded him, and whom he thought he would have as a travelling companion, had been murdered at Nyassa. He determined, therefore, at once to travel to Lake Nyassa, to save, if possible, any papers which his friend might have left behind. He was to be accompanied by a faithful servant, named Koralli, who was very clever in acquiring languages, and whose services proved altogether invaluable. He found at Zanzibar Messrs. Speke and Grant, who made preparations for their great journey for the discovery of the source of the Nile, but who, by the profuseness of their expenditure and the ease with which they granted all the demands made upon them, occasioned great difficulty to Baron Van der Decken. However, by degrees, he made his preparations. There are two towns of the name of Kilwa, the one where Van der Decken landed, Kilwa Kisiwani, the island, 8° 57′ South lat. The other, Kilwa Kibendsche, 14 miles to the south of the former, on a small bight of the continent.

Kilwa Kisiwani, the oldest of the two towns, counted in the days of her prosperity 300 mosques, but at present consists only of a number of huts, amongst them about 10 inhabitable stonehouses. At present Kilwa Kisiwani has no more of its former importance of the slave trade, as Kilwa Kibendsche has by degrees become the principal place for the exportation of slaves. To this place the various slave routes from the interior converge, and as the insecurity of the harbour gives them a protection against English men-of-war, there assemble annually a number of vessels to carry the much desired human merchandise to other markets.

Kilwa Kibendsche extends a to great distance along the flat seashore, and has the appearance of a large town, though the number of inhabitants will scarcely exceed 15,000, and the miserable huts are in no wise better than those of the negro quarter of Zanzibar. The town is surrounded by a splendid wood of cocoa-nut trees, in which the shambees of the inhabitants are scattered. The most important building is the custom-house; at a distance of about a hundred yards arises a small fort garrisoned by a small number of Belooches, the commander of whom is also the military governor of the place. The country around it and the ground itself are very swampy, and therefore exceedingly unhealthy.

Kilwa Kissiwani has by its geographical position a certain likeness to Mozambique, and has like it a very bad climate. The Bay of Kilwa receives from the north two arms of the river Kuavi, and from the south the Kisimafngo, both are in reality only creeks, and in the rainy seasons receive the drainage of the surrounding country.

From the sea Kilwa does not at all look an important place, the custom-house is the only two story building in the place; the charming background of the palm wood, which adorn the Kilwa of the continent, is here entirely missing, and even the hills of the continent which surround it are bare of vegetation, and look as if it had been burned up by the sun. The harbour, however, is much better than that of the other Kilwa; it is protected against all winds and gives security to even large vessels at all seasons of the year. The anchorage, however, deepens only very gradually, and larger vessels must anchor at a very great distance from the town, and even smaller dhows cannot come nearer than 1,500 paces, and lie on dry ground at each change of the tide.

At present Kilwa Kissiwani is the capital on the south of the Snaheli Coast. It has two representatives of the Sultan of Zanzibar. The one called Wali administers both civil and military affairs; the other the collector of customs and everything belonging to finances. Next to them the Kadi, or chief judge, exercises great authority. Nothing of importance, however, could be done without the consent of the numerous tribes, both of the island and adjacent country. This division of authority made it extremely difficult to come to any decision, or to make any binding agreement with any one concerning the journey into the interior.

After a solemn assembly of all who were supposed to have any voice in the matter, and after various delays, false promises, and prevarications, Van der Decken saw himself obliged to go back to Zanzibar, to get fuller power from the Sultan.

At last, on the 22nd November, they left Kiloa, and went at first to Mukapunda, where their guide, Abdallah, resided. Here some time was wasted, in order to assemble the necessary porters, and to have a charm prepared which should insure the prosperity of the journey. Though the natives called themselves Mohammedans, they are full of heathen superstitions; and though such charms are contrary to Mohammedan law and religion, yet they were considered indispensable for the auspicious beginning of a long journey. The family life of the new converts—and even of Arabs who have lived long among the heathen—is much worse than even Mohammedans will tolerate. Thus Abdallah, though he called himself a Mussulman, had eight wives and two concubines, and amongst them his own daughter. Incestuous marriages between parents and children, brothers and sisters, are not at all rare, and this vicious system poisons all other relations of life.

On the 28th November they started to the eight miles' distant place, Mnasi, a very poor place. On the next day, after a five hours' march, they arrived at Mpuemo, which is considerably higher than the coast. The next place was Narissu; and on the 2nd December they went along the chain of mountains called Kiluendama and Matumbi. Later on, passed some single peaks; one of them Van der Decken mounted (called Kololi); from here he had a beautiful view of the whole country, which he found well cultivated and thickly inhabited.

On the 4th December, the rainy season commenced; it was ushered in by intolerable sultry weather and violent thunderstorm. The clay soil was softened, the roads became slippery, little rivulets changed into large and fierce rivers, all which combined to delay the journey considerably. Some natives of Kilwa had, moreover, spread the report that a European was travelling in the country, having with him tamed lions, in order to kill all the inhabitants of the country, which report caused many villages to be entirely deserted. The lions were nothing but large hounds, which Van der Decken had brought from Europe.

On the 6th they crossed the river Muira, which, in spite of the strong rains, contained as yet but little water; they stayed in the village of the same name as the river over-night, and the next day arrived at Meruri, which consisted of large gardens, each of which contained one or two huts. The greater part of the inhabitants are Wagindo, and are characterised by having their whole body painted with all kinds of figures, and in order to lend a greater charm to their faces, they have their front teeth filed to a point; a few are Wahiyou, and are distinguished by their bodies not being painted.

Throughout the journey Van der Decken made the same experience as all other African travellers —great reluctance on the part of his escort, porters included, to do their duty; their chief aim was to travel and work as little as possible, and to gorge themselves with food. Complaints of insufficiency of provision were of daily occurrence. And the natives of the locality travelled through did their best to create as many obstacles as possible, by refusal of shelter and supplies, or, at least, extravagant prices for both, in order to delay the journey as much as possible.

A difficulty of the journey was the superabundance of water; one day they had to cross the Kinerele, 25 feet broad and two deep. Next day two more rivers had to be crossed, Namitelle and Mihuhu, the latter so steep that the donkeys had to be thrown into the water and drawn up again on the other side.

Between Kipindimbi and Luere no less than three rivers had to be crossed. The next day Nangungulu was reached, at the north-west of which there was the Lukunde, a hill about 1,000 feet high, and looking as if formed of several very large fragments of rock, from the top of which Van der Decken had a splendid view of the mountain chains of Mbaha and Makundue, the grotesque forms of which reminded the beholder of home and the Bohemian Mountains.

At Mesule there seemed to be plenty of provisions and no great obstacles to be apprehended from the natives, and Abdallah, the principal guide, raised difficulties, and left Van der Decken with all his old people, who were the porters, thereby compelling Van der Decken to return.

The other traveller, Roscher, started, at the end of August, 1860, from Kilwa for the interior, accompanied by two servants, Raschidi and his brother Omer, and nineteen porters to carry his goods. He was ailing through the whole of his journey, and for several days before he reached the lake he had to be carried in a kitanda. The last few stages he travelled in advance of the caravan, and arrived several days before it in Nusewa, on Lake Nyassa. At Nusewa the Sultan Makana treated him very kindly, and with great honour, provided him with everything—rice, milk, meat, fish, and fowl; and the country being at that time unsafe, through an incursion of the wandering tribe Mafiti, the Sultan took him for greater security into his own house.

Roscher had, however, left the half of his goods at the river Rovuma, and asked Said ben Abdallah to send them on to him; as they did not come, he left Nusewa on the 17th March, 1868, in company of his servants and two porters, escorted by several men whom Sultan Makana had given him, and reached the frontier in safety. And after three days he arrived at Kisimguni, where he was murdered.

The compiler of the memoir proceeds to say:—From Kilwa to the interior the ground rises steadily. Mukapunda, only two or three stages from Kilwa, is already 509 feet above the level of the sea; the road to it leads through a country containing various hill chains, amongst which are numerous schambas (villages).

Between the second station, Mnasi and Nahigongo, the ground rises 150 feet. Here also are various hill chains, the road is no more through an arid plain, but an extensive forest, mostly acacias, overtopped by a few plane trees. On the other side of Nahigongo the ground rises more rapidly, but still is easily travelled over, only from Nangungulu really mountainous country commences, and which lies 1,300 feet above the level of the sea. Another peculiarity of the country is the superabundance of water, especially towards the end of the journey a great number of rivers had to be crossed, amongst the largest were the Kiperele and the Ruhuhu; but none are navigable, while from the coast to the hills there is rather a want of water.

It may be well to allude here to the very hostile reception which Sir Bartle Frere met with at Kilwa on his recent visit, as indicating the necessity of propitiating in some way the Arabs of the place, whose gains are gone, and who may be inclined to be revengefully hostile to the white man in consequence.

The plan proposed by Mr. Stevenson is mainly in connection with the Scotch missions on Lake Nyassa, and while the protective duties of Portugal continue to obstruct the utilisation of the Zambesi and Shire, it does seem to be necessary that our Scotch friends should find a direct access to the coast to the north of Portuguese territory. But Mr. Stevenson desires to claim for his plan the superiority over all others, as, in his own words, affording "probably the best route to Central Africa."

Mr. Stevenson's plan shortly is to construct a road from Kilwa to the north end of Lake Nyassa, a distance of about 370 miles, and to continue it thence to the south end of Lake Tanganyika, according to him 120 miles more. He would form stations from 80 to 100 miles apart, and have a central terminus or trading station at the north end of Lake Nyassa. By these roads Mr. Stevenson argues that the traffic of the Nyassa and Tanganyika districts would find their way to the coast, and they would form, if strengthened by the stations he proposes, a cordon across which no slave gangs could pass. The central terminus would help in the distribution and receipt of goods over and from a vast area, not only along the shores of Nyassa and Tanganyika, but by land to the Zambesi, also the shores of Lake Bangweolo, and on to the Luapula river. He estimates the cost of a preliminary survey of his proposed road at £3,000, and the construction of a rough road at about £40 per mile, making a rough total of £25,000. This, however, does not include the cost of erecting and maintaining the six or eight stations necessary to keep the roads open, nor the cost of improving the harbour of Kilwa. Mr. Stevenson has consulted all the authorities available for information, on the condition and circumstances of the regions through which the roads he advocates would have to pass. Let us see how far the proposed route and plan, as a whole, comply with the three conditions I have laid down. I propose to examine, first, the geographical and physical features. Mr. Stevenson says, referring to Van der Decken's route, the physical features seem to present no difficulty in the making of a road that might not be reduced to a minimum by the selection of a line to the north of that taken by Van der Decken. Again he says, speaking of the route from the coast to the point at the head of Lake Nyassa:—"The route would be on the watershed of the country between the Rovuma and the Lufiji." Now, it has already been pointed out that Livingstone, following the Rovuma, was apparently driven to the south by the range of mountains now called by his name; these mountains, rising to 10,000 feet, have been seen from the tenth parallel of latitude. Between this point and Zungomera on the Kingani River, about 120 miles to the north, the country is unknown, but there is no reason to suppose that that which is so marked a feature in the physical geography of East Africa, namely, the great chain of mountains which run along dividing the Mrima from the great central plateau, should disappear here. The Usegara Mountains, rising to 6,000 feet, and the Livingstone, to 10,000, are, no doubt, a part of that same chain. We may, therefore, suppose the continuance of the chain between those points. The only scrap of information on this region is given by Keith Johnston, on the authority of an Arab dealer, Khamis bin Othman, who describes the Rufigi as flowing for nearly two months' journey through a chain of mountains. Indeed, our knowledge of the East African rainfall teaches us this, that any such gap leading from the central plateau to the Mrima, as the disappearance of the mountain range between 11° North lat., and Zungomero would involve, must become the bed of a considerable river, and probably the only gap of this kind is that of the Rufigi river. I fear, therefore, that the exploration of the proposed route will not show it to be the best geographically for the construction of a road. Mr. Stevenson also makes the construction of a road from the head of Lake Nyassa to the southern end of Lake Tanganyika an integral part of his scheme.

It appears to me that this road stands on a different footing altogether. In view of the usefulness of communication north and south on Nyassa and Tanganyika, it is desirable as a link between the two lakes, and its importance and usefulness do not turn upon the construction of the road from the coast to the north end of the lake; but on this point I shall remark further on.

Let us now turn to the commercial advantages of the proposed road from Kilwa to Lake Nyassa, and inquire what they are. At the present moment I fear we shall find none, and for the future the possible creation of a trade when prosperity shall have been restored to lands now desolated.

There is now no trade at Kilwa; its great staple, the slave, has been cut off, and of other trade none remains. The incursions of the Mazitu have reduced the country adjoining Lake Nyassa on the north to a state of anarchy and confusion, while the ravages of the Magwangara have done the same for the country between the Lufigi and the Rovuma. Mr. Stevenson says the dense industrial population found by Van der Decken on the way to Mesule have all been swept away during the last 16 years, the jungle has covered most of the cultivated lands, and progress must be tentative till we know whether remnants of the destroyed races remain to come from their hiding places. Indeed, Mr. Stevenson incidentally includes in his plan the necessity of making strong defensible stations, to which the tribes who are exposed to the ravages of these marauders might rally. Such stations, he thinks, might stop the ravages of the Magwangara. But, he adds, the great problem is how to approach the Mazitu, who dominate the country for 200 miles around the head of Nyassa. It would be a difficult task, but there can be no settlement of the country till it is accomplished. Let me here notice, with pleasure, the recent effort made by Bishop Stere towards the settlement of the country in the vicinity of the Rovuma; he succeeded in taking up a party of 50 liberated slaves, and has planted them on a little colony near that river, and about 100 miles from the coast. We may fairly hope for the safety and success of this little colony, and though not in the direct road from Kilwa to the head of Nyassa, the influence of the experiment will, no doubt, tend in the direction sought by Mr. Stevenson.

This review will, I think, show that much has to be ascertained, and very much done, ere the proposed route can be formed and the plan worked. It also remains a question whether, when all suggested is done, and both roads made, the scheme can do more than serve a part only of what we call Central Africa.

In view of the pressing importance of time, let us ask whether another plan may not offer opportunities of more immediately realising our hopes for Central Africa.

Much has been said as to the importance of utilising as speedily as possible the means of communication north and south afforded by the great lakes. The passages of land which separate the Northern Nyanza and the Southern Nyassa from the central Tanganyika, are to be spanned by partages along roads; and just as Mr. Stevenson, on behalf of the Scotch missions to Lake Nyassa, has urged his road from Kilwa, so others have proposed to carry a road straight across from Mombasa to Victoria Nyanza. This idea might bear examination almost better than Mr. Stevenson's. At any rate, the travels of Rebmann and Krapf, Wakefield and Mr. New, taken with those of Sadi bin Ahedi, fully reported by Mr. Wakefield in the "Journal of the Royal Geographical Society" for 1870, give us full information on the subject, while the recent inquiries of Mr. Mackay, of the Church Missionary Society Mission, show that three or four Arab traders regularly make the journey from Mombasa to the lake. But with all the advantages possessed by Mombasa as a port, the traffic is too unimportant to justify any large expectations being formed in connection with it. Another route to the Victoria Nyanza has, however, attracted some attention, and I have good reason to believe that an offer has actually been made to place £100,000 at the disposal of an eminent man, if he would attempt the opening up of the route. The route I refer to throws open the possibility of utilising one of the great rivers of the northern part of East Africa.

About the latitude of Mombasa, the mountain range I have already adverted to—here called the Arusha Mountains—assumes more of the character of a mountainous region, widening out considerably around the bases of, and culminating in, the two great mountains, Kilimanjaro and Kenia. The northern continuation of the chain is called the Dhaicho Mountains. From the north-eastern slopes of Kenia the River Dana takes its rise. This river was found by Dr. Krapf in 1859, 150 yards broad, and about 7 ft. deep in the dry season, some 50 miles to the east of Mount Kenia, and at a supposed elevation of 6,000 ft. above the sea level. At its mouth the Dana is connected with the Osi, which falls into the Indian Ocean at Formosa Bay, about twenty-five miles south of Lamo, a noted port of the Banadir, the northern part of the Zanzibar dominions. This river was visited by Van der Decken's Expedition in 1865, and was examined by Brenner in 1869 as far as Baole, lat. 2.5 N, long. 39.20 E.

The following is an epitome from Van der Decken's second volume of his ascent and Brenner's journey:—

Experienced some difficulty in passing the mouth of the river, through the violence of the surf. Stopped at Kau, the utmost point where Arab influence reaches. The width of the river is here about 150 paces, and is of considerable depth; becomes dangerous through the number of small islands with which the river abounds. Here several excursions were made. Kau lies surrounded by a forest, on the mouth of the Magagoni river, on the Osi, but the last-named takes, instead of the hitherto easterly, a southerly course. On the north it is washed by the Schungo river. The land is well cultivated, in spite of its marshy condition; since 1865 it has been under the jurisdiction of the Sultan of Zanzibar. The inhabitants consist, besides Arab soldiers and merchants of Wapokoma, of a half-suppressed tribe from the Dana river, and are related to the Snaheli. The people are well-built, and, although partly dressed, yet seem to live in the innocency of paradise; they perform their work, like the Snaheli, in a sitting posture.

The country round Kau belongs to the much-feared Galla shepherd people, whose dominion stretches itself to the mountains of Abyssinia. Their principal provision consists of rice. In order to further his plans, Van der Decken thought to win the leader of the Gallas, but was not successful. He discovered here the westward flowing river, the Belondsoni Canal.

The Osi is navigable for twenty-four miles, is not very wide at the commencement of its course, but winds itself very narrowly, having an extremely strong current, reaches to the Belondsoni Canal, which combines the Osi and Dana.

The Dana has a much longer course, it takes its rise near the Kenia Mountain. Krapf describes it rocky, six to seven feet deep, and lower down Brenner measured three to four feet deep, and 40 broad. In the months of May and August it is navigable without difficulty from Engatana to Malokote, about 100 miles from the coast. Near the mouth it measures 18 to 24 feet in depth; but the bar with 5 feet in depth hinders ships to enter; and though its strong current is principally navigable for steamboats, the high forest banks keep the winds off, and make it exceeding difficult for boats; against the stream, scarcely a mile per hour can be made.

What Kau is to Osi, the village Tschara is to Dana; it has 22 clay-houses, and its plantations consists of cocoa, palms, rise, and meama. The dominion of this peaceful and industrious people extends 25 miles in breadth and three times as much in length, and their number is estimated at 8,000.

The Formosa Bay, in which these rivers flow, offers also navigation to larger vessels. Brenner says even the close proximity of the four coral reefs make it in quiet weather navigable without the least danger.

Vice-Consul Holmwood, who has recently visited the northern part of the dominions of Zanzibar, gives the following particulars in his report:—

The two rivers, Ozy and Tana, which flow through it and enter Formosa Bay within twenty miles of each other, undoubtedly form one of the natural highways to inner Africa, which have never been explored, but which there is reason to believe will eventually become of the first importance. Having spent a considerable time in questioning natives from various parts of these rivers, and traders and slaves who have traded on them, and finding their testimony agreed in a way most unusual among these people, I give the substance of it at some length.

Kipini and Kao are two small towns near the mouth of the Ozy, from which caravans usually start on this route, but occasionally one is organised at Mambrui, to which reference has already been made, proceeding *viâ* Gulcha and Garawa, two villages in the Galla country, which here reaches nearly to Ras Ngomeni.

The goods taken to purchase ivory are white and blue cottons, beads, red (maskat) dye, thick copper wire, iron oes, brass rings, and copper chains. 6 dol. to 10 dol. worth of these goods is reckoned as the price of one frasilah (35 lbs.) of ivory. The greater part of the route is by water, the canoes used are capable of accommodating fifty men, and four of these is the average number to each caravan.

The usual time for starting is in December or January, when the river Tana is at its height and the country flooded, except in a few places where the banks on both sides are high ground. The route soon leaves the Ozy and enters the Tana by a deep but narrow channel, which is said to be an artificial canal. The passage of this canal occupies three hours, and the town of Chara is situated at its junction with the Tana. The next stage is to Simikaro, 4½ hours, and here the Pokomo country is entered, and the river is commonly known as the Mto Pocomo. The Wapokomo are an extraordinary people, living in a country which the smallest freshet turns into a vast lake, and which, during the annual rise of the river in December, January, and February, is always under water. Their huts are erected on wooden stages to keep them out of the water, and from the nature of the country they can only cultivate in small patches, and the consequence is that they are constantly in want. They suffer very little from fever, and two natives from Lamo assured me that for years they had traded on this route, having huts and wives on each important stage; they rarely slept in the boats, yet they were remarkably free from illness. The great drawback they experienced was the plague of mosquitos, which they described as never absent; so numerous are these pests that the largest fires were useless in preventing their attacks, and where a native complains of these insects, they must be indeed venomous.

The Wapokomo are a mild and inoffensive race, and endure the many disadvantages of their country for the sake of the safety it affords them; the Gallas, whose territory extends to the right bank of their river, having no canoes, and the Somalis, whose predatory excursions reach the country immediately north of theirs, which is also partly occupied by a Galla tribe, never caring to disturb these swampy villages. There are sixteen other stages in the country Pokomo after leaving Simikaro.

There is a large district taking the name of Kalindi, thinly populated, but rich in ivory. Large herds of elephants come down close to the villages during the floods.

Here the river spreads into a lake, which is called Mchagababu, but the descriptions I got of this water were very vague.

About twenty days' journey bring us to Malalulu, on the borders of the Masanya country, and caravans are refused permission to pass through it; even during the latter stages mentioned the people are more independent, and the "garama," or black mail, has to be paid to the chiefs.

At Malalulu the traders meet the Wasanya and Wakwavi. The former come from Malakote, twelve days' march, and Korokoro, fifteen day's march further inland. The latter place is said to be near a large mountain, probably Kenia, where the river possibly has its sources. At any rate it is difficult to account for the flooding of the Tana, except on the supposition that it is caused by the melting of the snows on some lofty range of mountains which would take place during the hottest season, in this latitude about January to March, as the rainy season here on the coast does not commence till the end of April, and travellers report that further inland it comes on in June.

I was informed that, although very savage, these tribes would be quite willing to admit strangers amongst them for the purpose of trade, but they insisted on also having the right to bring their produce safely to the coast. It appears that, some years ago, one of their trading parties which endeavoured to come down the river to Kipni had been seized, and one of their number murdered, and that the messenger they sent to obtain redress was told by the Arabs that the Sultan's orders were to refuse permission to all the upper tribes to pass to the coast on any pretext.

The Banians at Lamo were, however, very enthusiastic as to the advantages to be obtained for their trade by the opening of these countries.

Much of the ivory of the Ujanda and North Unyamwezi country is said to find its way by this route. This I think doubtful, but it is certain that were the road open, it would complete successfully for the ivory from the shores of the Nyanza Lakes, which at present goes through Egypt by the immensely long route of the Nile.

Moreover, the distance is so short that the cultivation, for export, of coffee, there growing in perfection, and other produce never likely to pay for its carriage *viâ* the Nile, may eventually become profitable should communication by this line be established.

From the notes furnished by Mr. Wakefield, and published by the Royal Geographical Society in 1870, which I have already referred to, it appears that caravans going north pass close to Mount Kenia, then cross the Osi by a permanent bridge, and, passing over the watershed, reach a large river flowing north-west called Guaso Nyuro. This river seems to receive the westerly drainage of Kenia, and is said to fall into the Bahri Ngo. The limit of their journeys is the Samburu Lake mentioned by Krapf and Leon d'Avancher, and apparently lying about 1° North and 38° E.

The Samburu people are pastoral, and have much cattle; they also possess horses, and what is of much importance, camels. Their speech is a dialect of the Wakwafi, and they carry spears, bows and arrows, and shields, but no swords. It is just possible they may be the people possessing camels whom Sir Samuel Baker met.

From the points reached north-west of Mount Kenia there would appear to be no difficulty of access to Lake Nyanza. Both these States are in hostility to the Wahuma races of the western and northern shores of the lake; and Usoga especially is in a state of constant hostility to Mtesa, King of Uganda. Still, if King Mtesa could arrange matters with Usoga, and if the Sultan of Zanzibar were aided to keep in awe the Bush Somalis, who are gradually closing on the coast towns, the route by the Dana would become (supposing no physical difficulty arise) a very simple and rapid water way to Uganda and the Victoria Nyanza. It should also be remembered, as adding to the importance of the route, that a little to the north of the mouth of the Osi lie the fertile and apparently healthy districts of Patta and Manda, which may soon become important centres of trade.

This is the route which Colonel Gordon seems to have had in view in the recent expedition under McKillop Pasha, and there is no doubt that the advantages it offers are sufficient to make it worth attempting. Still it is not either geographically, commercially, or politically, such a route as to satisfy the requirements of the development and civilisation of Central Africa. It would be found leading only to the east or northern shore of the Victoria Nyanza, either to Kaviorondo or Usoga.

We have now dealt with two routes from the coast to the central lake regions; they touch respectively the northern and southern ends of the lake chain, and for the utilisation of either route much remains to be done. Let us now turn to consider the remaining approach from the coast to the lake region. The nature of the country and the maximum of facility, or rather the mimimum, such as it is, of difficulty for travel, have carried the Arab trader as well as the English traveller over a route which, after a certain distance, does not much vary north or south. Through the Mrima, the course has generally run along the valley of some river, the Kinganior the Wami, then, ascending the hill range, the plateau is reached, and, save in exceptional places, no great difficulty seems to present itself. On this subject, however, I need not dilate. My paper, of the 2nd June last, contains all that is necessary in the way of preliminary information. It is sufficient to say that since that time the route has been tried by two parties.

It has been found that, by going to the north of the Wami River, a tract of higher land is found free from swamp, or intersecting stream and marsh, and with a gradual rise until the spurs of the Usegara mountains are reached. Among these hills the road winds until it reaches an open, gradually ascending valley or strath, until the district called Mpwapwa is reached. The Rev. R. Price, of the London Missionary Society, has actually driven four oxen along this route. It is the concurrent testimony of another more recent traveller, Mr. Mackay, of the Church Missionary Society, that a road sufficiently good to accommodate such rough and strong bullock waggons or carts as are used in South Africa and on the rough roads of the Western Deccan, and I am able to say that there is good reason to believe that the construction of this road has actually commenced, and, further, that a strong party will make the attempt to ascend by it from the coast to Mpwapwa in July next. Now Mpwapwa is situate just opposite to the gap in the great chain of hills called the Rubaho pass, and though some difficulty must be met here, still the difficulty is not insuperable, and with cutting here and levelling there a rough track can be made. We are then on the level of the great plateau along which those accustomed to South African travel have no hesitation in saying that they can drive their bullock waggons as far, at any rate, as Unyamyembe.

As much turns upon the use of bullocks, it is very necessary to notice here that the scourge of tropical Africa, the *tsetse* fly, was not met by Mr. Price on his journey. So fair are the facilities for travel, and so safe the route, that one of the party of the Church Missionary Society Mission walked from Mpwapwa to Bangomoso in eleven days, while, more to the interior, the large party who left Mpwapwa in October were, on the 2nd of December, within 100 miles of the southern shores of the Victoria Nyanza Lake.

Of the commercial advantages of this route we may form some idea when we remember the general direction of trade to the interior. First, there is the great Arab centre, Unyamyembe. From this point trade routes run north to Mininga, Karague, and the Victoria Nyanza, west to Ujiji, then across Lake Tanganyika to Nyangwe, and south past the end of that lake through the country of Ufifa to Lake Bangweolo and to the country of the Cazembe.

I think the experience of the promoters of railways in this country has been that it is impossible to deflect traffic from accustomed routes, provided equal facilities are given, and that financial success lies in fostering and developing existing traffic on its accustomed lines.

In the course of trade, especially such as now exists in Central Africa, there are more elements to be taken in account than the mere roadway; the habits of the trader must be considered and accommodated. The Arab trader of Zanzibar has his corresponding house at Unyamyembe or Ujiji, or on the Victoria Nyanza. Those living at Unyamyembe will still send their caravans on the old routes, and they will return from south and west and north to Unyamyembe, nor will they heed the opening of a road from the head of Nyassa, nor the tiding of a new route past Kenia down the Dana. To make these of general adoption would involve a change, amounting almost to dislocation of idea and practice, among a people not given to change. The Arab trader, even at Unyamyembe, must have facilities for transport brought to his door, ere he will discard the rough and costly system of turning human beings into beasts of burden, and send his goods by cart and road. But assure him of safe transport, and you may rely in a little time upon a development of traffic which will repay the outlay, upon the plan which I would now proceed to shadow forth. I do this in proceeding to deal with the advantages of the route from a political point of view.

Our main object is the settlement and civilisation of the regions under consideration, by suppressing the slave trade and inter-tribal warfare, introducing better systems of agriculture and manufacture, and elevating the people. I may say generally that, to effect this, we need the presence of respectable Europeans, acting upon and influencing some fairly large and homogeneous native races. This necessitates a locality where the European may hope to live, not as in India, but with some hopes of permanent occupation. These conditions are to be found within easy reach of Unyamyembe, and no better *point d'appui* could be aimed at than the kingdoms of Karague and Uganda on the north, with Tanganyika to the south, both served alike by the route I have just described.

The importance of this route becomes apparent when viewed, not merely as part of a theory, but as part of an actual scheme, which is being carried into effect, for the very places I have mentioned, are now being, or are about to be, occupied. In a little time the Church Missionary Society, which is trying to make the road from the sea-coast to Mpwapwa, and has already established a station there, will have stations in Karague and Uganda, while the London Missionary Society hope to establish themselves at Ujiji and the south end of the lake, and also half way between Unyamyembe and Ujiji, at some such place as Mininga, to the north of Unyamyembe. Thus they will be able to keep open communication with Karague to the north, and from their southern station on Lake Tanganyika they may ultimately make the road to the head of Lake Nyassa.

Having thus detailed and considered the characteristics of the three parallel routes, it will, I think, be apparent that the area they each serve is so vast that all three may exist without affecting each other. It seems to me that Lake Nyassa with its *entourage*, including the southern slopes of the Muchinga Mountains, must find their outlet down the Shire and Zambesi. Let not our Scotch friends despair of an equitable arrangement with Portugal. I should be very sorry that they should withdraw their beneficial influence from the Shire and Zambesi just at a time when we have to fear the importation of French rum into these regions. Let them push up and meet the London Missionary Society from Tanganyika, and make that road a cordon past which no slave gang shall go. Let the London Missionary Society work Tanganyika and South Kittora, let them push on to Nyangwe, and let the Church Missionary Society hold Karague and Uganda.

Still the plan remains incomplete, for such efforts must be supplemented by a larger power at the back, a power which shall ensure safety and respect for the traveller, and what, judging by West Africa, is of the last importance, shall ensure in some measure the character of those who enter the country as traders.

I would advocate the formation of a company —such as the old Hudson's Bay Company—to be composed of men ready to join, not with any hope of immediate profits, but, after a little time, reaping them from the gradual introduction of trade. For such a company I would seek a concession from the Sultan of Zanzibar, to erect a jetty or harbour—say, at Saadani—and to construct a simple road, a light, wooden tram, such as is used in America, running up to Mpwapwa. Here let a station be planted, and land put into cultivation, and protection secured. This might be held by Europeans. From this point, the Sultan of Zanzibar should be asked to make arrangements with the Chiefs of Ugogo, as to the payment of tribute for passage through their territories. Another station should be planted, say, at Mdabura, which the Sultan of Zanzibar should hold. Beyond Unyamyembe, let the company enter into friendly relations with Mirambo, and try to make peace between him and the Arabs. Place a steamer on Tanganyika, and establish the cordon already alluded to between that lake and Nyassa, and open up the Manyuema country to Nyangwe.

In conclusion, I would venture to suggest for consideration, that there lie ready to hand two very important explorations; the first the route (*viâ* the Dana) to Mount Kenia and Bahri Ngo; and secondly, that which I believe may prove a route of great importance to the centre of Africa.

It will be remembered that an expedition penetrated up the Ishadda branch of the Niger, as far nearly as Adamana. Now it has recently been found that a trade route exists from Adamaua in a south-easterly direction to Lake Tanganyika, and an Arab trader is known to the merchants at Eggar who makes this journey regularly, to buy ivory from the tribes, to the north-west of that lake. It is also believed that a river of some size enters the Ishadda from the south.

Here is a field for inquiry. A line drawn from Adamaua to Lake Tanganyika runs through the centre of the only large unexplored part of the African Continent.

Would not either of these be admirable fields for enterprise and geographical discovery?

DISCUSSION.

Sir John Kennaway said he held very strongly to the opinion expressed by the Chairman, that England having put her hand to the plough, did not need to turn back. He could not pretend to follow the details of the paper, but in his opinion nothing but experience could determine which of the proposed routes would be the best. He was glad to see the various signs of interest being taken in this subject, and he referred particularly to the attempt made last year by the King of the Belgians to enlist the sympathies of the whole of Europe in this subject; but, as he had expected, it was difficult to get Englishmen, Germans, Frenchmen, and Russians to work together, even in Africa; still he hoped that each nation would be stimulated to make further effort, and, whether working together or in a spirit of generous rivalry, that good results might be obtained; but it must, he thought, be done by private enterprise. Although Parliament could do a great deal, it could not civilise or Christianise Central Africa. There was nothing to discourage, but much to encourage us to go forward, particularly the marvellous steps taken by the Sultan of Zanzibar; and he certainly thought the call to England was to go in and take possession of the land.

Dr. Hecherley said he was organising an expedition to go up the Rovuma, and they proposed starting in May, if all went well. He should like to ask whether lung disease amongst the cattle was not very prevalent on the Kilwa route.

Mr. Hutchinson said the only information he had about it was that given by Roscher and Van der Decken, but Livingstone's journals did not speak of it as being prevalent. Nearly all his cattle had died, but that was through being bitten by the *tsetse*, and the abominable treatment they received from the sepoys who had them in charge.

Dr. Mann said the lung disease was an epidemic of limited range, which passed over all parts of Africa in succession. Thus, although once very prevalent in the districts about Natal, it had now almost disappeared again.

Dr. Hecherley asked if the river route would not be preferable to a caravan route at any time. They hoped the River Rovuma would be found navigable for a distance of 300 or 400 miles.

Mr. Hutchinson said the Church Missionary Society had a steamer built which drew only thirteen inches of water, worked with two powerful engines, and would make ten knots an hour. They had tried her on the Wahini and Kingani rivers, but not very successfully. On the former, after going for sixty-five miles against a very powerful stream, it was found she had only made fifteen miles from the point of starting, and in the latter a similar result was obtained. The fact was, on those rivers the stream was so rapid, especially when swollen with rain, that very little was to be hoped for in the way of navigating them. He hoped they might have better success on the Rovuma, but he feared they would be disappointed. Dr. Livingstone tried to get up it in 1861 with the *Pioneer*, but only got as far as the point marked on the map attached to his journals. If they had a vessel constructed with a very light draught of water, so that, as the Yankee said, it would go wherever there was a little damp, they might succeed; but he questioned whether they would get far up.

Dr. Hecherley remarked that Mr. Young, in a paper read before the Cape Chamber of Commerce, gave the Rovuma as having an entrance into Lake Nyassa, and it was supposed that was the Rovuma.

Dr. Mann observed that there was no evidence of identity between the two rivers.

Mr. Hutchinson said the Rovuma was deflected considerably to the south by the same mountains which turned Livingstone aside. It entered the sea not far from the parallel of the lake, but was deflected considerably downwards, and he should be inclined to think that the Livingstone Mountains, rising to a height of 10,000 feet, would be a bar to any river flowing out of the north of the lake and going to the sea.

Dr. Atcherley said he had a map drawn by Mr. Belville, which gave a considerable gorge close to the north end of the Nyassa.

Mr. Hutchinson said the map on the wall contained the last information on the subject. The pamphlet of Mr. Stevenson was only just out, and Mr. Keith Johnson had lately shown him a map with Mr. Young's own annotations on Dr. Livingstone's discoveries.

Dr. Mann remarked that Dr. Livingstone did not go within 100 miles of the district now known as the north end of the lake.

The Right. Rev. Bishop Crowther being called upon, said he could not say anything about the East Coast of Africa, but he described what had been done in the expeditions up the Niger in 1841 and 1854, in both of which he took part, and accounted for the mortality in the former to the ignorance of what was required for such an expedition. One thing which struck him, and which, on his suggestion, was discontinued on the second attempt, was the practice of cutting green wood on the banks of the river, and stacking it in bunkers to get dry, whence the pestilential vapours arising from it were carried all over the vessel by the very ventilating apparatus employed for the purpose of purifying the air. Since then, although the river seemed to him much the same as ever, several trading stations had been established upon it, and white men were constantly navigating it in perfect safety. In 1872 or 1873, a trader coming from the east was met with some 300 miles up the river, who declared that he had seen a white man far away to the east, whose dress he described, and it occurred to him that it might have been Dr. Livingstone. He wrote a note, and gave it to the trader, requesting him to give it to this white man if he should again meet him. Last year, the son of the same trader returned, and brought word that when his father returned to the country where he had seen the white man, he was told that he was dead, and their idea was thus, to some extent, confirmed. There was a great difficulty in getting accurate information as to the geography of the country, because the names, even of such a river as the Niger, changed with every tribe through which it passed, and the only way, therefore, to get a true knowledge of the country was through its being explored by scientific travellers. He was now establishing a mission on the Niger, 300 miles from the coast, and there anyone who was a British subject was well received. When their vessel, the *Victoria*, was stranded, and they had to return by land, the king freely made them a present of twelve horses, and though he had since died, his nephew, who succeeded him, though a Mohammedan, was very friendly, had assisted him with presents to obtain the favour of his chiefs, gave permission to take building materials, and subscribed towards the erection of the mission station.

Dr. Mann said it was stated, at a recent meeting of the Royal Geographical Society, as a reason for not adopting the route now advocated by Mr. Hucthinson, that it cost a trader £1,000 to get from the coast to Ujiji; but to his mind there could be no stronger reason for opening it up. The reason why it cost so much to go so short a distance was that the trader met with so many different chiefs, who each required a subsidy before he was allowed to pass. Captain Cameron narrated that, when he was approaching the Portuguese settlements, he had exhausted all the goods he had with him, and had only a few small treasures which he kept in a box, intending to use them as a last resource. A plan was laid by one of his own servants to steal this reserve from the box, to give it to the Portuguese trader under whose protection he was travelling; but another servant knowing what was going on, secured it, and hid it in another box. When this was found out, the trader actually charged Cameron compensation for the robbery which had not taken place; and, before he could get away, he had to give a bill for the amount. This sort of thing was the reason why travelling was so expensive; but, if the ground were opened up for regular communication, the expense would soon come down materially.

Mr. Hughes suggested that elephants might be employed for draught purposes.

The Chairman said it was a very curious fact that a negro had never been known to tame an elephant or any wild animal. Although on old Carthaginian coins elephants were represented as being employed both by these people and the Romans, they were trained either by Arabs or Carthaginians, never by the negroes. You might travel all over Africa and never see a wild animal tamed and petted. It had often struck him as very distressing that the little children never had a pet animal, and though he had often offered rewards for young elephants, he had never succeeded in getting one alive. They must all agree that, whether they looked to gold, ivory, or anything else, they must have accessible routes for commerce, or even a mountain of solid gold would be useless. He was not quite sure that he caught what was the character of the route which was to cost £40 per mile, and whether it was intended for wheel traffic, or simply for foot passengers and beasts of burden, but he could see no objection to wheel traffic. Of course there were difficulties, but they could be surmounted in great measure by taking advantage of the seasons. There was always a dry season, when the surface was so hard that practically no road was necessary; the only requirement would be to bridge over ravines, and get along with the waggons as they did in South Africa. The question of the cattle to draw the vehicles, however, was of far greater importance. The waggons must have iron wheels, because the white ants in two or three nights would utterly destroy wooden ones. His own opinion was that camels would be far more serviceable than bullocks. When he started in 1861 he had to pay for his own expedition, and therefore had to weigh carefully the chances of success, and when talking of the enormous cost of travelling, it should be remembered that it cost Captain Cameron about £11,000 to cross from one ocean to the other, and very few private individuals, or even public, would venture upon such an expenditure. When he was at Khartoum he suggested the use of camels, but every one said they would be sure to die; that horses also would die, and that donkeys also would be no use, because in the wet weather the ground was so soft that they could not move, and in the dry weather the cracks in the ground were so wide that their feet would slip in. However he took some of each, and found that they all succeeded. They died no doubt, but not before they had done their work, and if it had not been for these animals he never could have succeeded, and he was the only traveller who had done this, starting from the north. Of all the animals, however, the camel was the best; he could go a long distance without water, possessed enormous strength, and was a wonderful animal for draught purposes as well as for carrying burdens. It was known that the Bactrian camels were accustomed to draught. The camel of the African deserts did not draw, but this was simply because there was nothing for him to draw. He had often noticed in those dreary deserts the whitening bones of poor camels which had sunk down to die, forming miserable milestones on the track, and it was very interesting to notice one of the customs religiously observed by the Arabs. When a camel broke down and died, the load which he could no longer carry was laid by his side, and there it would remain for weeks or months, until the owner had an opportunity of returning to the inhospitable spot and fetching it. No Arab would ever think of touching it. Imagine a cab upset in London, and the portmanteau placed on the pavement—where would it be on the following morning? He had often noticed, far in the interior, little patches of verdure which had sprung up after the rainy season around these whitening bones, and it reminded him that there were hundreds of travellers whose names were simply written on the sand, men who had left England full of energy and determination, and who, if the flesh had been as strong as the spirit, would have returned to be admired by their fellow-countrymen, but who had lain down to die in these African deserts. Yet their death had not been in vain. Though their names were unknown in England, they were known amongst the natives, and there was a verdure left behind them. If the spirits of these men could only watch over the progress that was now taking place, they would feel that they were not without their reward; he felt confident that the same spirit which had led so many to their deaths without any reward, except that the knowledge that they were sowing the seed which was now bearing fruit, was still animating their successors; that the wedge had been driven in, and would soon be driven home; that such discussions as the present would be repeated until at last not only the right routes, but the right animal would be found, and that the right men would always be found to carry on the great work of African exploration. He concluded by moving a vote of thanks to Mr. Hutchinson for his admirable paper.

The resolution having been carried,

Mr. Hutchinson, in reply, thanked the Chairman for his suggestion with regard to the camels. It had often occurred to him that on the plateau wheel traffic would be a necessity, and that camels might prove very useful, because if the Sombara people could use them, he did not see why they should not go from Mpwapwa to Unyamyembe and Ujiji. He might add that a gun-carriage had been seen at Eggah, which had been used in the Abyssinian war, bearing the English broad arrow, having come all across the continent in the hands of Arab traders. The use of elephants had been often urged upon them, and there was no doubt that African elephants were capable of being trained, there being one in the Zoological Gardens.

Votes of thanks were also passed to Sir Samuel Baker for presiding, and to Bishop Crowther for the information he had given, and the proceedings terminated.

CONFLAGRATIONS COMMITTEE.

REPORT ON INSECURITY FROM FIRES, AND FROM PANICS AT THEATRES AND PLACES OF PUBLIC RESORT.

The alarm created in this country by the great fires at Boston and Chicago led the Council to appoint us as a special committee to consider what protection science could give against ordinary fires and extraordinary conflagrations in this metropolis. On this reference we have already made one report, the result of a considerable examination, and this has been followed by an examination of the same topic before a committee of the House of Commons, which has not yet concluded its labours. The subsequent terrible example of the fire and loss of life at the Brooklyn Theatre, and the apprehension of similar heedlessness and want of foresight, as a frequent characteristic here, have led to a resumption of our labours for a special examination of the existing means for preventing the like calamities—including the loss of life from rushes of audiences under panics—as well as from fires in the theatres of this metropolis.

From the inquiries made, we find that the means in use in the theatres in this metropolis exhibit varied degrees of imperfect protection, some requiring little addition, others requiring almost entirely new construction, but all needing additions and systematised provisions for the public security. In some of the theatres the internal provision of water-supply, by properly distributed hydrants, appears to be as satisfactory as the existing imperfect conditions of the metropolitan water-supply will allow. In these—the larger theatres, chiefly—there appears to be, also, the number at present required of trained firemen for the application of the water-supply; but in none is there an amount of trained men for the purpose, which, we shall show, a proper application of sound administrative principles would provide. In a proportion of the theatres the provisions against fires appear to be utterly inadequate; scene-shifters, untrained men, are dressed up as firemen. Within the last thirty years there have been fifty-seven fires in the theatres in London, in which seven have been totally destroyed. Their existing conditions as to danger from fire are accurately denoted by the insurance risks, determined on careful examination. The mean of the premiums required for theatres are twenty times as much as in first-class private mansions, six times as much as in warehouses containing cotton goods, or, three pounds per cent. The premiums range, however, from thirty shillings per cent. in theatres of the best construction and organisation, to six per cent. for the theatres of the lowest grade in these respects.

In several of the theatres the architectural arrangements for the safety of the audience, by means of speedy exit by proper passages, appear to be dangerously defective. In some, additional means of exit are provided, by extra doors opening outward, but there appears to be no regular and responsible authority, to see that these doors are always kept unobstructed, or in a fit condition. It appears to be optional whether the managers of theatres, or of other places of public resort, apply or not for the services of the police force for the maintenance of internal order and security. Where they do apply for the service of the police for these purposes, the Commissioners exercise their discretion in prescribing the minimum of force which they deem proper to be employed. In a number of cases the services of the police are dispensed with, chiefly in inferior establishments, where, for the maintenance of public order, they are generally the most required.

The general conditions as regards disposition of the protective force appear to contravene the primary principles of administrative economy and of the public security. In the larger theatres, for example, there is one section of men trained in the use of fire-engines, and to act in the application of the means at their disposal when a fire occurs, but these do nothing else in the long intervals of their occurrence; and there is another section of a public force—the police force proper—untrained as firemen for any concurrent action when fires do occur.

On the other hand, we have the example of the application of a combined force—the police—all trained to the application of fire-hose and engines, directed to the protection of the larger public buildings; the Houses of Parliament, the Woolwich Arsenal, the British Museum, the National Gallery, the General Post-office, and the larger Government offices. Take the example of the British Museum, as a place of popular resort, especially on holidays; the whole police force in charge there is, with the more specially trained fire-men, trained to act in concert in the occurrence of any fire, as well as in the maintenance of order on all ordinary occasions when there may be no fire. Under the existing arrangements at the theatres there is, then, only a half-trained force as against fire extinction, and a trained police force to act when there may be no fire, but when there may be disorder and panics, by which life is endangered. Moreover, the half fire brigade force within the theatre is confined very much to the application of the internal appliances, with auxiliary action from the distinct and distant brigade force when this has got to the spot. By arrangements on the footing of a combined force, on the administrative principles in action at Manchester, Liverpool, Glasgow, and elsewhere, with a constant supply of water kept at high pressure, and with an extra number of hydrants immediately on the outside of the edifice, the means within the theatre would be immediately supplemented by auxiliary jets of great power in two or three minutes, or in a third of the time practicable under the existing conditions of a separate brigade force. The lowering of the jets by the simultaneous use of a number, would be met by telegraphing to the chief or highest water station, whence, the surrounding private services being cut off, an additional pressure could be put on within two or three minutes sufficient to sustain all the jets in greater force than could be brought to bear by the steam or manual engines on their arrival. For example, if the ordinary pressure on the mains in or surrounding the building was 100, the distant pressure that would be brought to bear direct from the distant resorvoir might be 200. To take the example of the fire at the Pantechnicon. Had it been under such protection as that proposed, several powerful jets in the interior of the building would have been brought to bear upon the fire within two or three minutes, with a probability of its immediate extinction. In about the same time, from properly arranged hydrants fixed on appropriate enlarged mains, at high pressure, a number of auxiliary jets could have been brought to bear from the exterior of the edifice by the police, who would have simultaneously shut off, for the time, the private service supplies; and on telegraphing to the highest water station, pressure would at once be obtained if the trunk mains of the various companies were united and connected with the high road reservoirs to sustain the force of all the jets inside as well as outside the building in simultaneous action. By these combined means a force exceeding that of all the steam or manual engines might have been brought to bear in a third of the time required for the arrival of the steam or manual brigade engines.

In illustration of the existing fragmentary arrangements, and of the different degrees of fire risks incurred by losses of force, it may be stated, by way of example, that in a large theatre, where the internal arrangements as to the disposition of hydrants at constant supply under high pressure are sufficient, it would be deemed a satisfactory provision by most insurance offices that there should be six trained firemen in attendance during the performance, three during the night, and one during the day, unless rehearsals are going on, when there are two. The duties of these firemen extend only to the fire contingency, however remote it may be. At the same time there will be in such a theatre an equivalent police force, whose service is to regulate the admission of visitors, to maintain order and to prevent theft, but who have no special service for the extinction of fire, no connection with the firemen, and no trained concerted action on the occurrence of a fire; such action as they might take would be the very inferior action of a voluntary and irresponsible service. If the administration were on, the same footing as it is at the British Museum viz., that of an amalgamated force, there would be a double force within the theatre to act at once against the fire, and from outside the edifice, and from the nearest police-stations, on the amalgamated system of Manchester, Liverpool, and Glasgow, the trained police would be available in number, and there would be an auxiliary trained force brought up usually in a third of the time that the brigade can, on the present disjointed system, be brought to bear. One trained fireman (a policeman) on the nearest beat, is worth more than two or three trained men, for the object in question, at the brigade station. If the arrangement of the force were on the footing of the amalgamated forces at the British Museum and other public institutions, and were confined to the use of the means within the theatre for the extinction of fire, that arrangement of itself would be held to be an additional security operating to an important extent in the reduction of the insurance charge. But if, in addition to this augmentation of the internal forces, there were the external addition of proper mains, kept at constant high pressure, with proper hydrants, as above described, immediately available for the amalgamated trained forces outside, the risks would be reduced, even more than in those cities, and the insurance charge also in the like proportion. The interior amalgamation of service may be considered as equivalent to a double force; and the exterior as well as interior amalgamation more than a quadruple force.

As a rule, external hydraulic arrangements, on the correct principle of large mains with hydrants in constant use, would be of greater security than the best of the ordinary internal arrangements for the protection of large edifices. On the sudden outburst of a great fire, the passages are commonly filled with suffocating smoke, and often with flame, which render the hydrants in the internal passages inaccessible, and generally cut off communication with superior reservoirs, and of this there have been frequent instances. At the War-office, for example, there are displays of neat and elaborate provisions of hydrants and hose in the passages on all the stages; but, if a fire were to burst out amidst the stores and inflammable materials at the basement, communication with the internal appliances would be speedily cut off. The internal protective arrangements in the British Museum may be exceptionally good; but, from want of room for the display of specimens, and waiting the completion of the new construction at South Kensington, there are at the basement of the Bloomsbury building immense collections of natural history preserved in spirits of wine—dangerous inflammable magazines—which, if fired by accident, would speedily inflame the superior part of the building so as to neutralise the working of a great part of the internal appliances. This condition, by the way, exemplifies the unwise economy of protracting the works at the new museum and postponing its completion. The external appliances described, always in use and always immediately accessible, capable of being brought to bear through windows and external apertures, and elevated to the higher stages by ladders, are the greatest securities necessary.

It is to be borne in mind that, under a combined system of the fire service in connection with the police force, and a system of constant water-supply on a public footing, as in Manchester, Liverpool, and Glasgow, the need of steam or manual fire engines is reduced, as stated, to about three or four per cent. of the cases of fire; and the losses of life and property from fire, to about one-third of the losses prevalent in the metropolis;—the arrangements too, in those cities, are as yet materially incomplete. For example, as stated by Mr. Bryson, the head of the fire brigade department of Glasgow, the distributing apparatus for the water supply has been arranged simply for ordinary domestic consumption, and without the adaptation of enlarged sizes of pipes due to the public edifices, to large warehouses, and other properties. Some of the theatres in the chief thoroughfares of the metropolis will be situated near suitable large mains, but others in side streets will require proper provisions to be made in that respect. Moreover, from defective town drainage works, and the ignorance of the local authorities, or the sinister interests of scavenging contractors or other causes, the method of street cleansing by the jet, in use in Paris, Vienna, Hamburgh, and other cities, recommended on sanitary as well as economical grounds, has not been brought into use here, though it appears to be at length accepted in the City of London (after having been recommended ten years ago by the Corporation engineer). The public are hence deprived of the proper security of an apparatus in constant readiness because in constant use. In this metropolis the present mean distance of the brigade stations—a mean of closely and comparatively widely populated districts—appears, from the returns of the distances run, and the number of fires attended, to be about a mile and a half. By the combination of the fire brigade with the police force at Manchester, the stations for engines, hand or horse, are brought to an average distance of eight hundred yards, a gain which, by similar arrangements, would be achieved here by the adoption of the police stations as fire stations. But, by the proper distribution of hydrants, as at Glasgow, the immediately available relief would be brought within every fifty yards; or, as at the city of Hamburgh, within every hundred feet. For a great edifice like a theatre the hydrants would give all the security within some five or six minutes that can be brought to bear by the existing separate brigade force within some twenty or thirty minutes or more. The same want of forethought is displayed as to the arrangement of water-pipes for the large waterside warehouses, where pipes have been provided only for domestic use, and these of not above one-tenth the capacity that would be required for the extinction of fire, and that might be made available, as we have exemplified, in a fifth or less time, than it can be now brought to bear upon those same warehouses by floating engines from the river, especially when the tide is low.

Further, it does not appear to be understood by the witnesses examined before the Committee of the House of Commons, how immense is the gain of power through bringing all the water supplies of the metropolis under unity of action and management as against great fires. The first effect of machinery for fire extinction will be to extend the pressure of the most elevated reservoirs over the entire area, and—in the opinion of Mr. Quick, who is an hydraulic engineer of the largest experience in the metropolis and in Europe—to give to the lower district an addition of probably a third or more of additional height, for all the jets now obtainable there. Another effect of unity, as pointed out by the insurance companies several years ago, would be, in case of need, to enable the whole force of the entire metropolitan supply to be concentrated at once upon any one district or subdistrict threatened with a large conflagration. By electricity this concentration of power from miles of distance is effected almost as speedily as if the great reservoirs were contiguous to the spot. A short time ago, at Liverpool, on the lowering of the jets by the consumption at a fire, a fire-messenger was despatched on horseback to the chief pumping station, to direct additional power to be put on. Now, the electric telegraph does this and would do so in the metropolis, and in a minute or two the accelerated stroke of the piston would be perceived in its results at the most remote station several miles distant, and leave nothing to be sought from locomotive engine power. Electric science also gives means of instant warning of the increase of temperature, or of a fire arising in a closed room in any part of a public building in which there is no one present during the day or night.

In the rooms of cotton and other manufacturies, where the materials are frequently in flames in the course of the operations, "extincteurs" are now being kept and used with great advantage. These implements, it was recently shown at the Congress of Hygiène, at Brussels, are getting into extensive use on the Continent, and will prove of peculiar value as being less injurious to property than water-jets, if kept at hand in the most dangerous places for fire—*e.g.*, the workshops of theatres, and the places of preparation in pyrotechny for scenic effects.

On a competent and impartial review of the operation of these available administrative principles, and the evidence of engineering and mechanical appliances afforded in our chief provincial municipalities, all of which, if adopted, would place the metropolis in advance of them, the fire-insurance risks in the peculiarly dangerous edifices in question, may be greatly reduced below the best of those existing, most probably to one-third of what they now are.

Mr. Wybert Reeves, the manager of the Royal Theatre at Edinburgh, has expressed very clear views of structural improvements and scientific appliances, requisite for the protection of theatres from fire and of audiences from panics. But the care and certain use of such appliances would require hands of more than common training, who might act very safely under such supervision as his own; but even under his own, an insurance company would require a much higher premium than they would accept if the appliances were under the care of a trained and combined public force known to them, such as the trained force having charge of the British Museum and the public edifices cited,—apart from the additional gain of security and reduction of charge derivable from the improved external appliances shown to be available.

In respect to the general system of combined internal works, and of combined external service for their application, they will need, at all events for their initiation a corresponding special service beyond any presented by the existing authorities. It must be explicitly stated that little but expensive further failure is to be expected from those authorities who have failed to see or appreciate the great economies and protective advantages of the unity of the water supplies, which benefits have been represented for years;—who have failed to see them, or to take any action upon them when they were urgently represented to them by the insurance companies after the Chicago fire;—who could not perceive the securities derivable from a patrolling force of several thousand police trained as firemen, or of double and nearer stations;—who visited Manchester and Liverpool, and returned from thence without any due perception of the economics achieved there by action on the administrative principles stated; and who put forward such monstrous exaggerations of the expense of the conversion from the intermittent to the constant supply and of hydranting the streets, as to raise obstructive difficulties in the way of those measures, by the operation of which the losses of life and of property are reduced to nearly one-third the rates that are prevalent in the metropolis. Officers of the greatest practical experience are clearly of opinion that the existing local administration is continued at the expense not only of continued excessive losses of life by fire, and such manifest increase of them as has been displayed during the last year, but of the danger of great conflagrations, such as those of Boston and other cities.

On the special question of the theatres and edifices of public entertainment there remain to be considered the securities needed and obtainable against the loss of life from panics. On occasions when there are no fires, but disorder, or at fires when the greatest danger may be from panic, the special firemen, or brigade force, would act as an important contingent to the line of the police force. At the British Museum, for example, the special firemen, on occasions when there is no fire, form part of the police force, for the maintenance of order on the occasions of crowds at holidays. On the occurrence of such an event as a panic, as at the fire at the Brooklyn Theatre, the combined force would first act against the greatest immediate danger to life, the danger from the panic. The chief police officer on duty at the theatre would give the command, "Men, to your stations; officers, to your posts;" then the chief avenues would be thrown open. He would then go on the stage and tell the audience that if they did as they were told he would assure them of their safety; and he would tell those in the gallery to remain in their places until the upper rows got out as they were directed by the police. Simultaneously telegraph messages to the nearest police-stations would bring up the support from thence of additional external trained men to aid in the maintenance of order.

On a consideration of the principles of jurisprudence for the protection of the public from fire, as by the enforcement of party walls, and of incombustible materials in cities, and on a view of the existing conditions of theatres and of places of resort, it will appear that private discretion as to mechanical internal arrangements of all places of public resort, and as to care for their maintainance and action, as well as protection from disorder, should be subjected to further restraints and tutelary police regulations. These establishments in the metropolis would participate in the advantage of the general external arrangements which have been so successful in our larger provincial cities, from the constant public supply of water, under the combination of the trained fire brigade force with the general police force. In requiring theatres to be placed, for the public security, on the footing of such public establishments as the British Museum and the National Gallery in respect to the internal mechanical and police supervision, it appears, taking into account the reduction of insurance rates, by the diminution of fire risks, and also other benefits, amongst which would be the increased sense of security, and thence increased popularity, of their entertainments, that no unremunerative charge need be imposed upon them, nor anything be required of them to do which it would not be their real interest to do if they had the means, which they now have not, of doing of themselves. It is to be borne in mind, that theatrical properties contribute largely to the local rates, from which they do not, in the present state of the local administration, receive equivalent advantage. The authority of the Lord Chamberlain has been exercised for the provision of proper means of exit for the audiences on the occurrence of panics. But he has no executive machinery, such as the police would supply, for seeing by regular trials, that those means of exit are kept ready and in a fitting condition. Presuming, as we venture to do, from the force of the precedents of the great advantages derived, in the instances cited, from the amalgamation of the trained fire brigade with the police force, that the provincial precedents of the gain in efficiency will be acted upon, it would follow that no place of public resort should be allowed to be opened without due authoritative provision of proper requirements, structural and administrative, for the public security.

In respect to the special structural arrangements for new theatres, and the use of incombustible materials, the committee can only refer to the evidence already taken, and published in the transactions of the Society. But the Science and Art Department, consulted by the French Government upon the subject of the construction of theatres in Paris and upon their police, appears to us to have yielded the most advanced and complete answers for practical application yet given, and to have left this Committee only the duty of expressing concurrence in them, acknowledging obligations for them, and soliciting particular attention to them, as they are hereafter set forth in the appendix.

On the subject of the provision of water supplies, we may make a further observation. The fact of the pressure on some of the mains, a very small portion in London being very low, has been made an objection to giving the protection of hydrants to any portion, or to the three-fourths of the whole of the houses, for which a very serviceable pressure, and for a great portion of the houses a very great pressure, is already available. The objection, which appears to have been received with great surprise by the manager of the Salvage Corps, as well as by others practically conversant with the subject, displays an entire absence of knowledge of the primary principle of prevention, the greater value of small supplies near, than of large supplies at a distance.

At Manchester and at other places, fires are extinguished in a majority of cases by the use of a pail with a small hand-engine attached to it, which can be supplied with water on the spot. If the whole of the water supplied in London were delivered at so low a pressure that it would not rise higher than the basement of the houses, it would be worth while, nevertheless, to provide the whole of the streets with hydrants, so that the immediate supply might be brought to the doors for the use of small implements, until the larger engines could be brought to the spot. Over the whole of Paris the delivery of the water is at a much lower pressure than in London, as low, perhaps, as in any of the districts in London. It is to be noted, however, that it is proposed by the authorities there, in accordance with the principle of protection stated, to "make it imperative upon the proprietor of every house"—which would include every flat—"to set up a hydrant sufficient for the supply of an ordinary fire-engine." This being the case, even with the low pressure of water there, "every floor of every house in Paris will be under command."

The general conclusions deducible from the examination of the facts, specially relating to the theatres and places of public resort, maintained by private enterprise in the metropolis, may be thus stated:—

That by the combined application of settled principles of mechanical, engineering, and administrative science—the risks and losses of life and property in the edifices in question may be reduced to fully one-third of the risks that now attach to them.

But that such gain in public security is dependent on the close, authoritative, attentive examination and understanding of the precedents cited; of the practical working of their principles, and their adoption in clear and decided general measures of legislation; and on their competent administration in the metropolis.

By order of the Committee,

P. Le Neve Foster,

Secretary.

Appendix.

PARIS THEATRES.

The following particulars have been obtained as to the course adopted for the attainment of the objects in Paris. It is especially to be noted that Paris generally will soon be in advance of London in its general provision of hydrants, and the application of public water supplies, for the protection of life and property, by hose and jet, as it already is in street cleansing.

Regulations Respecting Construction, Arrangements, Public Safety, &c.

Previous to the year 1864 special privileges existed with respect to theatres, but in that year an Act was passed, giving every one the right to construct and work a theatre on giving previous notice of his intention to the proper authorities. At the same time a number of police ordinances, extending from 1790 to 1864, were repealed, and a single one issued in their stead. The regulations respecting construction are as follows:—

1. Everyone who desires to construct and carry on a theatre must make a previous declaration to the Minister of the Imperial Household, and of the Beaux Arts, as well as to the Prefect of Police. To such declaration shall be attached detailed plans with sections, a statement of the number of places, calculated on the basis of 80 centimetres in depth (32 inches) and 45 centimetres (18 inches) in width for those places which are to be let, and 70 (28 inches) by 45 centimetres (18 inches) for the others. The building not to be commenced until formal permission is given after examination. With the exception of certain departures which may be admitted under special circumstances, the building must be constructed and arranged according to the following rules:—

2. The building may or may not be isolated. In case of solation, there shall be left all round the theatre, except where it is bordered by the public way, a free space (*chemin de ronde*), which need only be three inches in width provided the adjoining houses are not lighted from such road or space, but in the contrary case the width must be increased in accordance with the importance and arrangement of the edifice.

In case of a theatre abutting on another building, a wall at least in brick, at least 25 centimetres (10 inches) in thickness, shall be built to protect the party walls. The thickness of this wall to be increased like the free space mentioned above, and for similar considerations.

The regulations concerning construction, especially with the view to the prevention of accidents from fire, are as follows:—

3. The inner walls, the walls which separate the dressing-rooms from the theatre, the proscenium wall, the wall which separates the auditorium, the vestibule, and the staircases, must be in masonry.

4. The doors of communication between the dressing-rooms and the theatre must be of iron, and swinging so that they may be always closed.

The proscenium wall, which rises above the roof, may only be pierced by the opening of the stage and by bays of communication closing by means of iron doors.

The opening of the stage must be provided with a curtain composed of iron wire, with links of not more than ·05c. (2 inches), which shall completely cut off all communication between the combustible portions of the theatre from the auditorium. This curtain to be kept up by incombustible cordage.

The fixed scenery in the upper part of the front of the stage must always be incombustible.

5. All the stairs, the flooring of the auditorium, and the partitions of the corridors should be of incombustible materials.

6. The ceiling of the auditorium to be of iron and plaster.

Fire Engines and Water Supply.

7. In one of the most elevated positions of the proscenium wall and under the roof there shall be placed an apparatus for aid in case of fire, with a column of water, with additional hydraulic pressure in case of necessity, to supply a jet of water reaching the highest parts of the building. The capacity of the apparatus to be determined by the importance of the theatre.

8. The pumps must be placed on the ground-floor in a place separated from the theatre by walls in masonry.

9. They must always be supplied with water from the city works and stowed in reservoirs, and by a well, so that each of these sources alone should be sufficient for the full working of the pumps.

10. Outside of each place of public amusement must be established hydrants, supplied by the water of the city, each hydrant being sufficient for the supply of a fire-engine; the number of such hydrants in each case to be fixed by the authorities.

Heating and Ventilation.

11. The auditorium shall not be warmed except by flues, the furnaces of which are situate in the cellars. The orifices of the flues to be not less than thirty centimetres (12 inches) beneath the flooring.

12. All places of public amusement should be properly ventilated; the air should be renewed by means the efficiency of which shall be judged of by the authorities. Thermometers shall be placed within sight in the corridors.

ARRANGEMENT OF SCENE-PAINTERS' LOFTS, &c., ABOVE THE THEATRE.

13. No such place shall be permitted above the stage.

14. No workshops shall be allowed above the auditorium, with the exception of those for the scene-painters and tailors, and the floors of these shall be tiled. In the case of the scene-painters' loft being placed in this position, unless the roof is formed of iron and plaster, the *sorbonne* (the place for the chandelier, apparently) must be shut in by a partition, made of broken stone and plaster, with a ceiling, tiled, and closed by an iron door.

15. No division of the space in the roof shall be made for any other purpose than those above indicated.

CORRIDORS AND STAIRCASES.

16. The width of the corridors, the number and width of staircases, as well as of the entrance doors, shall be in proportion to the size of the theatre. In all cases there must be two staircases specially devoted to the public, and communicating directly with the street.

SCENE LOFT AND MACHINERY.

17. Every theatre must be provided with a place for scenes and machinery outside its own walls, and under such conditions as the authorities shall approve.

18. No stores of scenery or machinery shall be made either beneath the stage or the auditorium, all such stores shall be separated from the theatre by a wall or walls of masonry.

RESTRICTIONS CONCERNING THE OCCUPATION OF SHOPS, &c.

19. No shop or warehouse appended to a theatre shall be let for any trade or calling which presents special danger as regards fire in any respect. The chimneys of such shops, if they pass through the theatre or its dependances, must be constructed of brick or other masonry, and carried up vertically to above the level of the roof. They shall also be further protected by means of a brick casing.

20. No person except the concierge and the treasury attendant is allowed to live in a theatre or any building which communicates with it.

[The second portion of the ordinance relates to the management.]

APPROVAL OF THE BUILDING, POLICE SERVICE, &c.

21. No theatre shall be opened until the authorities shall have certified that it is well constructed, and with proper arrangements for safety, salubrity, and convenience. The modifications made in the interior afterwards, division of places, &c., to be the subject of a second examination previous to the opening.

22. The agents of the superior authority shall exercise a daily supervision not only as respect to the dramatic censure, but also in the interest of order and public security.

23. There must be provided an office for the officers of police, and a guard-room.

24. A commissaire of police is charged with the general surveillance of each theatre; a suitable place shall be provided for him in the auditorium.

25. Any person who may be arrested either at the door of the theatre or within its walls shall be taken before the commissaire, who will decide on the case.

26. The police are specially charged to maintain order and free circulation outside of the theatre, as well as with the regulation of carriages. They will not enter the auditorium except when the public peace is in jeopardy or when called in by the commissaire.

27. In every place of public amusement a medical service shall be established conformably to the regulations of 1852.

28. The service of the firemen is arranged according to a plan adopted in 1852. Tell-tale counters, showing the rounds made during the night, shall be placed in the interior of each theatre in such places as the commander of *safeurs-pompiers* shall select.

MISCELLANEOUS.

29. The directors shall establish urinals, fixed or otherwise, suitable to the locality, and under such conditions as shall be approved by the authorities.

[Here follow the regulations respecting prices, placards, &c., and other subjects, only of local interest.]

58. At the close of the performance, all the side doors and other means of exit shall be opened, in order to facilitate the egress of the public.

These doors should all open outwards, and they should be constantly kept perfectly free of obstructions of any kind, within or without.

All the doors of the boxes shall open from within at the will of the occupiers.

59. The directors are expressly forbidden to cause the lights to be extinguished in the auditorium, the staircases, the corridors, or vestibules, before the theatre is completely emptied.

60. Oil lamps, placed in glass lanterns, shall be kept burning from the moment of the opening of the theatre till the closing, in sufficient numbers in the auditorium, the corridors, and staircases, to prevent complete obscurity in case of the gas becoming extinguished.

[The rest of the ordinance refers to the regulation of carriages, &c.]

With respect to general precautions against fire, the *Bulletin Français* says that it is proposed without delay to complete the arrangements for the protection of Paris against fire. The authorities possess five steam fire-engines, of which only three are at present in use, the two others being in store at the Conservatoire des Arts et Metiers. It is found that all eight are required to complete the *materiel* for the protection of the city. The number of hydrants calculated to be necessary for the supply of the steam fire-engines is 600; the present number is only 345, but it is to be immediately increased. It is proposed, further, to make it imperative upon the proprietor of every house to set up a hydrant sufficient for the supply of an ordinary fire-engine; this being the case, with the pressure of water in the city, every floor of every house in Paris will be under command.

MISCELLANEOUS.

EARLY STEAM NAVIGATION.

The Secretary of the Society having accidentally learnt that his friend, Dr. Mann, was acquainted with the Wright family, some members of which were intimately associated with the introduction of steam navigation into this country, sought his assistance in procuring information in reference to the matter, which might prove worthy of record, as an incident in the early history of this application of steam. Dr. Mann writes, in reply, to the following effect:—

"At your request, I have seen Mr. Richard Wright, and I find that he retains a very full and exact memory of all the facts connected with the early establishment of steam navigation upon the river Yare, in Norfolk. I have accordingly procured from him a brief narrative of this imperfectly known little episode of the early history of the mechanical application of steam.

"Mr. Richard Wright is the second and only surviving son of Mr. John Wright, originally of Southtown, and afterwards of Buxton, in Norfolk, one of the chief actors in this enterprise, and who, as you are probably aware, was personally known to me whilst living at Buxton. The elder son of this gentleman, who also resided at Buxton for a long period, but is now, unhappily, deceased was the "John Wright" who had a large and well deserved reputation in the world for various beneficent works, perhaps foremost and chief amongst them, for the establishment of a boys' reformatory upon his own estate, which had a very successful and useful career, and which, during his life, had also the advantage of his unintermitting superintendence and care. My own personal intimacy was chiefly with the younger of these John Wrights; but during that intimacy I had frequent occasions for intercourse with the elder gentleman, and consequently knew him well. The important point, however, at which I aim in these remarks is simply to state that I have the best possible reason to place implicit reliance in the accuracy of the information upon this matter that I have gleaned for you from the younger brother of my old friend.

"Since my interview with Mr. Richard Wright, I have been further favoured with a most interesting letter from Mr. John Wright, of Rochester, the nephew of the elder John Wright, of Southtown, from which I learn that two brothers, John Wright and Richard Wright—the latter being the father of my correspondent—were concerned in the preparation and starting of the steam-boat upon the Yare. I have therefore fused the information that I have derived from these two sources into the narrative which I have the pleasure to send you, and I have no doubt you will agree with me that the part played by these two gentlemen, in this episode of the early application of steam to river navigation, should have a place in some permanent record."

NOTES REGARDING THE INTRODUCTION OF STEAM NAVIGATION UPON THE RIVER YARE, IN 1812, BY MR. RICHARD WRIGHT, OF STOCKWELL, AND MR. JOHN WRIGHT, OF ROCHESTER.

In the year 1811 a French privateer, called *L'Actif*, was purchased in the port of Yarmouth, by Mr. John Wright, a member of the Society of Friends, for £35. This vessel was an open rowing boat, carrying 20 oars, and 3 lug sails, clinker built, and 52 feet long.

The first purpose in reference to this boat was, that it was to be driven by an engine worked by the explosive force of hydrogen, mixed with air. This plan, however, in which it appears that Mr. Richard Wright, the brother of John Wright, was principally concerned, failed after a considerable expenditure of money in experiments. The boat was then cleared of the unsuccessful machinery, and sent round, under sail, to the Humber and Leeds, to have one of the—at that time new—"Trevithick" high pressure steam-engines put into her. The engine supplied was of eight-horse power, with an eight-inch cylinder of two feet six inches stroke, and with a cast-iron boiler some six or eight feet long, and the machinery was made by Messrs. Murray and Wood, of Leeds. Mr. Richard Wright accompanied the boat to Leeds, and remained there to superintend the fitting of the machinery, and then returned with her to Yarmouth. She was insured for the sea portion of the voyage on the condition that the paddles were to be unshipped and that the engine was not to be worked. On leaving the Humber, however, the boat was caught in a gale of wind, driven on shore, and left high and dry on the beach. Mr. R. Wright, who was on board, propped her up as the tide fell, and then rigged up the paddles and got up steam, and upon her floating with the return of the tide boldly forced her out to sea, in the face of the risk of the loss of the insurance which he consequently incurred, and in this way saved her from wreck, and brought her safely into Yarmouth. His son, however, believes that he only worked the engines until he had secured a sufficient offing, and then again had recourse to the sails.

Mr. John Wright has a distinct memory of the day of the first trial of the boat at Yarmouth. There were many thousands of people assembled to witness the attempt. The boat started against a strong tide and head wind, and at once obtained a speed of about six miles an hour. On the following day the boat began its regular service between Norwich and Yarmouth, and used to perform the passage in five or six hours. She has, on extreme occasions, carried 107 passengers. There was a full account of this first experimental trip printed in the *Norwich Mercury*.

This was possibly the earliest application of steam to the purpose of regular passenger traffic in a boat in England. Mr. Richard Wright, of Stockwell, remembers that there was some talk of the experiment on the Clyde, about a fortnight after the establishment of his father's boat in regular work. The boat was started as the *Experiment*, and, as an experiment, proved to be eminently successful. She was of about ten tons burthen, and the Trevithick engine turned out to be a very excellent one. The speed attained was occasionally from ten to twelve miles an hour, and the boat ran regularly upon the Yare, between Norwich and Yarmouth, performing the voyage each way, on alternate days, including stoppages, in five or six hours, the distance being about thirty-two miles. The first voyage was made either at the end of 1811 or at the beginning of 1812. Mr. Richard Wright is not absolutely certain which; but he is quite sure that the starting of the boat was within that limit.

The *Experiment* ran in this way as a passenger steam-boat, under Mr. John Wright's own immediate supervision, until the end of the year 1812. He then determined to give the *Experiment* an associate in her work, and he built a new boat at Yarmouth, which he launched as the *Telegraph*. A high-pressure steam-engine of ten-horse power was fitted into this boat; but the second engine never worked as satisfactorily as the first one. The *Telegraph* and the *Experiment*, nevertheless, plied upon the Yare in concert, passing each other on the up and down voyage half way. It was Mr. John Wright's habit, at this time, to start each morning with the up boat from Yarmouth, and to change into the down boat from Norwich when the steamers met.

Soon after the completion of the *Telegraph*, the engine of the *Experiment* was removed into a new hull, which was launched as the *Courier*. From that time the *Experiment* disappeared, and Mr. Wright's steam-boats upon the Yare were, the *Telegraph* and the *Courier*.

After a period of about nine months, Mr. Wright conceived a great desire to test the sea-going qualities of his boats. The *Telegraph* was for this purpose sent to the Medway, and ran for a few weeks between Sheerness and Chatham. The current in the Medway, however, proved to be too much for her powers, and after about a couple of months the trial was abandoned, and the boat taken back to Yarmouth.

When the boat was returned to Yarmouth, it was found that her boiler had become very much incrusted with saline deposits, and that one end was very much injured from that or some other cause. The faulty end was in consequence taken out, and a new end plate of cast-iron, an inch and a quarter thick, was bolted into its place. Mr. Richard Wright was at this time a lad of about nine years of age, and has a very distinct memory of the transaction, in which he took great boyish interest at the time, locking on whilst the mechanical operation was in progress. When these repairs were effected the boat was put on the river again, upon its old footing, and for another six months continued to run, turn and turn about, with the *Experiment*.

It so happened, however, some little time after this, that an engineer, named Watts, resolved to take up the running, and to put an opposition boat upon the river. This boat was prepared to start on the Good Friday of 1817, that date being selected in consequence of its being the day after the Tombland Fair at Norwich, when it was expected that there would be a large concourse of passengers returning to Yarmouth. The engineer of the *Telegraph*, however, unhappily resolved that he would not be beaten by the new opposition boat upon this occasion, and it is suspected that he loaded his safety-valve with a fourteen-pound weight, to increase the working pressure of his steam. He afterwards persisted in a resolute denial that he had done so, and, as there was no actual evidence upon the point, it was never known whether he did so or not. But, however this might have been, the boat started from its station at the Foundry-bridge at its appointed time, gave three whiffing snorts as the machinery began to work, and the boiler then burst into fragments, of which some went through the fore-cabin and some through the after-cabin, clearing away everything before them. Mr. Richard Wright thinks, so far as his memory now serves him, that eight persons were killed by the explosion, besides others who were more or less severely injured. The engineer was blown into the river, and swam to the bank, somewhat seriously scalded. The steward, who was standing on the deck above the engine-room at the time of the explosion, came down into the place vacated by the boiler, unhurt, and a young infant, lying in a cradle under one of the seats in the fore-cabin, also escaped without injury.

Mr. John Wright, the proprietor of the boat, paid a large sum in compensation for injuries, or for loss of relatives, to the victims of the accident, and was seriously crippled in his fortunes in consequence. The sister steam-boat was immediately taken off the line, in deference to the panic which was caused, and the opposition boat, for the same reason, was heard nothing more of.

Mr. Richard Wright states that he remembers his father, some little time after the accident, asking him one day whether he thought four horses could be made "to walk round" in the hull of the *Courier*. He next remembers the engine being taken out of the *Courier*, a platform five feet wider than her beam being erected upon her, and an upright shaft in brass bearings, with a bevelled toothed wheel below, like the shaft and wheel of a thrashing machine, being established in the centre of the platform. Four horses were then put into gear, and the horse-boat of the Yare was soon afterwards successfully established. This horse-boat was, in reality, the old *Courier*, with horses and suitable machinery substituted for the steam-engine.

The horse-boat used to work with four horses, and attained a speed of between seven and eight miles an hour. The horses went half way, and were then changed for a second team, which completed the voyage. The boat ran up and down between Yarmouth and Norwich on alternate days. It commenced its operations within twelve months of the accident to the *Telegraph*, and then worked steadily under Mr. Wright's auspices for about twelve months. After that time it was sold to Messrs. Tuck and Fisher, a firm of plumbers at Yarmouth, and under their management continued to run as a passenger-boat either three or four years, when the horses and horse machinery were once again taken out of the hull, and steam machinery was put into their place. The real reason for the use of the horse-boat was the necessity to meet for a time the public sentiment of dread of steam which had been roused by the accident to the *Telegraph*.

Mr. Richard Wright states that he believes the actual loss to his father from this accident amounted to, at least, £10,000.

THE PATENT-LAW IN GERMANY.

At the present moment, when our own Patent-law is under discussion, it is interesting to note what is being done elsewhere in the same direction.

As before the union of the various States under the Emperor, each has its own Patent-laws, which differ enormously from one another. The Imperial Government has already given unity to the currency, the bank, the post-office, and to the commercial, civil, and penal laws, and is now intent on producing a Patent-law for the Empire. This being announced, a Commission was formed of twenty-four or twenty-five persons, including professors, manufacturers, directors of schools of commerce, and industrial museums, and even the chief of a patent agency. This association began its work in August last. The results of its inquiry were made known to the Imperial Chancellor, who caused a draft Bill to be drawn, and sent to each State of the Empire for consideration, this is further made known to the public through the papers, and is being discussed with interest.

This project contains some points well deserving of consideration. The first clause states that patents are to be granted for new inventions, with the exception of such as are offensive to morality, those which merely refer to the ornamentation or decoration of an object which is public property, and, lastly, articles of food and medicaments, but the modes of preparing these may be patented. It is laid down as a rule that it is not the invention that is patented, but its industrial application; therefore, an invention to be patentable must be useful.

The second clause declares that stating a result which is in opposition to the laws of nature is not an invention, and cannot be patented. Thus, inventors of "perpetual motions" are notified that it is no use their applying for the protection of the law.

As in Prussia at present, so in all Germany, applications for Letters Patent are to be submitted to examination, and the novelty of any claim is thus referred to in clause 3:—"An invention is not new when it has been clearly described in any other than an official publication of patents granted in foreign countries, or if it have already been sufficiently practised in Germany to have been copied or imitated."

Article 4 gives priority to the first applicant, but does not withdraw the right from another, who may have brought out the same invention previously. The Government retains to itself the right using any military or naval invention, and, indeed, any which may affect the public well being, giving the inventor a fair remuneration; the tribunal or authority to which such remuneration would be referred is not mentioned.

Prussia at present grants patents for a number of years, sometimes as low as three, often five years, as considered sufficient under the circumstances; the new project fixes the duration of a patent at fifteen years as in France and some other countries. The fees are made progressive, as in Belgium, the amounts being 30 marks so on increasing annually 50 marks, till the sum reaches 700—making a total of 3,480 marks, or in round numfor the first year, 50 for the second, 100 for the third, and bers, £170. No fees to be charged as additions to a patented invention. In case of the non-payment of an annual fee the patent is forfeited, but three months' grace is allowed.

In the case of an invention being obtained by fraud, or in case of a stranger not having a representative in Germany, the patent is forfeited; it may also be forfeited if the patentee refuse to allow it to be used in Germany on similar terms to those accepted in any other country, or, if he do not himself work it. The Chancellor attaches much importance to these provisions, more perhaps than will be generally accorded to them.

The most remarkable novelty in the plan is the establishment of a Patent Court (*Patenthof*), which is empowered to confer and withdraw patents, at once an administrative office and a tribunal. It is to sit at Berlin and to be composed of three jurisconsults, one of whom will preside over the sittings, and of a certain number of specialists (engineers, chemists, mechanicians, and others), divided into committees. Experts may also be asked to take part in the proceedings of the Court, but not to vote. No patent is to be annulled without the presence of two of the jurisconsults. This Court is also to be a Court of Appeal, but the final decision rests with the Supreme Tribunal of Commerce of Leipsic.

When a patent is allowed, the name of the inventor is to be announced in the official journal, and the protection is accorded from that moment. From the day of publication, however, the claim undergoes public inquiry for eight weeks; all the documents are open to investigation, and any one may enter opposition in writing, accompanied by a fee of twenty marks. A curious arrangement comes in here, if the applicant persist, in spite of the Court's declaration that the invention is not new, publication and inquiry proceeds as if the application were acceded to, but the inventor is not protected. This seems manifestly unjust, and has already been seriously objected to.

A provision in favour of needy inventors deserves special mention. If the Court be convinced that the applicant has not the means of paying the fees, it may give him credit for three years.

The Court is endowed also with the power of taking the initiative by declaring a patent void, but the patentee must have a month's notice and may oppose the motion.

Cases of infringement are left to the Civil Courts, which may ask the advice of the Patent Court in any case, just as it would take the evidence of an expert. The penalties are limited by a maximum fine of five thousand marks, or six months' imprisonment, and damages; or the damages may, on the application of the complainant, be commuted to a fine, payable to him, of ten thousand marks, in which case all the defendants would be liable individually and collectively.

The fees proposed to be charged are considered too high, and this is not to be wondered at when we consider that they are nearly three times as heavy as those charged in France, and about six times those of Belgium; on the other hand, the adoption of the principle of progressive fees, as in the last-named country, and especially the power of the Court to grant poor inventors three years to pay them in, are very important concessions; and, considering the small proportion of patents which survive—and it is not in the nature of inventions that a large proportion should be successful—the high fees charged during the latter years of the period are not very onerous; the duty in the third year is less than five pounds, and that of the seventh year not fifteen pounds, a very appreciable difference here between the provisions of this proposed law and our own, while a patent maintained during the whole of its period would cost nearly the same in fees in both countries. It must be remembered, however, that Germany is a poor country, and fees which are considered high here appear exorbitant there.

THE JAPANESE MANUFACTURE OF FANS.

Osaka is the principal city for the manufacture of the "ogi," or folding fans, which are those almost exclusively exported, all descriptions of the bamboo kind being made there, the figures, writing, &c., being executed in Kiyoto. The prices vary from 12 yen to 30 yen per 100, and even occasionally higher figures than this are given. The bulk, however, consist of the low-costing goods. The Japanese get their supplies for home consumption from Nagoya, and these are cheaper, although, perhaps, less endurable than those made for export. The superior fans, called "uchiwa," are manufactured at Kiyoto, and are extensively used by the better classes of Japanese, children, &c., while the inferior kind of the same decription come from Fushimi and Tokio. Consul Annesley furnishes the following extract from the *Hiogo News*, of 24th November, 1875, regarding Japanese fans and their manufacture, which may be interesting to quote:—"Like many other manufactures, the principle of division of labour is carried out a long way by this branch of industry. The bamboo ribs of the fans are made in Osaka and Kiyoto by private people, in their own homes, and combinations of the various notches cut in the lower part is left to the finishing workmen, who forms the various patterns of the handles according to plans prepared by the designer. In like manner the designer gives out to the engravers the patterns that his experience thinks will be saleable for the season next ensuing; and when the different blocks have been cut it still rests with him to say what colours are to be used for each part of the design, and what different sheets are to be used for the opposite sides of each fan. In fact, this official holds, if not the best paid, at any rate the most important position on the staff in ordinary; just now, however, his talents are, to a great extent, thrown into the shade. Foreigners have had fans made ornamented with flags, with pictures of the exhibition, with advertisements, and with other eccentric devices, and the only choice left is the choice of colours. When the printed sheets which are to form the two sides of the fans have been handed over to the workman, in company with the sets of bamboo slips, which are to form the ribs, his first job is to fold the two sheets which are to form the fan, so that they will retain the crease. This is done by putting them between two pieces of heavily-oiled paper, which are properly creased. The four are then folded up together and placed under pressure. When sufficient time has elapsed, the sheets are taken out, and the moulds used again, the released sheets being packed up for at least twenty-four hours in their folds. The next process is to take the ribs (which are temporarily arranged in order on a wire), and "set" them into their places on one of the sheets, after it has been spread out on a block and pasted. A dash of paste then gives the woodwork adhesive powers, and that part of the process is finished by affixing the remaining piece of paper. Three or four times the fan has to be folded up and opened before the folds get into proper shape, and by the time the fan is put by to dry it has received an amount of handling that no foreign paper would endure. The qualities of native paper now used are not nearly so good as those of which the old fans were made, and, in consequence, the style of manufacture has had to be changed. Instead of first pasting the ribs, the ribs are square, and (as said before) pasted in their places. The outside lacquered pieces, and the fancy work, are all done in Osaka and Kiyoto, and some of the designs in gold lacquer, on bone, are really artistic, but the demand for the highly-ornamented class of goods is not sufficient to encourage the production of large quantities of first-class work. When the insides are dry, the rivetting of the pieces together (including the outer covering) is rapidly done, and a dash of varnish quickly finishes the fan. The highest priced fan that was ever used in the days of seclusion from the outer world was not more than 5 yen. Since the dealings with foreigners, however, some few have been made to order as dear as 10 dollars and 15 dollars each. The general prices of ordinary fans range from 50 yen per 100 to 15 yen per 100, though an extraordinarily expensive fan is turned out at 50 yen per 100. The number of fans on order for the Philadelphia Exhibition amounted to over 800,000, at a cost of about 50,000 dollars. The sale of fans in olden times seldom exceeded 10,000 a year for the whole country, but there have been (independent of the Exhibition fans) nearly 3,000,000 exported from Hiogo and Yokohama during the past twelve months. The Tôkio fans surpass those made in this neighbourhood in design and neatness of style, and also in price." It will be seen the above remarks refer only to the folding fan, the "ogi."

PIERCING THE ISTHMUS OF DARIEN.

The long standing project of a canal through the Isthmus of Darien has been taken up by a French company, including a considerable number of well-known names, with Lieut. Bonaparte Wyse as commander of an exploring commission, which reached Panama on the 4th of December last, and left there to proceed up the Tuyra on the 13th of the same month.

The points of general interest are those which are contained in the programme of the steps to be taken with the view to carry out this important work by M. Celler, a chief engineer of *Ponts-et-Chaussées*, and president of the company. Omitting the history of the project, which is given at some length by M. Celler, the chief points in this report are as follows:—The object is to make a canal similar to that of Suez, without locks, from the gulf of San Miguel, in the Pacific Ocean, to that of Uraba, in the Atlantic, making as much use as possible of the existing streams and rivers.

In 1871 levels were taken and plans drawn, under the direction of Commandant Selfridge, by order of the United States Government, but these operations, although long and laborious, are not considered by M. Celler as sufficient to completely elucidate the subject. But the documents, which have been published, include detailed hydrographic plans of the maritime portion of the Tuyra, and important information concerning the Atrato, which, the reporter thinks, leave no doubt that there exist two natural ports at the extremities of the proposed canal, completely closed and having a depth of from 2·50 metres to 30 metres at low water, with a superficial area of 5,500 and 66,000 acres respectively. The latter of the ports, to which the name of the Bay of Columbia has been given, but which is in fact the inner portion of the gulf of Uraba, is described as a magnificent port.

The Atrato, the width of which varies from 1,000 to 1,500 metres, presents a safe and easy navigation, with 8 to 30 metres of water to Vijia-Fuerte, which is about 183 kilometres above the confluence of the Cacarica, and the Tuyra is accessible for large vessels to the extent of 48 kilometres, and might be made, by means of a little dredging and embanking, navigable up to the mouth of the Chucunaque. The hydrographic plans prove, according to M. Celler, that very little expense would be required to make the proposed canal between the gulf of Saint Miguel and Chucunaque, and along the Atrato to the mouth of the Uruba, over the respective distances of 62,500 and 70,000 metres.

The canal, properly so called, however, is that part which lies between the Rio-Chucunaque and the Atrato, at the distance of five kilometres above Lorna de Cacarica; the extent of this, as far as shown by the American survey, would be 100,000 metres, would require a tunnel two miles long, and excavations to the extent of 43,574,532 cubic metres of earth, and 62,185,013 cubic yards of rock. Thus the cubic mass to be excavated would amount to about a twelfth or an eleventh more than was estimated for the Suez Canal. This calculation is based on the width of the canal being 59·51 metres in the earth, and 34·44 metres in the rock, but M. Celler thinks that there is no reason why this width should not be greatly reduced.

There is much contradictory evidence about the level of the various existing passes of the isthmus; all that can be presumed, says M. Celler, is that the tracing may be made so as to avoid all locks and tunnels.

Comparing the probable work when done with that of the Suez Canal, the reporter says, that if on the one hand there will be larger cubic contents to excavate in rock of medium hardness of the tertiary formation, on the other hand there will be no ports to form or to maintain as in the Suez case, and no fresh water canal to be cut, the conclusion being that the Darien Canal cannot be much more costly than that of Suez.

To complete the information in hand, M. Celler lays down the following programme:—1. To take exact levels of a line, starting from the confluence of the Chucanaque to that of the Cacarica, following the valleys of the Tuyra, Paya, and Cacarica, keeping as nearly as possible to the probable tracing of the canal; 2. Secondary levellings to show the profile of the ground to the extent of 200 metres on each side of the central line of the base of operations; 3. Hydrographic plans in detail at the mouth of the Uruba, and the maritime portion of the Tuyra, with soundings, geographical examination, &c.

The report was unanimously adopted by the acting committee of the Society.

COFFEE CULTURE IN COORG.

From a brief report on the agriculture of Coorg, it seems that the coffee crops of 1875-76 did not realise the high expectations that had been previously formed. The rice fields also yielded less than an average crop, and the cardamoms sank so low in value that there was little profit, if any, on the outlay. Large concerns in coffee changed hands, and new capital was invested in opening out fresh plantations. The comparative failure of coffee planting in the forest region of the ghats directed all eyes towards the bamboo districts, where thousands of acres of reserved State forest land are thrown open to new enterprise, and where, by a considerate Government, liberal exchanges for deserted ghat estates are being assigned. It only required a good season, after an exceptionally dry one, to make things as pleasant for the planter as he could desire, since the scarcity of food in Mysore, on account of drought, promised him an early and ample supply of labour. The strong east winds and high temperature in January and February were mitigated in the middle of March by refreshing showers for many days together, the rainfall amounting to nearly three inches, and in the bamboo district to over four. All the coffee estates showed a splendid blossom, which fully burst out towards the end of March and generally set well. April and May proved very hot and dry, and June, which in the driest season carried nearly 13 inches of rain over the bamboo district, brought this year only six inches and a half. The monsoon of 1875, being an exceptionally light one, was followed by another dry season; the drainage of the country became very low, and all the springs and wells nearly exhausted. Coffee nurseries that had to rely on hand watering from springs and rivulets, were withering, and thousands of seedlings dried up. Estates much exposed to the scorching heat of the sun and of the east wind suffered intensely, and quantities of the formed berries dropped off, and with them so much of the hope of a bumper crop. The greatest damage, however, at least in the bamboo district, to most of the estates, was done by the planters' old enemy, the "borer," the ravages of which are as destructive and extensive as ever. Though some planters may shake their heads and shut their eyes, and declare the insect is not in their trees, the unmistakable revelation at crop time will convince the sceptic of the insidious approaches and devastations of the enemy, which can be overcome and subdued only by timely and resolute extermination of every bored coffee-tree. It is stated to be a pitiable and heart-sickening sight, the appearance of the borer stricken trees, full of withering crop, in a luxuriant coffee field, or the piles of sturdy stems, perforated by the unmistakable holes through which the beetle made its escape, collected in the estate roads to be burnt. No wonder that so many shrink from this unpleasant task; but how often is a mistaken forbearance punished with a tenfold loss in the following season. The planter who cannot bring himself to the task of uprooting these croppy, but doomed trees, which contain hundreds of the borer insect in its pupa state, will, months afterwards, have to behold a tenfold number of trees attacked by the progeny of the beetles of his own rearing. However great the first sacrifice may seem to a hard-working planter, in its result it is the most economical proceeding, where once the borer has made its appearance, to destroy every attacked tree, for the borer, undisturbed, will spread, and a bored estate will yield no crop, and soon perish. Whatever may be the immediate cause of the borer's appearance among the exotic coffee trees, there can be no doubt that it owes its periodically enormous increase to the prevalence of dry seasons, and it spreads most in open coffee fields in warm localities, and least in moist and shady places combined with high cultivation.

The other prominent enemy of the coffee tree, the leaf disease, seems to have disappeared, though last year there was plenty of it everywhere, since neither soil, shade, climate, nor cultivation, seem to have any debarring effect to its spreading. Though it is stated that the trees affected by this disease produce a light crop and lose many of their primaries, and, when stumped, do not throw up healthy shoots, and frequently die, the trees that came under the notice of the writer of this report appeared to be none the worse. Perhaps, however, the *Hermilira vastatrix* is under another form of existence, and may re-appear in those well-known orange-coloured spores, for like other fungi, it undergoes certain transformations. It is singular that these orange-coloured spores are generally encircling the stomata of the lower epidermis of the leaves, and they have been found even on leaves of coffee seedlings not one year old. It is difficult to conceive how these spores should have come there, whether from without or within, the whole of the circular tissue around the spots being affected as by an internal disease. It seems equally difficult to say whether the fungus is the cause or effect of the diseased leaf. As to remedies, these appear to be expected rather from climatic influences than from the sagacity of man, for all the propositions yet made may prove satisfactory in the laboratory, but are impracticable where any large area is to be operated upon.

THE VENETIAN LAGOONS.

The important and vital question for Venice of the progressive obstruction of its lagoons, caused by the accumulation of sand and offal, brought from the undulations of the sea, and from the many rivers flowing into them, is now become the serious and careful study of the Local Chamber of Commerce of the municipality, and of the Italian Government. The Superior Council for Public Works voted the removal of the River Brenta from the lagoons of Chioggia as far as Brondolo, and the engineer, Dr. Bocci, has been instructed by the ministry to study and report all the necessary measures to carry into execution this important decision; but the provincial authorities of Padua are opposing the project, objecting that by the deviation of the course of the River Brenta the territory of the province would be exposed to inundations. The rescue of the Venetian lagoons not being merely a local, but, indeed, an Italian question, it is urged that the Ministry for Public Works should not be influenced against such an urgent and essential decision, which, if carried into effect, would be contrary to all progress and civilisation, and cause the ruin of many commercial and industrial interests.

The late Signor Paleocapa, the greatest hydraulic engineer of Italy, was the chief promoter of the hydraulic works, the demolition of which is no indispensable to the existence of Venice and Chioggia as maritime ports. Paleocapa himself proposed, in 1830, the reorganisation of the port of Malamocco in lieu of that of the Lido, and in 1840 he brought the River Brenta into the lagoon. The civil engineers, Mati and Contin, in their report on the project of the re-opening of the port of the Lido, expressed their conviction, based upon strong grounds, that the eminent technical engineers of the French Commission, in 1806, as well as Signor Paleocapa, were in no way justified—the former in preferring the organisation of the port of Malamocco in lieu of that of the Lido, and the latter in encouraging the same project in 1830. From 1811 to 1874 the port of Lio Maggiore, which divided in two equal parts the coast of the Cavallino, was gradually destroyed, and the sands have almost entirely obstructed and covered the bank of the canal of the Lido, known also as the canal of Pordelio. This canal discharges itself into the canal of the port of Treporti instead of falling into the sea, by the total obstruction of the coast, and hence the disappearacne of of the port of Lio Maggiore, whilst the port of St. Erasmo is no longer distinct from the port of Treporti, as it was in 1811. The condition of the upper lagoons, from St. Giocomo del Paludo at Murano and Mazorbo to the Sile, is deplorable. It is sufficient to throw a glance at a plan of the lagoons of Venice, to see with how many marshes that part of the Venetian lagoon is encumbered. It is stated that:—

1. The coast of the Cavallino will inevitably extend as far as the port of Treporti, submerging it in the same way as the ports of Lio Maggiore and St. Erasmo with sand, and even obstructing the Punta dei Sabbioni, and will stretch out towards Venice, whilst the canal to the port of Treporti will be absorbed by the canal of the Lido.

2. The beds of the three contiguous ports will eventually rise so high as to be on a level with the coast.

3. The canal at the mouth of the Lido will afterwards be the only means of communication with the three lagoons, without even the resource of the overflowing of the waters, which at present takes place over the now depressed sand-bank. But by the rising of its bed the now half-choked canal of the Lido will be insufficient for the requirements of the port, and the general deterioration of the lagoon will rapidly progress.

4. From the tortuosity of the canal the sands will moreeffectually invade the lagoon of the Lido.

5. The above-mentioned circumstances will shortly produce a permanent obstruction between the port of Malamono and the port of the Lido, fatal to the latter.

The stream is so strong that all masters of vessels coming from the Mediterranean into the Adriatic are compelled to direct their course close to the Dalmatian coast, whilst when they sail out they steer close to the Italian coast to go with the stream. From the fact of the diminution of the depth of water, and the consequent progressive obstruction of the lagoons, the redemption of the port is of such supreme necessity as to involve not only the navigation and commerce of Venice, but also the very existence of the city.

CORRESPONDENCE.

INDIAN RAILWAYS.

The extreme importance of the question of the material improvement of India by public works, will, I hope, be considered a sufficient reason for my begging room for the insertion of a rather long letter on that subject.

Having only just recovered from a dangerous illness, I was unable to attend the late meeting of the Society to hear the paper by Mr. Danvers on Indian railways. There being none but railway men to take part in the speaking, there was not of course the slightest approach to any discussion of the question, only one side being heard.

The whole object of the Society being the real discussion of all such subjects, I cannot but hope that an opportunity may be given to the readers of the *Journal* to hear the other side of this great question, in which the welfare, not only of India, but of the British Empire is so deeply involved.

The questions are, what does India require in the way of public works? And secondly, what are the results of this tremendous experiment of spending 166 millions on railways, compared with that of about 10 millions on great irrigation and navigation works now in operation?

The fundamental point in the whole question is this, that it is now proved beyond all possibility of doubt, by the expenditure of hundreds of millions in various countries, that railways cannot carry cheaply, that they utterly fail to carry cheaply enough for the main traffic of any country of great extent; that $\frac{19}{20}$ths of the traffic that ought to exist, and that is absolutely necessary for the material well-being of every country, will not bear the cost of railway transit for several hundred miles. In a book published in India on public works in 1853, and favourably reviewed in the *Times*, by a gentleman, who if common report speaks true, has since held high office in the Government, it was said, "If a railway on an important line is constructed on so expensive a plan as to require a high rate of charge to enable it to pay a dividend, an irreparable injury will have been done, and the whole power of an influential body (influential and powerful just in proportion to the amount of capital expended) will be brought to bear on that line, not to secure cheap transit, but to prevent cheap transit ever being obtained on it."

This is precisely the present state of things, though with a great additional aggravation, which the writer did not foresee—that not only the shareholders, directors, &c., connected with these 166 millions invested in the Indian railways are in this position, but the whole body of the officials who are committed to this terrible mistake are now, as it were, compelled to keep the real commanding facts of the case out of sight, to do their utmost to keep India deprived of this essential of cheap transit, without which it cannot possibly prosper itself, or benefit England as it is capable of doing.

Thus we see, in the late meeting, an ex-Viceroy entirely agreeing with the railway men, in a so-called discussion which altogether excluded the essential point of the whole matter, viz., that all India is still utterly paralysed for want of cheap transit, notwithstanding the expenditure of 166 millions on railways and their debt. At this moment, to take one single item as an example, we are importing from America, and other foreign countries, some 30 millions' worth of wheat, and only about 2 millions from India, solely because we have not water-carriage for it in the latter.

If America had not canals and rivers, and was dependent on railway, the whole wheat trade would be destroyed, and if India had a canal to the north-west and other tracts, it would immediately have a wheat trade of 20 or 30 millions. All depends solely upon effective water-carriage, that is, carriage sufficiently cheap.

If there were water-carriage, Indian wheat could be landed in England for £8 a ton, against £12 the present market, and the average price. And what limit would there be to the trade if such a difference existed, but that of the wants of England; and if India were receiving 20 millions a year for this one item, what would be the demand then for English manufactures when they could thus afford to pay for them. And so with a multitude of other articles.

So on the other hand if America had to pay 1d. a ton a mile, by railway, for 1,200 miles, from Chicago to the Coast, £5 a ton, it would completely stop the trade.

But to meet the case as it was put before the Society at the meeting, by both the writer of the paper and the speakers. The paper says:—"There are two ways by which transit can be effected, by land and by water. In many places, and for many purposes, rivers and canals afford the cheapest and readiest mode of transit . . . . but the latter can only be constructed where there is water at hand to fill them, and where the gradients of the country favour its flow. The great advantage of land communication is, that it can be formed wherever it is wanted, that it can unite towns and military post by the shortest routes, that it ensures speed and punctuality, and that it is more free from interruption." Is this really the language of a gentleman whom the Secretary of State has entrusted with the charge of works that have cost India 166 millions? Do these words really exhibit his knowledge of the subject of transit in general, and that in India in particular? Who can be surprised at any troubles that may occur in India in the way of famine, failure of finances, poverty, discontent, &c., when this is all the knowledge of the subject of transit of the head of the Transit Department of the India-office, a subject of which this very writer says:—"It may be laid down as an axiom that the nation which has been best provided with the most suitable means of conveyance, has made the greatest advance in civilisation and prosperity."

Think of this comparison of land and water-carriage, in which not one word is said of either the cost of construction of the two modes, or the cost of working them. Whether a communication costs 33 millions for 1,500 miles, and incurs a debt of 10 millions, making a total of £30,000 a mile, as the Ganges Valley Railway has, or whether a steamboat canal costing £2,000 a mile, as this line would have done if constructed at the time the railway was, is a matter totally unworthy of mention in the case; and whether when made it carries at a charge at which the great bulk of the goods and passengers can be carried by it or not, that is at $\frac{2}{3}$d., or $\frac{1}{20}$d. per ton, and at $\frac{3}{8}$d., or $\frac{1}{10}$d. for passengers, is also quite insignificant anywhere, and especially in a miserably poor and unimproved country like India, where everything in the way of internal improvement has yet to be done, and this on a line where the supply of water is unlimited, and the gradient perfectly insignificant, a foot a mile.

Is it not wonderful that such should be the ideas on the great subject of transit; views so utterly without foundation, that the essential points of the question are enirely omitted, the points upon which depends whether the mode used perfectly answers its purpose, or utterly fails, nay, much more burthens the poor country with a perfectly hopeless debt.

On this line, instead of an expenditure of 43 millions, a lowest charge of $\frac{2}{3}$d. for goods and $\frac{3}{8}$d. for passengers, a traffic of 270,000 tons a year, and 1,000 passengers a day, we might have had a steam-boat canal, 40 yards broad, carrying steamers of 250 tons, costing three millions, carrying at a charge of $\frac{1}{20}$d. a ton, and $\frac{1}{10}$d per passenger, a traffic of two or three million tons a year and some 5,000 passengers a day, and forming part of a grand system of irrigation, affording cheap production as well as cheap carriage, and effectively preserving the whole tract from famine.

And with respect to speed, the canal could be worked, for the few things and persons that required it, at a higher speed than the railway is now actually worked at, if this were a matter of any considerable importance in the case of a poor country, which it certainly is not. In such a country, where $99\frac{1}{2}$ per cent. of passengers travel 2nd and 3rd class, it is certain that economy is immensely beyond speed in importance. The paper in question is thus introduced by a preface implying a total misapprehension of the whole subject of transit. What are we to expect from it. This question of transit in India is really one of immense national importance, and we must not trifle with it.

With effective transit, India would certainly be, in respect of material prosperity, the complement of England, both in supply of materials and a market for manufactures; without it, it must continue to be a source of continual anxiety, from its famines, its poverty, its low revenue, and its low estimation of our rule.

He adds, "There should be no rivalry between canals and railways in India." No wonder the railway men are afraid of the rivalry. The slightest examination of the question as to the results of the two, stultifies the whole of the past proceedings in this matter.

He proceeds to compare railways, not with steam-boat canals, but with unimproved rivers. He states that the Indus has been superseded by the railway; but, first, not one word of proof that this was a wise proceeding; and, secondly, supposing the railways did carry more effectively than the river, is nothing to be said of the cost of it? Supposing that the land beat the water, after spending £10,000 a mile on the former and nothing on the latter, does this decide the question? Would it settle the question if £10,000 a mile had been spent on the river, and nothing on the land? Is the bare fact that a railway is being constructed on this line conclusive of this question? That the Government is making the same monstrous mistake on this line, after the decisive results of this vast experiment on other lines, is only an additional proof of the terrible infatuation of the land-carriage advocates. On this line also a steam-boat canal could be constructed with exactly the same advantages over a railway as on the Ganges line. The railway will completely fail on this line to carry the great traffic as the other has; and a steam-boat canal will be just as much wanted when 10 millions have been spent on the railway as it is now.

The Scinde Railway has cost 2 millions for 108 miles, £18,000 a-mile besides its debt, and has been, perhaps, the greatest waste of money ever made in India. The net receipts from it, when it was reported as a separate line, were £24,000, 1¼ per cent.; and it is now, and must continue, overwhelmed with debt. Were a steam-boat canal made on this line, the wheat, &c., of the Punjab could be brought to Kurrachee for 3s. per ton, 1d. a bushel, with no charge on the Treasury, and it must be observed, by the way, that it is the same distance from the centre of the North-West as Calcutta, while Kurrachee is 2,000 miles nearer England, and is free from the risk and expense of the Hooghly navigation.

The railway will certainly leave a heavy charge on the Treasury, and completely fail in the amount and cost of traffic. What are the merchants of Kurrachee doing that they are thus allowing themselves to be cut off from the vast population of the Punjab and the North-West?

I need not answer the curious remarks on the enormous debt on the railways. No words can get rid of the fact that the value of the land, and the interest paid to the shareholders, is so much lost to India, and is as truly part of the cost of the railways as the sum expended on the works.

In the paper it is said:—"If a man builds a house and finds that the rent gives him 2 instead of 5 per cent., he does not year by year look upon his house as having cost the amount of difference in addition to the original outlay." I think a real man would probably say—That house cost me £10,000 to build, and £3,000 in loss of interest in the ten years since it was built, besides the accumulations of interest on that loss, so that the house has, in fact, cost me up to this time £14,000.

The actual cost of the railways is—

Cost of works	£106,000,000
Land, &c.	2,000,000
Interest in 1870, 21 millions. Now about.....................	51,000,000
	£160,000,000
Or per mile..................	£25,000

This is what India has been compelled to pay for these ineffective communications, and no words can get rid of this fact. She is now paying in interest of debt, and in deficient receipts, 3½ millions a year; and this amount is added to her debt every year. It is now at the present rate of interest 4 per cent., equivalent to an addition to her national debt of 84 millions.

The total receipts for goods were in 1875-6, 4½ millions, so that, while the merchants paid 4½ millions for carriage, the State paid 3½ more out of the Treasury. The average charge is 1¼d. per ton, and the Government, therefore, pay 1d. out of taxes—four times as much as as the whole cost of transit by the unimproved rivers, and twenty times what it would cost by canal.

The paper further says:—"The amount of goods carried by the railways depends upon the state of trade in a great measure."

This is certainly true in one sense; that is, supposing a certain charge is made. But the state of trade affects traffic in a very small degree. The quantity of goods carried on a certain line depends upon the cost of carriage—that is, the traffic does not make the communication, but the communication makes the traffic. This is the fundamental principle of transit.

Remarks are continually made by engineers and men connected with transit, as if there was a fixed amount of traffic on a certain line, and it was all the same what kind of transit there was. But traffic waits like everything else for the possibility of its being carried on. If the actual cost of transit, including risk, &c., is 4d. a ton a mile, as it might be up the valley of the Ganges, if there were no road and no river, it might be 100,000 tons a year; by the river at ¼d. charge per mile of course of river, besides risk, &c., it may be a million tons; by steam-boat canal at $\frac{1}{20}$d. and no risk or delay, it might 3 or 4 millions; by railway, with an actual charge of 1¼d., it is about 300,000 tons.

He then speaks of the actual results of the East Indian Railway, yielding about 2 millions net revenue last year, which on 43 millions, its real cost up to this present time, was about 4½ per cent. At this rate it may certainly be considered as paying its interest. But it is the grand and apparently insuperable obstacle to an effective communication on this line.

Though a large portion of the line is now actually occupied by steam-boat canals, such is the fear of their stultifying the railway, that there is the most manifest effort to prevent the different portions being connected so as to form an effective line of communication.

The Ganges Canal, the Lower Ganges, and the Sone Canals, would, if carried out to the extent required for irrigation, leave only a gap at the Jumna River of 50 miles, to form a complete line from the Himalayas to within 300 miles of Calcutta, 800 miles, and an irrigation work, the Rajmahal Canal, which has been fully estimated would complete the line excepting an interval of 70 miles which could easily be made; but even without the last work, there would be a very effective communication if only the gap at the Jumna were filled up, when the irrigation works now under execution are completed. A line of canal was actually began of 100 miles, by the side of the railway from Calcutta to the coal-field, but when it was perceived that it would certainly show the whole state of the case, when the traffic both in goods and passengers was transferred from the railway to it, it was stopped under the excuse that coal has been found at Midnapoor; but when this was discovered to be a fraud, this canal was not resumed, and Calcutta is thus condemned still to dear coals merely to save the character of the railways. Whether the coals are carried at a cost of 4 rupees a ton or ¼ rupee, that is whether they cost at Calcutta 10 rupees a ton or 6, and whether half a million tons are used or a million (for the reduction of price would probably soon double the consumption) is nothing in comparison of keeping up the *prestige* of the whole railway system. In the same way one of the main lines of the Sone Canal was stopped by a late Governor, and when this was overruled by the Viceroy, it was again stopped by orders from home, though it is a necessary part of the irrigation works.

So with the Orissa navigation, an interval of 80 miles is carefully preserved, lest Cuttack should be put in direct communication with Calcutta by an effective work. But think that even now, with the present irrigation works, a sum of 1½ or 2 millions would complete the line from Hurdwar to Cuttack a distance of 1,300 miles which could be worked throughout for three rupees a ton. Who can estimate what the traffic would be on this length of line through such an immense population if such an effective transit were established.

Almost the whole of the line would require no interest, because it would be paid by the irrigation, but on those short portions which would be almost only for navigation, when two or three million tons, and perhaps a million passengers, are carried on a communication costing £3,000 a mile, the charge for interest would be quite nominal, about 1d. per ton and per passenger for 50 miles.

One of the speakers spoke of the abolition of the export duty on wheat, which was 5s. a ton, and he said, "When they remembered that was 2 per cent., and that in these times this was considered mercantile profit, they could understand the great advantage of the abolition." What a pity it was it did not occur to him to remind them at the same time, that by a saving of £2 a ton, eight times as much, by effective water-carriage, the advantage would be much greater.

The Chairman said, "he did not think any one who had some knowledge of India could doubt that that was one of the most profitable investments that was ever made by a great nation." How can I help expressing my unbounded astonishment at such an expression from one who had governed India several years? Had he really never heard of the irrigation works? The late head of the Irrigation Department in the India-office showed, in his paper at the Society of Arts, that the average return of all the great irrigation works was 10 per cent.; and that of the Godavery 40 per cent. (that of the Jumna canal last year was 40 per cent.), and this was only the water-rate. The actual increase of revenue in Godavery and Kishnah has been £600,000 a-year on an outlay of a million, almost all due to the works. The net returns in the last Blue-book from the railways was £3,600,000 on 106 million, or $3\frac{1}{4}$ per cent. on cost of working; including cost of land and debt, the returns were 2 per cent.

What must be the force of that bias that can thus lead public men both in the Houses of Parliament, as in the late debate, and out of them, thus to endeavour to keep out of sight these vast works, the results of which have really proved them "to be the most profitable investments ever made by a great nation," while the Indian railways have been a most signal failure as an investment, and a far more disastrous failure as a means of transit suited to meet the wants of the country. These irrigation and navigation works are really the crowning works of our management of India, works which have proved themselves in every way really suited to meet the wants and capabilities of the country in respect of all the great questions, famine, finance, traffic, *prestige*, well-being of the people, &c.

What must be the effect of such statements upon the general English public, who know nothing of the real state of the case, but utterly to falsify it to them. Of course they will say, "You may say what you please; I am quite satisfied with what I hear from the mouth of the late Viceroy himself, that works which have returned $3\frac{1}{4}$ per cent. on bare cost, and only 2 per cent. on cost, land, and debt, are the most profitable national investments not only in India but out of it, and, therefore, that your statements to the contrary, of works yielding some 50 per cent., and on an average 10 per cent., must be simply falsehoods, and we need not waste time in looking into Blue-books about the matter, and as for the late Head of the Irrigation Department, he must have been dreaming. Its just impossible that the Viceroy could have been either ignorant of the results of these works, or could have thoughtlessly made such an assertion in the face of notorious facts."

In all this concluding address not a word is said about the cost of transit, or about the quantities carried on the railways compared with those required to be carried, &c., showing the utter misapprehension of the whole subject of transit by the highest Indian authorities. He says again, "the natural expansion of the railways would enable the Government not only to meet the expenditure in the provinces, but in the course of years would be ample to provide for the steady extension of the means of conveyance."

How is it possible to reconcile these words with the actual returns on the lines of first importance in the country. What is to be the result on secondary lines now constructing, some of them in places where the traffic is, and must be perfectly insignificant? Think of about £300,000 being spent on 46 miles of detached railways in Central India, two of which, in the last Blue-book that mentions them, didn't pay their working expenses, and I don't think any of them do more, while the irrigation and railway works in Godaverry and Kistnah yielding 50 per cent. could not be completed for want of funds. Those Central Indian railways have been omitted from the last Blue-book.

But the present state of the transit between Calcutta and the Burhampoota puts this question of land and water-carriage in the strongest light. The direct distance from Calcutta to Goalundo, the confluence of the Ganges and Burhampoota, is 130 miles. There is a railway making a distance of 160 miles, and intricate water communication through the Soonderbunds of 470 miles.

The amount and cost of traffic on this line, are thus:—

	Rs.	£
By boats, 1,200,000 tons at	6	720,000
By rail, 220,000 tons at	9	200,000
By steamer, 38,000 tons at	9	34,000
		954,000

And this is besides the Upper Ganges traffic, which goes by the Soonderbund route for a great part of the year, so that $1\frac{1}{4}$ or $1\frac{1}{2}$ millions a year is actually now paid for transit on this line for the present amount of traffic. Thus at least $\frac{5}{6}$ of the traffic is still by water just as if no railway existed, though the distance by the former is three times that of rail, and the navigation wretchedly bad, the time averaging six weeks.

The railway has cost, including its debt, 4 millions. Now, on this line a steamboat canal could have been cut for half a million, and the cost of carriage of $1\frac{1}{2}$ million tons by it would be at the rate of $\frac{1}{20}$d., and including interest, £75,000 a year, that is, almost the whole $1\frac{1}{4}$ or $1\frac{1}{2}$ million now paid, would be saved. But with this reduction of price from 6 rupees to $\frac{1}{2}$ a rupee, of course there would be an enormous increase of traffic. I may mention also that this is the highway to the tea districts, and the steamers which now take eight days through the Soonderbunds, would go by the canal in a night. These tea districts up the Burhampoota will soon become the most important tract in India. So palpable is this case, that one of the chief engineers of the railways has been urging the construction of the canal lately. Another chief engineer of railways said to a friend of mine, "but these railways are a great mistake; they are totally unsuited to India."

But what are we to think of this expenditure of $1\frac{1}{2}$ million a year going on under the very eyes of the Viceroy and the Governors of Bengal, without a thought of saving it, while they are spending £300,000 in Nagpoor on railways costing £6,000 a mile, where there is not a hundredth part of this traffic.

Is this case alone not sufficient to show the most profound ignorance of the whole subject of transit in India, and that no more worthy subject of investigation and efforts could possibly be brought to the notice of the Society? The real fact is, without any exaggeration, that the railways are at this moment the grand hindrance to the progress of India.

But for them, it is almost certain that the authorities might be persuaded honestly to examine the subject of transit, and to undertake the works absolutely essential to the raising of India from its poverty, its famines, its low idea of our rule, &c. But now, as was foretold in

1853, a tremendous power has been raised up to prevent India having cheap transit, and its accompaniment, cheap production.

India now requires these works much more than it did before, because it has the additional burthen of these expensive luxuries. If it could sell its produce in foreign markets, it could afford to pay for its railways quite easily.

What can be done to remove this determinated ignoring of notorious facts, which the railways have forced upon our authorities—facts of the very first importance to the well-being of India.

Surely so great a matter may excuse so long a letter as this. It is no exaggeration to say that it is one of the greatest questions in respect of the material well-being of the British Empire. What India would become if all its different parts were connected with each other, and with the world, by a complete system of transit at a practicable cost, or $\frac{1}{20}$d. per ton per mile, who can say?

The following extract from the report of the Chief Engineer in the United States, in 1875, will show what is thought of the cost of transit there, and what can be done by first-class waterways:—"Upon the vital point of the cost of transportation, it is noticeable that, at the time the enlargement of the Erie Canal was authorised, the engineer estimated that it would enable the carriers to reduce the cost 50 per cent. After a detailed statement, showing the progressive advance of commerce on the Erie, with the relative cost of transportation * * * State-Engineer Taylor gives the following result: Cost of transport by old boats, $\frac{1}{5}$d.; by existing boats, $\frac{1}{2}$d.; by proposed enlargement, $\frac{1}{20}$d. per ton per mile." These are the prices in the States, where the value of money is about one-fourth of that in India.

It is reckoned that 10 million tons are required to be conveyed to the coast from the Western States, and whether this is conveyed 1,200 miles by land at 1d., or by water at $\frac{1}{20}$d., makes a difference of 45 millions sterling per annum. And even this is a small matter compared with the fact that the land price would stop the traffic altogether, and leave the whole population of the Western States paralysed, as the interior of India is now, by entirely depriving its productions of their value in foreign markets. ARTHUR COTTON.

THE PATENT BILL.

As President of the Manchester Association of Employers, Foremen, and Draughtsmen Engineers, I have read with much interest the resolution as to preliminary examination of patents adopted at the recent meeting of your Society. The subject is one which has on more than one occasion been considered at meetings of the association over which I have the honour to preside, and I may mention that substantially the same proposal as is contained in your resolution was adopted by us last year, and again this year, and that we have quite lately embodied it in a petition Mr. Hick, M.P., kindly presented to the House of Commons.

It seems to me a great many of the objections urged against the plan, if not made from purely interested motives, must be the result of misconception.

As Mr. Trueman Wood's paper clearly indicates, the progress of invention is not due to great and sudden studies, but to the aggregation of very small improvements or steps in advance. These seemingly trifling improvements are very often such as an examiner would not call new; Mr. Mundella mentioned Townsend's needle, and a good example it affords. Some people will say, "Oh! but we should not refuse such a patent as that." It is easy to say so now the value of the thing is universally known; but I say, and it is a very general opinion, that these inventions that look so small would be refused for want of novelty under the Bill as it stands.

The plan proposed by the Social Science Committee, and favoured by Mr. Fleeming Jenkin and others is—I say this with all deference—almost equally objectionable, for reasons given below.

If an applicant is told by the authorities that they think his invention is not patentable because of something before it, and if he knows he cannot get a patent without actually mentioning the previous publication in his specification, thus (as Mr. Bramwell truly urges in favour of granting a patent despite an adverse report) if he (the applicant) persists, it will be because he knows he is right in doing so, otherwise he would not be so foolish as to go on, despite the obligation to put in his own specification all the evidence (not opinion) urged against him. And why is it proposed thus to allow a patent despite the adverse opinion? Because in such a case, as in all litigated cases, there are two opinions, and without a costly and exhaustive judicial investigation, probably with several appeals, no one can safely affirm which opinion is the correct one. In other words the object is to give the inventor the benefit of the doubt, whilst at the same time putting the public fully on their guard as to what has been already done.

Now if you endorse a primary adverse judgment on a man's patent, how can you call that giving him the benefit of the doubt? Remember that an official opinion, however incorrect, carries immense weight with the public. However erroneous might be the hastily formed judgment of the examiner (I do not say Lord Chancellor, few could appeal to him for obvious reasons), its being made public would damn the patent. No money would be forthcoming to work such a patent, and as it is easier to make inventions than it is to introduce them in the market, it would result that in face of the adverse report the public would not get the invention. Let this be well considered in connection with the many valuable inventions enumerated in Mr. Wood's paper, also let us remember that an invention not carried into practical commercial use benefits no one, and that a patent for a useless invention injures no one.

Please understand I am looking at the matter, not as a lawyer, not as an inventor, and not as a patent agent, but as a practical man of business. On the other hand where, through oversight or from some motive or other, an examiner neglected—as often he would—to report adversely when something really stood in the way, people would be led to take the validity of the patent for granted, and would burn their fingers. Thus the practice of the Patent-office under the Bill would often be positively hurtful in a very serious degree. I strongly object to the Bill, because it would not operate justly.

As head of an association in which masters and employés are alike represented, I am anxious that any reform should go in the direction of even-handed justice. The Bill in its present shape means patents for the rich, who can pay heavily for professional aid, experts, appeals, and so forth. No patents for those who cannot afford to be good clients to patent agents, lawyers, and the like. Indeed, I know some patent agents like the Bill, because owing to the difficulties it proposes to put in the way of obtaining patents, it will enable them to draw much heavier fees from wealthy clients, and will weed out many less notable practitioners, whose clientage is for the most part poor, or comparatively poor.

No doubt they are right, but is this desirable in the public interest? Is it not putting money against brains in the most obnoxious way? I for one, think it is, and I know many others of the like opinion. The object of a Patent-law should be to promote the progress of industrial arts for the good of the country. This will not be the effect of a law under which patents will be within the reach only of those who can afford to lay out large sums for the extra services of patent agents and lawyers' fees, that must afterwards come from the public as royalties. Why should the public lose the many valuable inventions of poorer men, as must be the case if such men are subjected to the special disabilities the Bill would impose upon them?

By all means let the authorities see, in the interest alike of the inventors and of the public, that specifications are well drawn, and clear, and that they conceal nothing that has been done before, but for the good of the community let it be done in the way of assistance, not hostility to the inventor. Do not let us commit the gross blunder Prussia has been guilty of. She has rather late in the day found out her mistake, and shortly the German Empire will have a Patent-law which to all appearances will be far more favourable to inventors than the existing English law. On the other hand, our new Bill, unless greatly altered, will be far worse than our present law.

JOHN P. WOODHEAD.

16, Tib-lane, Manchester, March 13, 1877.

SUBURBAN HOUSES.

Having just read Mr. Richard Weaver's letter (page 197 of the *Journal*), in which some houses in the neighbourhood of Clapham Junction are described, I am tempted to add my own testimony in confirmation of his observations and strictures. About two years ago I was driven from the neighbourhood of Croydon by typhoid epidemic, and spent many weary hours during above three months in "house hunting" on all sides of the metropolis. I cannot find words sufficiently disagreeable to express my disgust and indignation at what I saw in every direction among the newly-erected suburban villas, mansions, and cottages. Structural dishonesty of the most shameless character was the prominent characteristic of at least 90 per cent. of these villainous man-traps. I have had some experience in the building of furnaces, sheds for the shelter of colliers, and other out-of-door workmen in the North, and, therefore, have had to reject deliveries of bad bricks or "wasters." The worst wasters I have ever had to reject in the North as unfit for sheds, or colliery offices, or the roughest furnace work, were, average to average, far better than those commonly used for inside work in London suburban houses. The villas or mansions are veneered outside with beautiful cream-coloured or well made red bricks, or stucco, but all the rest of these impostures—with very few exceptions—is built of the vilest rubbish, mere rotten sponges for the absorption of moisture, and the continuous exhalation of miasmatic vapours. The mortar, the wood work, and all that allows concealment, is similarly atrocious. Everything that can be scamped is scamped, the ingenuity of the builder—which is wondrous—being devoted to the solution of the great practical problem of reaching the utmost limits of cheap and nasty flimsiness that is compatible with holding together until a purchaser is victimised. The art of building rotten houses that will not fall down before the tie beams—or rather tie laths—of the roof are fixed, appears now to have reached its climax. If London were visited by one of those slight earthquake tremours that are so common in the neighbourhood of Crieff and Comrie, three-fourths of the suburban houses erected during the last ten or twenty years, would go down; and, so far as the destruction of the houses and the ruin of the owners are concerned, this would be a great blessing and a righteous judgment.

Some remedy for this, some means of stamping out this builder pest, is one of the great wants of the age. A sanitary association for the inspection of houses, and the granting of certificates in favour of those decently built in fulfilment of ordinary sanitary demands, might do so much good. It must be above the reach of jobbery and the customary tips to house surveyors. A certificate once obtained, might be held by the owner of the house as part of its title deeds, and shown whenever necessary. The first construction only needs such certifying; the maintenance in repair being obvious from the outside.

I hear that sanitary building companies are projected or formed, and if they are honestly and skilfully managed, they must succeed, as the demand for such dwellings is already great and is rapidly advancing. The future of the investors in the gingerbread villages of the period is very gloomy indeed, their present occupants only holding them because they can find nothing better, or because they have been deceived by outside appearances, a delusion that a short residence effectually dissipates. The ruin of these proprietors may ultimately cure the growth of this evil, but before this comsumation is effected a generation of tenants must be sacrificed.

W. MATTIEU WILLIAMS.

Twickenham, March 8th, 1877.

STOVES AND FIRE GRATES.

You have possibly seen the letters in the *Times* of "The Country Parson," and "Another Country Parson," also, Mr. Mechi's account of a trial of the latter's grate.

I have been for several months experimenting with household fires in a very modest way, with the object of finding out for myself what can be done cheaply and easily, without either tradesmen or patentees. In course of such experiments I have repeatedly pulled to pieces my various grates, and rebuilt them with my own hands, although I never previously dreamt of doing brick-setters' or labourers' work. At a cost of some little trouble, a little skin off my knuckles, &c., I have learnt that it is possible to warm a labourer's dwelling (or any cottage where the kitchen is the living-room), at less cost, far more comfortably than is common even in the houses of those who do not care about their coal bills. As I do not advocate any "patent" system, and am not puffing any special ironwork that can possibly afford a pretext for long prices and consequently a margin for advertising, I can't quite clearly see how I am to get the system I believe in, well known to the class I desire to benefit, as I have not the means to spare to advertise a non-profitable system and, consequently, one unlikely to receive any encouragement from the trade.

I have long been an admirer of Count Rumford, and his essays of course gave me the basis upon which to start; Dr. Neill Arnott's work also furnished me with other ideas.

I started by contracting throat of chimney, and applying a blower air-pipe under the bottom of the fire, which furnished to the fire a supply of outside air. This alteration was made in a very draughty kitchen, 17 ft. long, 11 ft. broad, and 9 ft. high, opening into a yard by a large door which was very badly fitted. The chimney-throat was 16 in. square, the house "two stories and attic" high, say 35 ft. to 40 ft. of chimney. The fire was 11 in. deep (top to bottom) and 15 in. broad, the bottom 4½ in. wide, top 9 in. Fuel, Lancashire coal. To this I applied a 20 in. length of 1¼ in. gas-pipe, with elbow at end, the orifice covered with a cap of perforated tin. The chimney-throat I reduced with a piece of sheet-iron 10 in. wide, leaving a throat of 16 in. × 1 in., instead of 16 in. × 16 in. I was not very confident about smoke, so tried 6 in. instead of the 4 in. recommended by Rumford, but I put another piece of sheet-iron on top of first piece, and brought it nearer and nearer to the back, day after day; the result was I got to the astonishing result of an opening of 16 in. × 1 in., being capable of working the fire under favourable conditions; but if the servant would persist in leaving two doors open at other end, cross-draughts puffed smoke into the kitchen, this I remedied by making the opening 16 in. × 2 in., at which it is, and has been for weeks past, most satisfactory.

The kitchen at the further end from the fire average over 60°, and draughts have disappeared. The servant can sit at her table and work comfortably, without a thought of pulling the table up to the fire (as formerly she was in the habit of doing), and never troubles with the fire. The blower makes the fire's combustion more easy, and a fire now seems to last much longer; probably, one scuttleful of coal will suffice where two did, and all small coal and cinders can now be burnt up on the kitchen fire instead of wasted.

Sitting-rooms do not show the same economy, but do yield a similarly equable warmth and freedom from draughts, whilst a small room—$10\frac{1}{2}$ ft. × 16 ft. × 9 ft.—formerly much given to feeling stovey and overheated, can be agreeably warmed (65°) all the evening without any such drawback. A larger sitting-room—13 ft. × 16 ft. × 9 ft.—was never really warm, however good a fire, as its window-wall and fire-wall were both exposed to cold and damp (as shown by papers), and a third wall was formed by mere partition-wall off a cold passage against front door. A cellar underneath allowed plenty of cold air to force its way up through badly-jointed flooring, which a former tenant took the trouble to cover with strips of oil-cloth. A "good fire" invariably raised the heavy carpet two inches, by the in-pressure of the air from cellar to chimney. This is no longer the case; a piece of boiler iron—4 in. wide × 24 in. long (say $\frac{3}{8}$ in. thick)—narrowed the chimney-throat, with some mortar, to a slit 9 in. long by $1\frac{1}{4}$ in. wide. An air-pipe (with rose) under the fire increased combustion with cold outside air. The room ceased to be draughty, and condescended to become well warmed, with a fire up to first bar only, instead of far above the second bar.

A bedroom of a neighbour could never have a fire in it as the smoke always preferred most perversely to enter the house instead of the chimney. Two bits of slate and a tin blower pipe, cost 1s. 6d. ($1\frac{1}{4}$ in. diameter) converted it to more desirable ways, and it has become admirably amenable ever since.

A labourer altered his kitchen fire (the only one in the house used) with on old oil tin cut up and a bit of old gas-pipe. His wife questioned his vanity when he began to close up her precious "chimbley," and required information as to where in conscience he meant the smoke to go up. He left about 3 in., and his wife was very much "taken aback" by seeing the smoke going away quite decently, and her next trouble was, "she was sure she had caught a bad cold and cough by that 'ere fire making the place so hot." However, she is now of opinion that she has mistaken for a sequence what, in fact, was but a coincidence, and as the fire bakes and cooks much better than before, and warms the house better, and all on less than former fuel requirements, she thinks the innovation (costing actually nothing besides trouble) rather a good thing.

From these facts, and others I can mention, I deduce that much good can be done for the poorer classes at a very small cost in the matter of warming and ventilating, and if I could get some one better qualified to bring the plan before the public and property owners generally, I think benefit to many would follow. Any gentleman you know caring to try up the plan, I will gladly afford every information to enable him to experiment for himself, and so convince himself of the benefit practicable at so little cost and trouble. All my other experiments were divergences from my first attempt, and all ended one way, the first being in every respect the best, and applicable, I think, to all new houses of every class at less cost than existing plans; applicable to all cottages and small houses at very small cost, and to larger ones, as in London, at a cost certainly justified by the benefit accruing from the alterations. A really equable temperature is a pleasure which is seldom appreciated except by those who out of their own house find how exceptional it is. To convince yourself, two or three thermometers (corrected) placed about a room (whose position enables you to alter it as above most readily) will only convey to your sight what your body will have previously verified. Of course London houses being in rows increases the cost of air-supply pipes, but although Rumford's simple plan of diminishing chimney throat to four inches alone is hard to beat, an air supply and further diminished (one to two inch) throat is preferable where £ s. d. questions do not prevent it.

To artisans, &c., and to parties building for that class, above plan of warming is really well worthy of attention, as I have proved.

I note you have designed a good blow-pipe lamp; may I ask you where one can be purchased, and also a good blow-pipe. I want to experiment with clays, &c., on their fusibility and conduct under heat, but have no experience or knowledge to go upon, except I have "Dr. Percy on Fuel, &c.," 1875, most iron metallurgies, including Mushet's papers, also "Kirwan's Mineralogy and Experiments on Earths," but, unfortunately, I am neither chemist or mineralogist, only a would-be student, if I can afford apparatus, &c. If not asking too much of your courtesy, I would ask for any information as to works upon pottery (technology). I am fairly "up" in blast furnace slags, but want to study clays in connection with brick-making, with a view to learning to utilise any available earths at present held to be too fusible or otherwise unsuitable.

Apologising for length of this letter.

Fred. Seaman.

Over, near Wingford, Cheshire,
February 28th, 1877.

THE PRESERVATION OF IRON.

In the *Times* of Thursday last, I noticed an account of a recent discovery by Professor Barff for the preservation of iron, and by your courtesy I wish to make the following observations thereon.

Some years ago I was engaged in making experiments on the decomposition of water for the production of non-illuminating gases for special purposes, and one set of them comprised the passing of steam though masses of incandescent wrought iron.

In the course of these experiments I discovered that the iron gradually lost the power of decomposition, and on an examination of the reason, I found that it was due to a coating of black oxide formed upon it. The thicker it became the less the iron decomposes, so that the experiment I was making failed on that account. The beauty of the coating of oxide so struck me that I instituted a set of experiments to test its applicability to the preservation of iron, and for a variety of purposes, where tin, zinc, and enamel had hitherto been used.

Articles so coated were exposed to wind and weather for some time, but I found the coating scaled off, and I did not pursue the matter further.

If the method which Professor Barff has discovered will make a permanent coating, he will deserve to reap where I have only sown, for I consider the profit of every discovery should go to him who pursues it so far as to make it subservient to the uses of mankind.

I simply desire to record the fact that many years ago —and which can be verified by witnesses of the experiments—that I did that which is now declared to be a discovery of enormous value. Geo. Bowers.

St. Neots, Hants, 9th March, 1877.

THE RELATIONS OF TANNIN AND GALLIC ACID.

While tannin is one of the commonest of vegetable proximate principles, the cases in which gallic acid exists, ready formed in living plants, are so rare, as to suggest the conclusion that it is invariably a product of the decomposition of that particular species of tannin, known as gallo-tannic acid, especially as (so far as is known) the two are always found associated, and usually in company with a peculiar ferment, not yet well understood, but which has the power of converting gallo-tannic acid into gallic acid.

As the tannin of some of our most powerful tannin agents, notably of shumac, galls, and myrabolums, consists wholly or partially of gallo-tannic acid, and as gallic acid is of no value as a tanning agent, and at best, only serving to open the pores of the hide, this ready conversion is most disastrous to the tanner, and seriously depreciates the value of such tanning materials as are prone to it. Shumac, galls, &c., for instance, exposed to the air in a moist condition, very rapidly become utterly valueless as tanning agents, and this change is accelerated by the warmth which is necessary in many tanning processes.

Mr. H. B. Procter, F.L.S., has discovered a chemical agent, the nature of which he refuses to disclose, possessing the singular property of entirely arresting this change. To instance one experiment made by Mr. W. Evans, of Bristol. He took two 50 grain portions of shumac, one of which was infused with water alone, while to the other a small portion of "antigalline" had been added. The latter on being tested showed no trace of gallic acid, while the former contained 5 grains of gallic acid, and exhibited a corresponding loss of seven grains of tannin. Mr Procter states that antigalline can be produced at a nominal cost, and a very little goes a long way.

Shumac is at present low in price relative to other tanning materials, and it can be substituted in many cases with great advantage now that this process is in operation, and thus cause a great saving to tanners.

Divi-divi is largely used as a tanning material, and would be employed still more externally but for its liability to (a sort of) fermentation, in which an intense red colour is developed. It is believed that antigalline has the power of controlling this change, and the value of divi-divi will increase enormously. Several other tanning materials yield tannin, which in decomposition yield, instead of gallic acid, red products allied to phlobaphene,[*] and which are most injurious to the colour of the leather. T. C.

CHEMICAL RESPIRATOR.

I am led to communicate with you as to a suggestion which I am thinking of making for a "chemical respirator" for use in coal mines after explosions of CH_4 (fire-damp). The after-effect of explosions, or rather the effect of the resulting products (CO_2, &c.), often proves more fatal than the direct explosion, and it is unquestionably a matter of great importance that assistance should be afforded as early as possible to those in the pit after the explosion.

Such assistance is often prevented for some time by the presence of "after-damp" produced by the explosion in the mine, and if something could be effectually applied in the form of a respirator or otherwise, for the purification of the air from carbonic acid gas, it would evidently be of very great advantage, beside the ordinary method of supplying fresh air from the surface. The respirator which I am about to suggest is so arranged as to contain caustic potash. A convenient form of apparatus for containing this (solution of potash) is a tube such as that devised by Mitscherlich, and since modified by De Konick.

By passing air, containing carbonic acid gas, through such an arrangement, it is considerably purified. An experiment was made by drawing air, containing such a quantity of CO_2 as to be fatal to life when inhaled, through the arrangement described above. The air, after being thus drawn through, was almost free from it, and quite suitable for human respiration.

As to the portability of such an apparatus. The tube should be enclosed in a box, and might be carried in the coat-pocket. To it an india-rubber tube should be fixed and connected, when required, with the mouth of the individual using it, so that by it the air might be breathed through the tube containing the potash solution. Inspirations should be made thus through the mouth, and expirations through the nose. This would be easily arranged by having a valve fixed to the nose of the person using the apparatus, which would open on expiration, and close on inspiration.

I believe that Capt. Shaw, of the London Fire Brigade, suggested some time ago a respirator for use in atmospheres containing much CO_2, which consists of wool with glycerine, dry wool, charcoal, dry wool, an inch deep of each, and a layer of lime. This arrangement is a very complicated one; and if, therefore, the apparatus I have described should be found to answer in practice as well as in the experiment conducted in the laboratory, it would, I imagine, be of greater advantage. The arrangement I have detailed may be easily re-filled with the potash solution, which would, of course, be occasionally requisite. WILLIAM H. WATSON, F.C.S.

Braystones, Beckermet, *via* Carnforth, 9th March, 1877.

TOWN SEWAGE OF MANCHESTER.

Professor Ansted presents his compliments to the editor of the *Journal of the Society of Arts*, and feels sure that the matter of the enclosed letter will be recognised as a useful supplement to the communication read by him at the meeting on the 16th inst.

4, Westminster-chambers,
27th March, 1877.

Officer of Health's Department,
City-hall, Manchester,
March 24th, 1877.

MY DEAR SIR,—I have read with much interest and pleasure your admirable address to the Society of Arts "On the Treatment of Town Refuse and Sewage." The processes are undergoing development, and have been much simplified and improved since you visited Manchester, with further concentration of the materials.

By the processes now under trial, 1,000 tons of refuse brought to the Health Committee's yard in "pails" are reduced to 81 tons, the latter containing all the ammonia fixed as sulphate, and having in concentrated form all the manurial matter contained in the solid and liquid excreta, &c.

You were perhaps not aware that I was Medical Officer of Health for this city, and that the operations at the yard you visited are carried out under my authority and are my processes, as far as they deviate from known methods.—Yours, &c., JOHN LEIGH,
Medical Officer of Health for Manchester.

Prof. Ansted, M.A., F.R.S., &c.

STATISTICS OF TURKEY.

At a moment when the Eastern question is the all absorbing one of the day, it may not be without interest to give an outline of the administrative division with the population of each *vilayet* (province), separately of Turkey proper, which I gather from the *Sal-Namé* or official year-book of 1294 A.H., 1877 A.D., issued a few weeks ago by the Ministry of Public Instruction.

The *Sal-Namé* for the first time contains details of this nature, and is consequently four times the bulk of its predecessors, so a per-centage of error must be allowed; besides, as Turkish calculations are at best very defective, still, considering the mass of mere conjectural assertions published in statistical and other works of reference, the following official data will serve a better basis than heretofore obtainable. It may also serve as a warning to those who are deluded into exaggerated estimate of the various races of the Christian population of European Turkey, and more particularly among the readers of the numberless pamphlets on Turkey, more or less correct, which recently appeared in print, the *Sal-Namé* will tend to clear up many apprehensions.

According to the *Sal-Namé*, the entire population of Turkey proper is 13,739,738, but it will be remarked that the general synopsis does not include Constantinople and its suburbs, allowing, therefore, in round numbers, 700,000 on this head. Further, Asia Minor and Syria contain a large wandering population, such as Turcomans, Kurds, Bedouins, &c., we may therefore put this item down at a couple of millions. Also an allowance must be made for the concealment of children which takes place sometimes through neglect, but often to avoid the payment of the military exemption tax among the Christians, say fifteen per cent. of the entire population, or, in round numbers, two millions more. We now come to the army, navy, and police, which are not included in these calculations, and may put these items down at 560,000; finally, another 500,000 may be added for the population living under foreign protection, we thus arrive at a gross total of 19,500,000.

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[*] The brown colouring matter present in bark-roots, &c., soluble in alcohol, alkaline, &c.

Recapitulation.

European Turkey as per *Sal-Namé*	....	4,700,182
Asia and Africa do. do.	....	9,039,556
Constantinople and suburbs approximate		700,000
Nomads	do.	2,000,000
Concealments, &c.	do.	2,000,000
Army, navy, and police	do.	560,262
Foreigners	do.	500,000
Total population of Turkey proper	..	19,500,000

Population of Turkey Proper, as per "Sal-Namé," for the year 1294, A.H.

Name of Vilayet.	No. of Sandjaks.	No. of Cazas.	No. of Houses.	Total Population.
EUROPEAN TURKEY.				
Adrianople	5	34	52,455	652,676
Danube	5	28	150,251	907,774
Sofia	2	16	40,318	340,180
Salonica	3	16	27,053	393,029
Bosnia	6	39	186,431	1,013,568
Herzegovina	2	8	27,987	120,165
Monastir	4	29	240,651	539,054
Yarima	5	21	27,070	187,513
Scutari Albania	1	12	37,500	135,000
Sporadis Isles	6	18	65,963	178,382
Crete	5	16	65,128	232,841
Europe Total	44	937	920,807	4,700,182
TURKEY IN ASIA AND AFRICA.				
Bransa	4	22	153,173	365,985
Aïdin and Smyrna	4	20	87,388	770,022
Angora	4	18	97,544	282,799
Konich	5	24	134,247	410,393
Castamouni	4	17	119,501	422,906
Sivas	3	19	110,907	406,388
Trebizond	3	16	103,707	339,141
Janik	1	5	46,315	129,929
Erzerom	6	27	148,551	782,832
Van	1	13	83,799	233,629
Diarbekin	4	15	75,300	409,000
Memouret-il-Aziz	2	5	27,300	147,400
Syria	5	21	95,000	202,000
Mount Lebanon	1	...	18,426	110,000
Beirout	1	...	12,375	120,000
Jerusalem	1	4	19,400	130,000
Adana	4	12	58,347	204,372
Aleppo	4	32	95,270	296,760
Tripoli Barbary	5	22	19,000	1,010,000
Bagdad	7	30	236,851	1,604,476
Basnah	3	4	78,149	395,524
Yemen	4	23	176,000	266,000
Asia & Africa Total	76	349	1,995,550	9,039,556

The above refers to the population directly administered by the central Government of Constantinople; I now propose to make a few observations on the administrative division of the Empire.

1st. The directly administered part of the Empire consists, according to the *Sal-Namé*, of 30 vilayets, at the head of each is placed a Valy (Governor-General) 120 Sandjaks, each under the direction of a Mutissarif (Governor), 586 Cazas, each governed by a Caïmakam, (Lieut.-Governor). 2nd. To this may be added the vilayet of Hedjaz, which among the autonomous provinces is the one more directly connected with the central Government of Constantinople, with a population of 240,000 inhabitants. Next is the island of Samos, with a population of 70,000 inhabitants. Resuming the whole, Turkey proper, including the two last-named provinces, consist of 31 vilayets, 121 sandjaks, and 586 cazas, with a total population of 19,810,000 inhabitants. Divided according to religious denominations, the following may be taken approximately:—

Orthodox Greeks	1,500,000
,, Slaves and Roumans	4,000,000
Gregorian Arminians	3,000,000
Roman Catholics and Protestants	800,000
Jews	300,000
Total non-Mussulmans	9,500,000
Mussulman population	10,310,000
Total population of Turkey proper	19,810,000

The following are the officially recognised hierarchical dignitaries of the new Mussulman communities:—

Greek orthodox, Patriarchs	4
,, Metropolitans	81
,, Bishops	37
Bulgarian orthodox, Exarch	1
,, Metropolitans	11
,, Bishops	9
Gregorian Arminians, Patriarchs	4
Bishops ,,	23
Syrian, Patriarch	1
,, Bishops	4
Arminian Catholics, Patriarch	1
,, Bishops	7
Jews, Chief Rabbis	8
,, Rabbis	19

The following vilayets have local agricultural banks:—

	Piastres.
Adrianople	39,022,985
Danube	30,167,745
Salonica	2,791,516
Sofia	11,832,333
Monastir	5,072,614
Crete	8,063,966
Conia	3,582,936
Castamouni	3,064,653
Erzerom	1,744,469
Van	86,971
Total piastres	105,430,188

Several other vilayets have agricultural banks, but are not given in the *Sal-Namé*."

S. Stab,
Corresponding Member for the Society of Arts.
Constantinople, February 26th, 1877.

NOTES ON BOOKS.

Lectures on some Recent Advances in Physical Science. With a special lecture on Force. By P. G. Tait, M.A. Second edition. (London: Macmillan and Co., 1876.)

Three years ago Professor Tait delivered a course of thirteen lectures to a number of friends "who wished to obtain in this way a notion of the chief advances made in natural philosophy since their student days." These lectures were taken down at the time of delivery, and published. The rapid demand for a second edition gave the author an opportunity of adding the lecture on "Force," which he delivered before the British Association at Glasgow. The first lecture is introductory. Though it in part deals with the earlier history of the subject, it treats principally with definitions of elementary ideas; first, time and space: secondly, matter, position, motion, and force. It also shows the way in which the subject is to be treated, and controverts various erroneous theories, the main object of this first lecture being apparently to give the reader or hearer a distinct notion of the way in which the doctrine of energy is to be approached. Next, Professor Tait passes to the early history of the subject, showing very clearly that much of what is generally accepted as the recent discovery of science has, in fact, been more or less clearly known to the earlier labourers in the field. Many old discoveries, neglected or misunderstood at the time, are only now beginning to be received at their full value. It is remarkable to see how in many directions we are now only working up to the point reached by Newton, Rumford, and Davy, in their speculations. In 1812, Davy showed that heat was an effect of motion, and fourteen years before Rumford had disproved the old corpuscular theory of heat; yet it was not until Joule's labours (about 1840) that the subject was properly taken up—far behind where Rumford and Davy left it—and the truth of their results demonstrated to the world. Lecture III. brings the history of the subject a little further down, past Joule's experiments, and the establishment of the law of the conservation of energy, then some practical illustrations are given by means of experiment. Thus is shown the transformation of the potential energy in a galvanic battery into the kinetic energy of an electrical current, and thence the production first of an induced current, and then of sound, light or heat, in varying but relative proportions. This leads naturally to the subject of the fourth lecture, the transformation of energy; and here, again, experiment comes to the aid of the lecturer. First, current electricity is made to develop in an imperfect conductor the heat due to the combustion in the battery. Then the kinetic energy of the current is transformed into the "higher" potential energy of the mixed gases produced by the decomposition of water, or into the potential energy of a weight raised by an electro-magnetic engine. Work, also, is transformed into heat, and other experiments, with the same intentions, are shown. A sketch of Carnot's "Cycle of Operations," and his "Reversible Cycle," leads on in Lecture V., to a dissertation in his imaginary heat engine, and the reasoning to which it tends. Passing on from considerations of thermo-dynamics to the sources (in Lecture VI.) of solar and terrestial energy, we come, in Lecture VII., to a discussion of the possible age of the earth. Here Sir William Thomson's arguments are summed up, and his three lines of reasoning stated; (1) from the rate of cooling of the earth; (2) from the retardation of the earth's rotation by the action of the tides; (3) from the length of time that the sun can be imagined by its radiation to have kept the earth in a state fit for the habitation of animals and vegetables. The conclusion from all these arguments is in each case about the same; that it is about ten millions of years since the solidification of the earth's crust, or at least since the time when the earth first became capable of supporting the lowest known form of life. The rest of this lecture (No. VII.) treats of the transference of energy, through solids and fluids, and through the ether, and concludes with an account of some "Physical Analogies introductory to Spectrum Analysis." It is shown that if any substance from its vibrations is giving off sound, light, or heat, that sound, light, or heat will be absorbed by a second precisely similar substance. The application of this fact in spectrum analysis was delayed for some years after its announcement by Professor Stokes, but it was known more than twenty years ago. The natural sequence to this comes in the three succeeding lectures (Lectures VIII., IX., and X.), which all deal with spectrum analysis, and give an account first of the principles of the science, and next of the results of its application. Lecture XI. is devoted to the "Conditions of Heat," and the last two lectures of the original series, Lectures XII. and XIII., treat of the structure of matter, giving a short account of the theory of vortex motion, and of the molecular structure of gases.

The Practical Gold Worker and Jeweller's Instructor in the Art of Alloying, Melting, Reducing, Colouring, Collecting, and Refining; the Processes of Manipulation, Recovery of Waste, Chemical and Physical Poperties of Gold; with a new system of mixing its Alloys; Solders, Enamels, and other useful Rules and Recipes. By George E. Gee. Published by Crosby, Lockwood and Co.

Much of the information contained in the above-named work has already appeared in the form of articles in the *Jeweller and Metal Worker*, a journal published in the interest of the trade. The author has, however, in the present work introduced considerable additional matter, and revised the whole, so that it may form, as its name implies, a useful manual of reference, and a guide to the jeweller's workshop.

In the chapters on gold colouring and finishing, the various processes of both dry and wet colouring as applicable to different qualities of gold work are fully explained. The recipes and treatment during colouring are given in a sufficiently concise manner to render them intelligible to the ordinary workman.

The author also gives some information on collecting and refining jeweller's waste gold, besides some complete tables of the alloys of gold, manner of reducing to the different standards, and a variety of other information that will no doubt render this work (as has been the author's object) a text-book for the trade.

The Theory and Action of the Steam Engine. By W. H. Northcott. London: Cassell, Petter, and Galpin.

The object of this work is to explain the most important parts of the theory and action of the steam-engine, so as to be intelligible to those who possess no great knowledge of mathematics. After an introductory chapter on heat, energy, force, which gives, of course, but an outline of the theory, we get two chapters on combustion, one theoretical and the other practical, dealing with the actual effects of different fuels under different conditions. Chapter IV. is devoted to the subject of "Transfer of Heat." Chapter V. treats of the generation and properties of steam, and includes remarks on the effects of different sorts of water, the influences of impurities on evaporation, priming, &c. It also describes and remarks on the different states in which steam can exist, wet, saturated, and superheated. The next chapter is entitled "Motive Power from Steam," and may be said to treat of the actual effect of steam in the cylinder.

Such points as the use and effect of the steam jacket, the effect of "clearance," the rate of expansion, &c., are here discussed. Following this we have a short chapter on the "action and influence of the mechanism." fly-wheel, crank, connecting rod, &c. Next, in chapter VIII., the different varieties of engines are described, and their comparative efficiency discussed. The different arrangements of the cylinders in the various sorts compound are described and illustrated by diagrams, and some remarks are made on the considerations which should govern the construction of engines under given conditions. The last chapter describes the construction of indicators, and explains the way in which diagrams are obtained. It also describes the ordinary arrangement of friction dynamometer and its application. It will thus be seen that this is not intended for an elementary or popular work on the steam-engine. It assumes a practical knowledge of the engine, and endeavours to explain its theoretical action to those who are conversant with its working in practice.

GENERAL NOTES.

Mechanical Stoking.—A paper was recently read at the Society of Engineers by Mr. J. Walter Pearse on the "Mechanical Firing of Steam Boilers'." The author first pointed out some of the disadvantages of hand stoking, and observed that so far back as 1813, mechanical firing was proposed. In 1822, Mr. J. Stanley invented a stoker with crushing rollers and a single horizontal fan to which, in 1834, he added rocking fire-bars. In 1838, Mr. Juckes patented his first stoker, and in 1841, he invented the endless chain of fire-bars, modifying it again in 1842. In 1863, Messrs Wilson and Smith brought out their furnace in which the fire-bars were made to travel backwards, carrying the fuel from a hopper to the back of the grate, an arrangement which was improved upon by Messrs. Vicars and Smith in 1867. In 1870, Mr. Dillwyn Smith patented his stoker, in which the fuel is fed on to distributing fans revolving horizontally. This arrangement was improved upon, in 1870, by Mr. J. F. Deacon. Further additions were subsequently made by Mr. T. Henderson. In the Henderson stoker the supply of fuel is affected in the same way as in the Dillwyn Smith machine, but the fire-bars are made to move by simple gear connected with the stoker. Every other bar rises and falls, while the rest slide to and fro, the effect of this action being to clear off the clinker. The Frisbie feeder improved by Mr. J. M. Holmes, is for slow combustion and intermittent feed. The coal is thrust up underneath, and in the middle of the fire, so that the gases evolved are consumed on passing through the incandescent mass. This stirs the fire and propels all clinker to the circumference of the circular revolving grate. Mr. Holroyd Smith's "Helix" fire-feeder gives a continuous feed from below by means of a screw working in a casing connected at its upper side with a trough which takes the place of one or two fire-bars.

NOTICES.

PROCEEDINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday evenings, at 8 o'clock. The following arrangements have been made:—

April 4.—"A Pioneer Railway," by F. J. Rowan, Esq.

April 11.—"Compensation for Injuries received in Industrial Occupations," by T. Attwood Brockelbank. Lord De La Warr and Buckhurst will preside.

April 18.—Lecture by E. J. Reed, M.P., C.B., F.R.S., "The Modifications which Ships of War have undergone during the last Twenty Years."

April 25.—"Deaf not Dumb," by B. St. John Ackers, Esq.

May 2.—Lecture by J. Baillie Hamilton, Esq., "New Musical Instruments."

May 9. — "The Artesian System of the Thames Basin," by Joseph Lucas, Esq., F.G.S.

May 16.—

May 23. — "The Measurement and Settlement of Musical Pitch," by A. J. Ellis, Esq., F.R.S., F.S.A.

African Section.

Tuesday evenings, at 8 o'clock. The following arrangements have been made:—

April 10.—"The Social State and Prospects of the South African Communities," by Robert Richards, Esq., of Grahamstown.

April 24.—"The Trade and Resources of Morocco," by Dr. Arthur Leared.

Indian Section.

Friday evenings, at 8 o'clock. The following arrangements have been made:—

April 20.—"The Existing and Possible Commercial Communications between Persia and India," by Major-General Sir Frederick John Goldsmid, C.B., K.C.S.I.

May 4.—"Thaumato-dendra, or the Wonders of Trees," with illustrations from life, by Wm. Tayler, Esq.

Chemical Section.

Thursday evenings, at 8 o'clock. The following arrangements have been made:—

April 12.—"The Cinchona Alkaloids; their Sources, Production, and Use," by Dr. B. H. Paul.

April 19.—"Spontaneous Combustion in Factories and Ships," by C. W. Vincent, Esq., F.C.S.

April 26.—"Phosphor-Bronze and its Applications," by Alexander Dick, Esq.

May 10.—"A New Process for the Production of Carbonate and Caustic Soda, without the Formation of any Noxious Waste and the Recovery of the Sulphur," by George E. Davis, Esq.

Science Lectures.

These will be given on the following Wednesday evenings, in place of the usual paper and discussion. The rules for admission will be the same as for the Cantor Lectures. Each member can admit ONE friend by giving the usual order from the book supplied at the commencement of the Session:—

April 18.—E. J. Reed, Esq. C.B., M.P., F.R.S., "The Modifications which Ships of War have Undergone during the last 20 Years."

May 2.—J. Baillie Hamilton, Esq., "New Musical Instruments."

MEETINGS FOR THE ENSUING WEEK.

Mon.... Royal Institution, Albemarle-street, W., 2 p.m. General Monthly Meeting.

Tues... Pathological, 53, Berners-street, Oxford-street, W., 8½ p.m.
Photographic, 5a, Pall-mall East, S.W., 8 p.m. Adjourned Discussion on "The Nitrate Bath; its Defects and Restoration."
Biblical Archæology, 33, Bloomsbury-street, W.C., 8½ p.m.

Wed.... SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. F. J. Rowan, "A Pioneer Railway."
Entomological, 11, Chandos-street, W., 7 p.m.
Microscopical, King's College, W.C., 8 p.m. Mr. Thomas Palmer, "The Various Changes Caused in the Spectrum by Different Vegetable Colouring Matters"
Pharmaceutical, 17, Bloomsbury-square, 8 p.m.
Archæological Association, 32, Sackville-street, W., 8 p.m.
Obstetrical, 53, Berners-street, Oxford-street, W., 8 p.m.
Royal Horticultural, South Kensington, S.W., 1 p.m.

Thur. ...Linnean, Burlington House, W., 8 p.m.
Chemical, Burlington House, W., 8 p.m. Professor N. S. Maskelyne, "The Discrimination of Crystals by their Optical Characters."
South London Photographic (at the House of the Society of Arts), 8 p.m.
Inventors' Institute, 4, St. Martin's-place, W.C., 8 p.m.
Psychlogical, 11, Chandos-street, W., 8½ p.m.

Fri.......Institution of Marine Engineeers (at the House of the Society of Arts), 7 p.m.
Geologists' Association, University College, W.C., 8 p.m.
Philological, University College, W.C., 8 p.m. Mr. H. Sweet, "Comparative Teutonic Philology."

Sat.......Foreman Engineers (at the House of the Society of Arts), 7 p.m.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,272. Vol. XXV.

FRIDAY, APRIL 6, 1877.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

HEALTH AND SEWAGE OF TOWNS.

The Annual Conference on Health and Sewage of Towns will be held on the 3rd May next, the Right Hon. James Stansfeld, M.P., late President of the Local Government Board, in the chair.

An exhibition of sanitary appliances will be held during the Conference. Only such apparatus will be admitted as have a distinct bearing on the subject of the Conference. Intending exhibitors should at once communicate with the Secretary.

A prize of £20 is offered for "The best Sanitary Pan for collecting pure excreta, unmixed with ashes or refuse, having regard especially to cleanly use, the separation of the urine from the fæces, and a ready and cleanly means of removal and transport." These pans will be exhibited at the Conference. The system must have been in use six months previous to the 31st March. The Council reserve the right of withholding the prize, should nothing be submitted which is considered worthy of reward.

NATIONAL TRAINING SCHOOL FOR MUSIC.

The first annual examination of the scholars was held on Monday and Tuesday, the 26th and 27th March, under the direction of the Principal and the Board of Professors. The professional examiners to the school were represented by Sir Michael Costa and Sir Julius Benedict on Monday, and by Professor Ella on Tuesday.

The Easter Vacation commenced on the 29th instant, and will terminate on Tuesday, the 17th April.

ALBERT MEDAL.

The Council will proceed to consider the award of the Albert Medal for 1877, early in May next. This medal was struck to reward "distinguished merit in promoting Arts, Manufactures, or Commerce," and has been awarded as follows:—

In 1864, to Sir Rowland Hill, K.C.B., "for his great service to Arts, Manufactures, and Commerce, in the creation of the penny postage, and for his other reforms in the postal system of this country, the benefits of which have, however, not been confined to this country, but have extended over the civilised world."

In 1865, to his Imperial Majesty, Napoleon III., "for distinguished merit in promoting, in many ways, by his personal exertions, the international progress of Arts, Manufactures, and Commerce, the proofs of which are afforded by his judicious patronage of Art, his enlightened commercial policy, and especially by the abolition of passports in favour of British subjects."

In 1866, to Professor Faraday, D.C.L., F.R.S., for "discoveries in electricity, magnetism, and chemistry, which, in their relation to the industries of the world, have so largely promoted Arts, Manufactures, and Commerce."

In 1867, to Mr. (now Sir) W. Fothergill Cooke and Professor (afterwards Sir) Charles Wheatstone, F.R.S., in "recognition of their joint labours in establishing the first electric telegraph."

In 1868, to Mr. (now Sir) Joseph Whitworth, F.R.S., L.L.D., "for the invention and manufacture of instruments of measurement and uniform standards, by which the production of machinery has been brought to a state of perfection hitherto unapproached, to the great advancement of Arts, Manufactures, and Commerce."

In 1869, to Baron Justus von Liebig, Associate of the Institute of France, Foreign Member of the Royal Society, Chevalier of the Legion of Honour, &c., "for his numerous valuable researches and writings, which have contributed most importantly to the development of food economy and agriculture, to the advancement of chemical science, and to the benefits derived from that science by Arts, Manufactures, and Commerce."

In 1870, to M. Ferdinand de Lesseps, "for services rendered to Arts, Manufactures, and Commerce, by the realisation of the Suez Canal."

In 1871, to Mr. (now Sir) Henry Cole, C.B., "for his important services in promoting Arts, Manufactures, and Commerce, especially in aiding the establishment and development of International Exhibitions, the development of Science and Art, and the South Kensington Museum."

In 1872, to Mr. Henry Bessemer, "for the eminent services rendered by him to Arts, Manufactures, and Commerce, in developing the manufacture of steel."

In 1873, to M. Michel Eugène Chevreul, "for his chemical researches, especially in reference to saponification, dyeing, agriculture, and natural history, which for more then half a century have exercised a wide influence on the industrial arts of the world."

In 1874, to Mr. C. W. Siemens, D.C.L., F.R.S., for his researches in connection with the laws of heat, and the practical applications of them to furnaces used in the Arts; and for his improvements in the manufacture of iron; and generally for the services rendered by him in connection with economisation of fuel in its various applications to the Manufactures and the Arts."

In 1875, to Mons. Michel Chevalier, the distinguished French statesman, "who, by his writings and persistent exertions, extending over many years, has rendered essential service in promoting Arts, Manufactures, and Commerce."

In 1876, to Sir George B. Airy, K.C.B., the Astronomer Royal, for "eminent services rendered to Commerce by his researches in nautical astronomy, and in magnetism, and by his improvements in the application of the mariner's compass to the navigation of iron ships."

The Council invite members of the Society to forward to the Secretary, on or before the 14th of April, the names of such men of high distinction as they may think worthy of this honour.

SEVENTEENTH ORDINARY MEETING.

Wednesday, April 4th, 1877; Edwin Lawrence, Member of the Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Dodd, John, 6, Thomas-street, Liverpool.
Dunn, Thomas Edward, The Cottage, Rusper, Horsham, Sussex.
Greene, E. B. C., Chatham College, Ramsgate.
Gwinner, Hermann, International Bank of London and Hamburg, Cannon-street, E.C.
Harris, Arthur G. R., 39, Dorset-square, N.W.
Souter, John Clement, M.D., 88, Junction-road, N.W.
Stevenson, Thomas, M.D., Guy's Hospital, S.E., and 21, Caversham-road, N.W.
Ward, George, Buckingham-terrace, Headingly, Leeds.

The following candidates were balloted for, and duly elected members of the Society:—

Conyngham, Lord Francis, M.P., 46, Half Moon-street, Piccadilly, W.
Harrison, Henry, Maple-lodge, Surbiton, Surrey.
Hay, James A. C., Royal Arsenal, Woolwich.
House, Joseph, 41, Bruce-road, Bromley, E.
Huntley, George Thomas, 191, Tooley-street, London-bridge, S.E.
Southall, Thomas, Town Clerk of Worcester.

The paper read was—

THE PIONEER RAILWAY, OR STEAM CARAVAN, FOR UNDEVELOPED AND DIFFICULT COUNTRIES.

By F. J. Rowan.

It is manifestly the rational and proper mode of procedure, in carrying out engineering or other practical works, not only to keep steadily in view the special requirements of each individual case, and, as far as possible, to render technical appliances subservient to these, but also to combine practical skill with commercial sagacity. To do this in all cases demands an absence of professional prejudice, and a readiness to study and turn to good account every hint, supplied from even the most common and apparently the most insignificant sources.

Such considerations as these are readily assented to as general principles, as long as they remain in the region of theory; but it is a strange fact, that whenever any one leaves the beaten track, and propounds a new method of successfully reaching certain ends, which hitherto have been reached unsuccessfully by other means, if attempted at all, he encounters opposition and difficulty which others think it necessary to throw in his way, because they measure his methods by existing ones, whether right or wrong. His plans are also often condemned for no better reason than that they are different from, or contrary to, the established practice.

The Pioneer railway, or steam caravan system, of Mr. J. L. Haddan, C.E., and the author of this paper, as in some respects an innovation on existing systems of carrying, has had no exceptional lot, nor have those connected with it been able to avoid the prejudice which insists on comparing it with the ordinary railway system, and judging of its merits by the measure in which it does not come up to the requirements of that system, in spite of the inherent dissimilarity between the two.

The Pioneer consists of a low fence, or continuous girder, constructed of wood or iron, as desired, supported on edge upon posts or pillars, and surmounted by a single rail (not a single line of rails); the engine, carriages, and waggons running on this rail, and sitting astride of the fence, after the fashion of the panniers or the packs on a camel or mule, the idea of the general design having been (in Mr. Haddan's case) suggested by these simple modes of carrying.

The main intention underlying the plan is to provide a mode of communication and transport which is cheap, elastic, and efficient; having a low first cost, easily and rapidly erected and removed, and capable of paying with the scattered or meagre traffic to be obtained from thinly populated and undeveloped countries. Such a line can never become the master of its owner; it remains his servant, and can in due time be made to give way to larger and heavier means of transport.

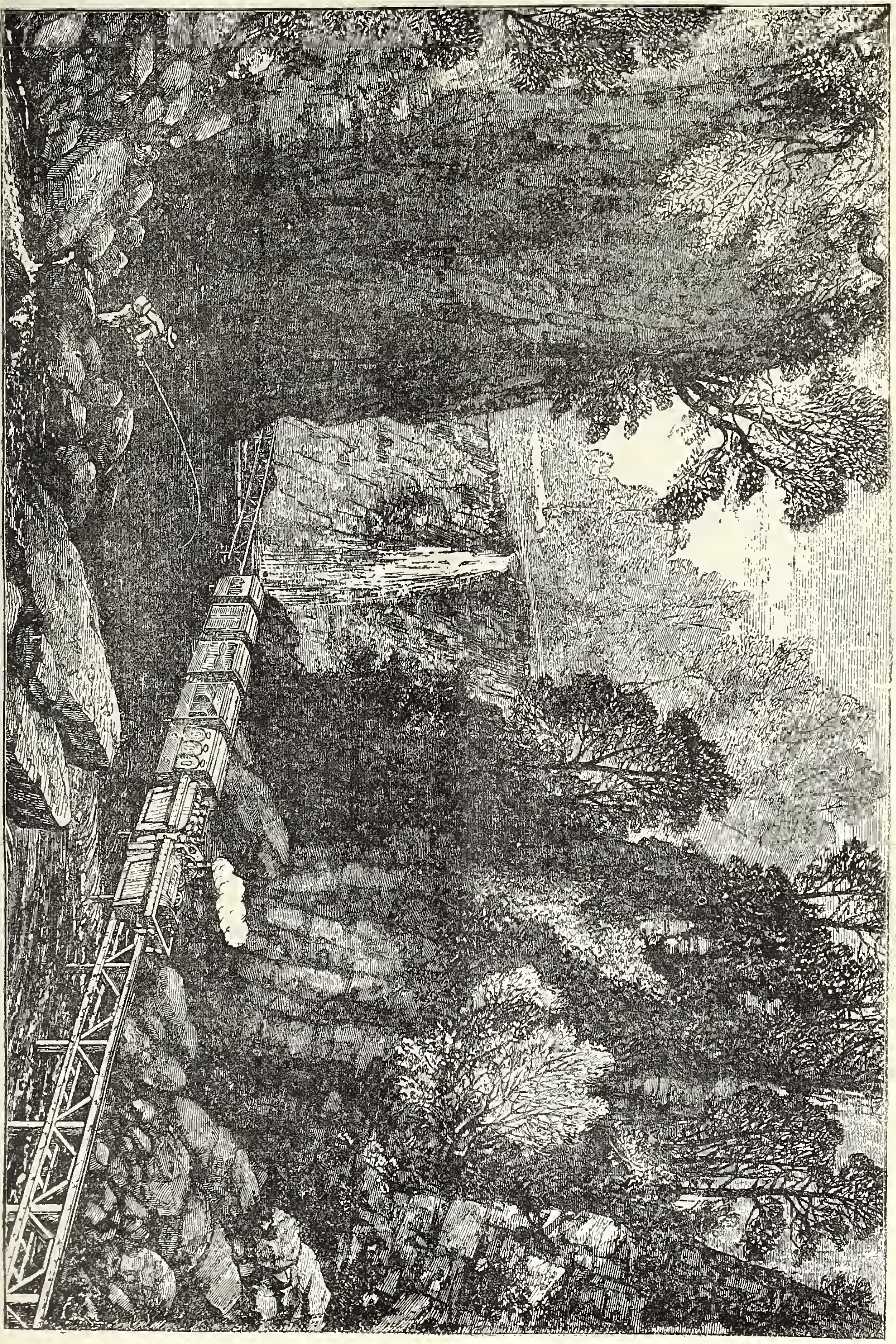
The idea of a "post and rail" railway is not new; its manifest advantages in facility of construction, and in enabling the contour of country to be followed without involving the construction of embankments and cuttings, having suggested themselves as early as in 1821 to Henry Robinson Palmer, an inventor who pretty fully describes such a system. Subsequent plans were proposed by Etienne in 1846, Sadler in 1847, Westley in 1854, Fell in 1868 and 1869, and Humphrys in 1870.

These plans present various interesting features, but only Palmer and Fell have proposed a single rail, or an approach to a single-rail, system. In his later improvements Mr. Fell adheres to the use of a narrow-gauge double-rail plan, erected upon elevated supports, and thus shows that the single-rail plan mentioned in one of his specifications was merely a proposed modification.

In all these plans, however, if we except Palmer's, which, though the earliest, seems to be singularly complete, the railway really proposed was merely an ordinary railway for ordinary locomotive traction, erected upon supports with the view of saving ground laterally, or of providing a light railway without embankments. The narrow gauge has been adopted by Fell and others to still further lighten the railway and plant, especially in view of providing a portable railway for military purposes.

But the Pioneer system, while possessing some features in common with these, carries out the principles of a light, economical, and portable railway to a much more complete issue.

In asking for this system a full consideration of its features and merits, it is necessary to urge that all customary or habitual notions connected with railways should be laid aside. A railway, according to English ideas, means an iron permanent way laid upon a costly road, which is first prepared, and which at enormous expense for cuttings, embankments, and tunnels, is made as level as circumstances will permit. On this costly highway trains are run at great speed, and heavy engines



THE PIONEER RAILWAY.

are called into requisition for this end, the weight of the engine fixing the amount of vertical grip or adhesion which is (under certain circumstances) possible, and which represents the power available for driving. This, under ordinary circumstances of weather in this country, amounts to about 450 lbs. per ton, or one-fifth of the total load on the engine wheels. The engine is necessarily much heavier than the rest of the rolling stock, but the road must be strong enough to support the heaviest vehicle travelling over it at the highest rate of speed.

Now, such arrangements are perhaps good enough—at any rate their defects pass without much notice—in a moderately level country like this, which contains many great centres of commerce and manufactures, where wealth and merchandise are accumulated, and between which the traffic is considerable. But it has been anything but beneficial to more countries than one that British ideas of railways have been introduced where a totally different set of conditions has had to be met. It is not sufficient for a railway engineer to alter the pattern of the rolling stock by putting double roofs to the carriages and a sun protector to the engine, and, with such trifling innovations, transport the superfine English system intact to a country only just opening its unwilling eyes to civilisation; while the commercial points are also so utterly ignored that the shareholders never receive a penny of return on their outlay—a fact which is in itself sufficient proof that the consulting engineer did not do his duty. Nor is it skilful, though perhaps profitable, to adopt the French engineers' plan, and purchase a set of beautifully coloured lithographs of a railway complete, from the designs of a station roof down to patterns of guard's uniforms, and copy the whole *en bloc*.

It is manifest to any anyone who is not wedded to the stereotyped form of railways, that mountainous and difficult countries which are but sparsely populated, and are principally agricultural, demand means of transit which are essentially different from those which answer very well in this and other civilised quarters. Where there are centres of population and trade, the railway must connect these centres with one another, and the traffic accumulates there, but in new countries stations must be few and far between, and there are no roads ramifying from such centres, and, as a rule, no wheeled carriages to use them even were the roads made, while there is seldom even a force of mules or camels sufficient to answer the same purpose except in a limited degree. The effect of an ordinary trunk line of railway is necessarily local, and is not felt except for a few miles in the neighbourhood of the stations, so that to do good in such localities the line must go where there are goods to be picked up, and must, therefore, at the least possible expense, serve the greatest amount of area. It follows that the line must be capable of cheap and rapid construction, consequently of extension at will, and must be such in its nature as will ensure that the frequent running of light trains is commercially profitable.

Undeveloped countries are without roads, maps, or statistics, and therefore the construction in them of colossal permanent structures, such as our ordinary railways, demands long study of the country, and costly and tedious surveys. It goes without saying, therefore, that such structures should be avoided, and that a line which can the most closely follow the camel or mule tracks (the fruits of local experience generally of ancient date) throughout the country, and which can, with increased powers, imitate these primitive—but in many ways excellent—modes of carrying, will best suit the conditions which have to be met in semi-civilised regions.

The construction of earthworks itself involves serious difficulty, delay, and danger. It demands a large amount of manual labour, and in countries such as we are considering, this disturbs to a serious degree the labour market, and withdraws valuable labour from the cultivation of the soil. The works are costly and very slow of execution, and when completed possess no intrinsic value, so that no more uncommercial class of investments for capital could be imagined. Their cost often turns the scale, in alternative schemes, in favour of the least suitable one in a commercial sense, prime cost naturally outweighing all other considerations. Their use also restricts the engineer in many ways, obliging him to imitate the crab in his progress even over moderately undulating ground, to touch but not to traverse towns, and frequently to divide or destroy valuable estates because lateral deviation on rough ground is generally impossible. The want of elasticity in the choice of a route involved by them also enables land speculators and others to reap a harvest which fairly should pertain to the railway shareholder. Their abolition therefore represents an enormous gain, and a most weighty argument in favour of a system which has no need for them.

These observations convey some of the leading features embraced in the Pioneer system, and show that it has for its basis the principle with which we set out, viz., that of the adaptation of technical appliances to special requirements, and the harmonising of the practical and the commercial elements.

The entire line and its plant are constructed in workshops either at home or abroad, and the construction is thus carried out in a way which gives almost unlimited command over the rate of production, while it ensures the cheapest production, because workshop labour is the cheapest and most completely organised form of labour. Competition in manufacture can also enter as an element in this case, and play a not unimportant part in the regulation of cost.

When constructed, the line or railway may be erected at considerable speed, and as any incline up to one in ten is possible, in consequence of the method of driving adopted, no expensive surveys are required, nor levels except of the most simple kind.

The materials of which the line is constructed possess intrinsic value, and this gives to undertakings on this system a much greater commercial security than belongs to those in which a large proportion of the expended capital is simply sunk without the possibility of any return.

Being capable also of cheap construction, since even if made entirely in iron, the cost will not exceed £1,500 per mile, including the proportion of rolling stock, a railway may be owned by one individual just as a steamship is, and can thus be dealt with thoroughly as a commercial weapon, and not, as at present, as a mere stock investment.

A cheap tariff is possible with such a system as the Pioneer alone, and in this one simple point is involved much that is of great importance. For, as has been remarked in the elaborate articles recently published in *Iron* on this subject, "the tariff fixes the distance from which it will pay to transport produce. Therefore the lower the tariff the greater the area each mile of rail will bring under cultivation." And "if a railway on an important line be constructed on so expensive a plan as to require a high rate of charge to enable it to pay a good dividend, irreparable evil will have been done, and the whole powers of an influential body—influential and powerful, just in proportion to the amount of capital expended—will be brought to bear on that line, not in order to secure cheap transit, but to prevent cheap transit ever being obtained on it."

The plan of driving which we have adopted in the Pioneer system is by horizontal grip or adhesion alone. In ordinary railways vertical adhesion or friction is exclusively used for driving, and hence in that system weight is absolutely essential to the obtaining of driving power.

In one of Mr. Fell's earlier plans, and in those proposed by some others, a combination of vertical with horizontal grip has been employed, but with only very qualified advantage, since the two plans of driving are antagonistic, the one requiring weight, while the other excels where freed from it.

The Pioneer post and rail in its normal condition merely lifts its load so far off the ground as to clear the inequalities of, and consequently ignore, the rough surface; while the grip rail, so costly and unstable an addition when applied to the ordinary railway, in this case costs nothing, since it forms an integral part of the general structure, and is useful for maintaining the equilibrium of the train.

By abandoning entirely the use of vertical adhesion, we are placed in the happy position of being entirely independent of weight, in so far as our driving power is concerned, and hence we can make our locomotive engines as light as is consistent with obtaining the necessary power from them. The horizontal grip is given by mechanical appliances, which afford the means of varying the amount of pressure at will, in proportion to the gradient to be traversed, and therefore to the load to be drawn. A light locomotive engine on this system means a light construction of road, but not necessarily, as in the narrow gauge systems, a seriously diminished proportion of traffic hauled by it. This will be understood by comparing the two, for the narrow gauge system is one which is worked on the principle of "weight is power," and consequently its locomotives must exceed in weight the train and contents—and do so considerably where gradients are stiff—in fact, it is possible on this system to reach a point when the locomotive weight suffices only for its own traction, without any train attached. In the Pioneer, on the other hand, we have light weight and variable amount of power combined. In undeveloped countries, however, great speed of transit is not required, and as large capacity waggons and carriages are everywhere unprofitable, reasons of sound commercial economy have fixed the pattern of our rolling stock on a small model. The weight is, as nearly as possible, uniform throughout the train, and amounts when loaded to from 15 to 25 cwt. per wheel. The Pioneer is thus a homogeneous caravan, all the links of it being of similar weight, and the road to carry it being constructed on an outlay governed by the nature of the traffic, and in no way measured by the arbitrary weight of a conventional locomotive, whose dead weight alone would equal that of a whole Pioneer caravan, goods included. It possesses the very important element, from a commercial point of view, of providing a supply never in excess of the demand, but just so much the reverse as to keep up prices to a profitable rate without provoking public protest. A single line, costing about one-tenth of an ordinary railway, is first laid down, and as trade increases a second, third, or fourth can be added with facility, until it may be necesssary to construct a heavy double line of the ordinary type. In this way the system will fully answer its proper character of a "Pioneer" to the more durable and powerful type of railway.

Before adverting to some possible and profitable applications of the Pioneer railway, it may be well to say a few words as to working expenses on this plan. They will for a variety of reasons be light.

Since camel and mule caravans transport goods in a very slow and insecure manner, the Pioneer would do quite enough to secure a monopoly by carrying the goods more quickly and not demanding any insurance rate against pilfering or damage. The trains would stop anywhere to take up and set down goods, so that no stations or gangs of porters would be supplied, but, *au contraire*, the Russian plan might be followed and demurrage charged for the waggons, if on arrival at their destination their contents were not at once removed by their proprietors.

In like manner no passenger stations would be required, as the railway runs on elevated posts down the main street of the town or village, and the principal *café* of the place would serve very well for a ticket office, as it is at present used for the purposes of tax collection and similar matters.

The moderate speed intended for Pioneer trains, viz., 10 to 20 miles an hour, coupled with their light weight, and almost unlimited break power, renders it quite possible safely to dispense with the paraphernalia and cost of signals. In addition to these qualities, the line has no points or crossings, so that, with no night traffic, collisions could not occur; and such accidents as derailment are impossible on account of the special construction of the road.

No outlay for fences, or hedges, or retaining walls, is required, because in public and exposed places, as well as for the passage of roads and rivers, the viaduct is raised to any required height. A very small staff for these reasons would suffice, both for working and construction, nor need that staff be of a very highly paid class.

The accompanying sketch illustrates the adaptability of the Pioneer system to wild and unfrequented countries, and a consideration of the principles which govern its construction and working will demonstrate that there are no circumstances involving the opening up of a new country, or requiring the provision of an inexpensive, portable, and rapidly increasing means of transport to which it will not apply with advantage. It is for this reason difficult to refer to possible applications of the system without seeming to incur the charge so frequently earned by inventors of being over sanguine.

In countries where there is no transport, however, timber is really a drug, and this fact of itself reveals very many openings for the introduction of such a line which may be constructed entirely of that material.

In South Russia, for intance—where such a means of transport would not be despised—sixpence a foot cube for oak worked into a Pioneer road would be considered almost an extravagant price.

In both the United States and the dominion of Canada also this feature of our system will be appreciated, where either branch lines or "feeders" from mines and other works to existing railways, or trunk lines though rough and unpopulated country, are wanted. A very important example of the latter class of lines is afforded by the proposed Interoceanic Railway. By making use in the first instance of the Pioneer, the Dominion Government might, with the means at their disposal, open up the entire route and prepare the way for a heavier road, for which the modest Pioneer would readily break up into branches.

In Africa and China, on the other hand, and in countries where the white ant rules, iron is the more suitable material for the structure of the road. The projected opening up of the former continent affords an opportunity, the full value of which can be reaped only by the use of such a weapon as this. With this railway, an African company could effect quite as great results as did the celebrated East India Company, although, in the present instance, these results could be effected by much quieter and more peaceable means. The structure, even in iron, can be reduced to £750 per mile by diminishing the scale, should the conditions of traffic require only 150 tons daily. There are special labour and other difficulties in Africa which render the introduction of such works as ordinary railways practically impossible, but which can be surmounted by this system, and, I believe, it was in view of this that a reference to the Pioneer railway has been made by the celebrated African traveller, Commander Cameron, in his recently published work on that country.

Commander Cameron says ("Across Africa," vol. ii., p.p. 322, 323, 332):—

> "The export of india-rubber to the value of £40,000 from the Zanzibar ports, and the stoppage of the export of slaves from the East Coast . . . . . . are circumstances the significance of which it is impossible to over-rate, showing that a brighter future is already dawning upon Africa. . . . . . .
>
> "The whole trade of tropical Africa is at present dependent on human beings as beasts of burden, and valuable labour, which might be profitably employed in cultivating the ground or collecting products for exportation, is thus lost. Many of the large merchants are wise enough to see that slave-carriage is the most precarious and costly of all means of transport, and they would be glad to avail themselves of any other method that might be introduced.
>
> "I would recommend the acquirement of a port—Mombasah, for instance—from the Sultan of Zanzibar, by treaty or purchase, and thence to run a light line of railway to the Tanganyika, *viâ* Unyanyembe, with branches to the Victoria Nyanza, and to the southward through Ugogo. Such a line may be constructed for about £1,000 a mile. I allude here to the "Pioneer" form of railway, which seems to be best adapted to a new country. Such a railway advancing into the country would at once begin to make a return, for the present ivory trade to Zanzibar should be sufficient to pay working expenses, and leave a margin for profit, without making any allowance for the increased trade. Numbers of Indian merchants at Zanzibar would at once push into the interior if they could do so without physical exertion."

Some important remarks are made in a recent number of the technical paper, *Iron*, demonstrating the suitability of the Pioneer in view of the conditions inherent in the Euphrates Valley scheme, and to these I would beg to direct attention. It may be added, that Brazil, with its mineral and other resources; Spain and Portugal, with their ill-fed main lines of railway; Egypt, with its necessity for some means of permanently occupying newly conquered territory; and mining districts in general, whether in this country or abroad, very much require the services of an ally, at once so convenient and practicable in his powers and operations.

Iron also refers to the project, advocated by a writer in the *Globe* last autumn, and recently by Mr. Samuda, M.P., of employing a railway as the only means of making a permanent advance over the palœocrystic ice in future Polar expeditions, and points to the Pioneer as a possible mode of transit in such circumstances. To this I would add that no other system of railway can be expected to survive the conditions to which it would be exposed in such duty. The movement of the ice at certain seasons, though it may be slight, yet would endanger the existence of any line having what is known as gauge, and it is in view of this consideration that I claim for the Pioneer the power of succeeding where other plans must fail. It has no gauge to be disturbed, and even a moderate amount of deflection of the girder road would leave intact the power of travelling over it with safety.

India, too, presents now a not unimportant field for Pioneer enterprise, for the system of Government guarantees of railway dividends is, to use an Americanism, "played out," and, therefore, railways must earn their own living by work, and not by financial strokes. To meet such an emergency as the demands created by famine, too, its services in transporting supplies are of considerable worth.

With the example of Indian ½ per cent. dividends before them, the French and English colonies may be urged to take warning against spending money foolishly in costly schemes of railways, until the day arrives when further supplies from the mother countries are stopped. It would then be too late to regret that the money already expended might have covered the whole country with a cheap means of transport, in lieu of detached portions of railways, whose rates, by prohibiting instead of encouraging expansion of trade, have restricted commerce to the coast, and left the interior out in the cold.

Turkey seems to be a hopelessly chronic case of embarrassment; but, if it is ever to be regenerated financially, it is difficult to see how that end is to be attained, apart from the material assistance of such means as are afforded by the Pioneer, of rendering the resources of the country available. In fact, Turkish bondholders would do well to take advantage of the present position of affairs to insist upon concessions for railway development of this kind being granted to them, and thus practically take the commerce of the country in mortgage and redeem the debt themselves. They could not do better than revive the former Turkey Company, and, acting with an agent like the Pioneer, whose movements are rapid, and production unlimited, they could hope to see their money back again.

In concluding, I shall merely remark that the Pioneer satisfies, in a remarkably complete manner, the requirements of a railway for military purposes. To dwell upon this would, however, involve the reiteration of many of its features of construction, which have already been described.

DISCUSSION.

Mr. H. T. Wood asked if there was any provision for trains passing one another when going in opposite directions, because it was obvious that if there could be only one set of carriages on the rail at a time, it would be a serious disadvantage as compared with the ordinary system, where, if there were but a single line, there were sidings at convenient places. He should also like to know the cost of such a line as compared with that of an ordinary narrow gauge line. He had been informed that one of the latter had recently been laid down in Australia at a cost of £3,000 per mile, and he understood Mr. Rowan to say that the former could be constructed in iron for £1,500 a mile, which was exactly half. The advantages of such a system in opening up traffic in a new country were obvious, but the question arose whether it would not be easily liable to disarrangement from its slightness of construction.

Mr. Hale inquired what arrangement was made for holding the waggons on the line, and suggested that the cost must depend very much on the nature of the country traversed. It had been said that gradients of even one in ten were admissible, which was very surprising, seeing that one in fifty was considered rather a sharp gradient on an ordinary railway. There could be no doubt that any system by which transit could be easily and cheaply affected in new countries would prove of immense benefit to the progress of civilisation.

Mr. Torkington asked if this system had been tried anywhere, and if so, with what result.

Col. Cumming remarked that in the model on the table the break wheels were only affixed to the engine and the break van at the rear; and unless it were made a condition that the train should only be a short one, he apprehended there would be practical difficulties, especially where the level varied considerably, as for instance in going over the crown of a hill, when the front part would be descending while the after part would be ascending. As he understood, the theory was that these lines could be constructed entirely regardless of gradients, and if this could be effected it would be an immense advantage not only in sparsely-peopled countries, but also in those where land was very valuable and difficult of acquisition.

Mr. E. Brooke said he should have liked to see a sectional drawing of the locomotive employed, or at least, that some description of it should be given.

Mr. Gaisford remarked that if such lines were to be constructed in Australia, and similar countries where there were large sheep runs, it would not do to interfere with the free passage of the sheep or cattle from one side to the other. Some means of crossing would have to be provided, which it struck him would be rather awkward where the country happened to be level.

Mr. Rowan, in reply, proceeded first of all to describe more minutely the model on the table, which, he explained, was on too small a scale to show correctly the construction of the locomotive. The wheels on which the waggons were suspended ran on the top of the rail, and the grip wheels worked against its sides. All the carriages as well as the engine were furnished with guide wheels, running against a strip at the bottom of the erection, but only the engine and brake were furnished with grip wheels. The waggons were coupled along the top, and on going up hill there was of course a heavier pull on the draw-bar of the engine, which automatically increased the grip. The same thing could also be effected at the pleasure of the driver or guard. It was not intended to have points or crossings, and it was quite possible to serve a large tract of country by a series of figure of 8 loops, thus ∞∞, where the trains would be continuously running in one direction. Crossings could, however, be provided, either by turn tables, or by having a portion of the line working on a hinge. When he named £1,500 per mile as the cost of the line, he referred to the whole being constructed in workshops, nothing being done on the spot except the erection, which would be very easy and simple. If wood were employed, the whole work could be done on the spot, and the requisite labour would not be costly. It was impossible to compare this with the ordinary railway system, the end proposed being so different. As he had remarked, great weight was required in ordinary locomotives in order to ensure traction, but here the weight simply depended on the amount of boiler power, and the engines might be made very light, as was done by Mr. Merryweather for fire-engines, and Mr. Thornycroft for steam-launches. There was no doubt the old system would be more economical where you had an enormous traffic, which you never could have in first opening up a new country; but the result of making these costly railways in the first instance was to burden the country with a debt which it might take a century to get rid of. The ordinary cost of a railway was from £10,000 to £20,000 a mile; and, though he admitted that narrow-gauge lines had been constructed for £3,000 a mile, he believed £5,000 or £6,000 was an average price. As the trains wero only intended to travel at the rate of from ten to twelve miles an hour, there would be no difficulty in cattle getting out of the way, or if it was not possible to provide fences, and some such protection was desired, the line could be caried a little higher. The system as now proposed had not yet been tried, but something similar had been in use for trains moved by stationary engines. A tramway of this kind was erected some years ago in Lyons, and worked for some time successfully; and he believed a similar one had been erected and worked in Posen, but these were only intended for temporary purposes, and had not been continued. One or two also had been erected to be worked in the ordinary method, a specimen of this kind having been shown in the Philadelphia Exhibition, and a similar one was at work in New York, the rails being laid on pillars erected in the streets. It was called a saddle-back railway, but it was worked on the principle of weight giving the tractive force, the engine running on a couple of rails.

The Chairman, in proposing a vote of thanks to Mr. Rowan for his interesting paper, said the subject-matter of it was so new, and took them all so much by surprise, that they were hardly prepared to discuss it so thoroughly as they would have liked. One point struck him as of special importance, viz., that the railway could be constructed at home in portions and sent out, and when it was superseded by a more perfect and permanent line, it could be readily taken down and refixed elsewhere, to form branches and feeders to the main line. How far it would be found successful in practice, of course, he could not say. He did not think Mr. Rowan had quite understood the question put with regard to sheep and cattle, which did not refer to their being run over, but to facilities for crossing. This, however, could be effected by making hollows under the line, which, in the case of sheep, need only be about 2 ft. in height, and even for cattle a kind of tunnel 6 ft. in height could easily be made. With this form of line it seemed almost impossible that cattle could be run over. The special advantage seemed to be that the line could be constructed over very irregular ground. He did not understand that the saddle-back form was patented, this having been known for 50 years; but the novelty was the application of the grip principle to it.

Mr. Rowan remarked that neither the peculiar form of railway nor the horizontal grip could be patented, both being known, but the combination of the whole.

The Chairman said there was hardly an invention now successfully in use, the germs of which had not been known at a much earlier date, and even very frequently almost brought to perfection; but the real inventor was the man who succeeded in bringing such germs into practical use, and the law courts had decided that such men were entitled to the protection of a patent. As he understood, Mr. Rowan or Mr. Haddan claimed the combination of the saddle-back railway with the horizontal grip.

The vote of thanks having been passed, the proceedings terminated.

MISCELLANEOUS.

THE PATENT BILL.

In the current number of the *Nineteenth Century* is an article by Dr. Lyon Playfair, on "Patents and the New Patent Bill." The whole article is too long for quotation here, but the remarks on the Bill it may be worth while to quote. Dr. Playfair, after discussing the general question of the justice and the advisability of a Patent-law, goes on :—

"The Bill before the House is founded on the necessity of protecting public interests, while it accords private monopolies to inventors, and it is well that we should examine its guiding principles. These are, that only good and substantial patents should be encouraged, but that bad and frivolous ones should be repressed. The latter are to be sifted out by examiners, and the worthy patents are to be tested by their utility and by an increasing money payment as evidence that there is a practical interest to keep them upon the roll. The Bill also compels the inventor to supply the public with the products of his invention, or to grant licenses within a moderate time, and at reasonable rates. Patentees object to this condition of use. They contend that there are very few 'dog in the manger' patents, and that no one has a right to dictate the use of property. For example, a man may cultivate his fields as he likes, and even leave portions of them in fallow, without interference from the State. But patents, as we have shown, are not property in this sense. If they stand in the way of human progress, they are altogether indefensible. It is only by the right of use that the public can receive the benefit which is the justification of the monopoly. On the whole, then, the principles of the Bill appear to be fair conditions in the interests of the public, though by the manner in which they are applied in the Bill, poor inventors may be much discouraged, and rich capitalists may chiefly benefit by the new legislation. This is a great merit in the eyes of rich manufacturers. A celebrated inventor said to me a few days ago, 'No patent is worth anything unless £20,000 have been sunk in its preliminary stages.' The Bill now before the House may give us well-tested patents of this discription, but it may, on the other hand, unduly restrict invention. I have written enough to show that I do not desire to see the ground cumbered with useless inventions which trip up ordinary wayfarers in the field of industry. But I think that it is no improvement of Patent-law, to construct a system which has a tendency to repress invention among the poor, and only to stimulate it among the rich. Nevertheless, the Bill certainly offers new and important advantages to the inventor, for it lengthens by nine months the period of preliminary protection before the final specification is made; it cheapens patents in the early stages, and it extends proved patents from fourteen to twenty-one years. Against these advantages are the disadvantages. First, the Bill complicates procedure, and it enforces examination as to subject-matter and novelty by a machinery which must inevitably prove incompetent. Both these blots may be considered together. There are, as we have shown, two interests to protect—the interests of the inventor and of the public. In the case of a good patent these interests are identical, but in a useless patent they are antagonistic. When the public travel along a road, it is useful to have steps cut to shorten a hill, or to escape an obstacle, but it is positively pernicious to find the road strewn with lumbering obstacles, which trip up the traveller, and cause unnecessary hindrance to his progress. The previous examination for patents for novelty and utility is intended to prevent these hindrances, and has been recommended by a Royal Commission, by a Select Committee, and by the International Congress at Vienna. The weight of authority is thererefore strongly in its favour. But examination may be conducted in a spirit hostile to the inventor, as is done in Prussia, or in a spirit of instruction and friendliness, as in America. There are to be six examiners under the new Bill; in America there used to be a hundred, and now there are eighty-five! It is quite impossible that six examiners can cover the field of a thorough investigation of 5,000 patents yearly. The results of their examination, if hostile, after a reference to the law officers and appeal to the Chancellor, are to be final, and the expense of this procedure, with the certainty that six men cannot bring the knowledge of experts to bear upon inventions, will much discourage the poor class of inventors. According to the Bill the examiners are to act in rotation, and the result of this would be that the man versed in clocks might have to decide on a chemical patent, and the refuser of a patent this week might be the passer of a like patent in the following week. The examiners should consist of a sufficient number of experts on each subject, paid for each report, and not of a few men professing universal knowledge, which, in the present state of science, it is impossible for them to possess. If the experts be lawyers they cannot be mechanicians and chemists, and if they be the latter they cannot be good lawyers. A responsible and properly paid Commission of Patents could easily obtain the knowledge of experts by an adequate remuneration. The inadequate provisions of the Bill as to examination have led to the suggestion that, if it were not prohibitory but instructional, the poor inventor would gladly receive the knowledge and advice of the examiners to guide him in coming to a decision as to novelty and ability. It is contended that an examination of the authorities cited to prove that his inventton was neither novel nor useful, would, in nine cases out of ten, induce the inventor to withdraw his proposal, with a grateful feeling to the State for having saved him from further expense. If he still persisted in carrying his patent to completion, the unfavourable opinion of the examiners should be recorded on the patent, and would be strong evidence against him in future proceedings. It would only be in case of a strong conviction of originality that a patentee would go forward in the case of a hostile record. And we know of important cases where actual prohibition has acted injuriously. Bessemer's process for blowing air into molten iron, and Gifford's injector, were refused in Prussia on the ground of want of novelty, and yet have proved vastly important inventions. The enrolment of a patent, after all, can scarcely be called in a strict sense a secure monopoly, but is only a presumptive right of property, for the State does not defend it, or give any special privileges for its protection. Still, it would be illogical to grant a presumptive monopoly when you record upon the register that the claim is neither one of novelty nor of utility. It is true that if a few bad patents did get on the register through the pertinacity of obstinate men, the rising scale of fees would soon cause them to disappear if useless. Even now the average life of a patent is said to be only 3½ years; and with a little adjustment of the proposed scale of fees, bad and useless patents would soon disappear from the record. There is a good deal of plausiblity in this reasoning, but it is not conclusive. The new law is much in favour of the inventor, who ought in return to give fair concessions to public interests. The weight of all authority supports a system of preliminary examination which, to be of any public use, ought to be conclusive. But both the public and the inventor have a right to demand an adequate tribunal in the first instance, so that they may trust its competency and fairness. This the Bill does not provide, though it may be modified to meet this want. The patent revenue ought, moreover, to be used not merely to swell the Consolidated Fund, but to promote invention. It now amounts to about £90,000 per annum, and is little applied to the public advantage. Patent libraries to consult, and patent museums of an efficient kind, not only in London, but in our chief industrial towns, to show preceding inventions, ought to be provided, if inventions is to be stimulated and not strangled by new Patent-laws. A museum and library, indeed, exist in London, but on the scale little commensurate with their importance, and are miserably inferior to the museums of industrial inventions in France and America.

"The new Patent Bill, while it provides for the extension of new patents from 14 to 21 years, strangely omits to make provisions for the extension of existing patents for a further period of seven years. This would be clearly necessary when they are brought under the same conditions as to license and payment as those under the new Bill. It would be a singular injustice that good and effective patents now in existence should have a term of life one-third shorter than the more fortunate ones taken out after the present year. On the whole, it will be seen that the Bill before Parliament is founded on good conception of public interest, and requires only certain modifications to render it a valuable measure. It adopts the right principle that patents should not be considered in relation to any indefeasible right which the inventor possesses; for the State has no immediate interest in the individual patentee, but it has an interest in the public, and it is only when these interests are common that the State ought to give privileges to the former.

"I have made no allusion to the views of those who think that patents should not be given at all, but that the State should recompense inventors by honours and pecuniary rewards. The experience of State rewards for invention is melancholy in the extreme. It is true that there are a few instances in which such a man as Compton, the inventor of the spinning mule, got £5,000 as a wholly insufficient recompense when some five or six millions of spindles were enriching the country; but there are other records of large over-payments for the most trivial and useless inventions. Take, for instance, another reward of £5,000, given to Mr. Stevens,* in 1739, on the recommendation of a Royal Commission, consisting of an archbishop, ten bishops, the Lord Chancellor, three Secretaries of State, five peers, and ten men of science. The reward was for a remedy to cure gravel, and the remedy proved to consist of three items—a powder, a pill, and a decoction. The powder was made of pounded egg-shells, and snail-shells; the pill of egg-shells, soap, and honey; the decoction of soap and 'swine's cresses.' The Government is an unfit tribunal to assess public rewards, which never could be so efficient as the results of commercial success. As to paying in honours, the time is past when that would be accepted as a discharge for public work in relation to industry or science. The State has unwisely limited these honours to combatant, and more lately to civil services, while the victors of peaceful struggles in science and industry have lost their appreciation of them. At one time the Sovereign was the fountain of honour to all, and three letters of the alphabet, with a few inches or a yard or two of riband, was taken as payment in full for much service rendered to the State. But by the exclusive policy of the Government, in denying honours to scientific and industrial achievements, the fountain of honour which used to spring from the throne has become dried up, and both discoverers and inventors have learned to prefer the democratic letters 'F.R.S.' to the more royal letters 'K.C.B.'"

CITÉS OUVRIÈRES.

M. Engel-Dollfus has recently published a little *brochure*, containing a good deal of information respecting the experiments made in various parts of France to improve the dwellings of the working classes, and the experiences obtained in one country on this subject may be of value in another.

In 1854 there existed a model lodging-house, so called, erected by an Anglo-French company. It stood on what were then called the outer boulevards, not for from the Barrière de Clichy. This, however, was not the first establishment of the kind in Paris. There were *cités ouvrières*, a curious unsuitable name, for a *cité* is an agglomeration of houses within gates, while the *cité ouvrière* was a huge house let off in apartments.

Neither the model lodging-house referred to nor the *cités ouvrières* have flourished in Paris. They have been dubbed *casernes ouvrières*, and it is asserted that grave moral and sanitary inconveniences soon began to make themselves felt, and that, when epidemics appeared, the *cités* were decimated. Whether the Government interfered or not is unknown to the writer, but the fact remains, we are told, that not one of these establishments now exist in Paris.

The tract then deals with the efforts have been made in many great industrial centres, and the success which has attended them, especially in the departments of the east and north of France, where iron masters, manufacturers, and proprietors of mines have created *cités ouvrières* really deserving of the name. The houses in these establishments are generally devoted to a single family, and they are let or sold either to the workmen employed on the establishment to which they are attached, or to others, either working men, shopkeepers who settle in the neighbourhood, or even to persons of small means who are glad to join the colony. The price placed on the houses is very moderate, and consequently they are seized upon in most cases with avidity. In several instances these *cités* have grown to large dimensions, and have prepared the ground for many beneficial institutions, such as co-operative societies, savings banks, and provident institutions of all kinds.

The most important of all these establishments perhaps is that at Mulhouse, established about twenty-three years since, of which M. Engel-Dollfus, and his father-in-law, M. Jean Dollfus, were prominent promoters. The title of the *brochure* already referred to is

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* It was a woman, Joanna Stevens, who obtained this curious grant. Ed. *S. of A. J.*

Etude sur l'Epargne, les Institutions de Prévoyance et la Participation aux Bénéfices, the latter subject being highly popular in France.

The results at the Mulhouse and other establishments are certainly very satisfactory, and the publication cannot fail to produce some little good. It appears from an official report that, in 1876, the number of houses in *cités ouvrières* was 920, of which 918 had been sold for a sum total of 2,693,675 francs. The population of these cities amounted to 6,551 souls. A distinction is drawn between the old and the new *cité* of Mulhouse; the former contains only 200 houses, the latter 720; of these, 56 only date back to 1875. The callings of the purchasers of these last houses will show the composite character given to these "cities;" they consisted of 4 founders, 2 blacksmiths, 4 whitesmiths, 3 boiler makers, 2 metal turners, 5 finishers, 3 weavers, 3 foremen, 2 platelayers, 3 firemen, 2 porters, 4 labourers, 5 carpenters, 7 masons, 1 cooper, 1 shoemaker, 1 tailor, 2 engravers, 2 clerks, 1 postman, 1 hawker, 1 street porter, and 1 commissionaire.

In answer to the various objections urged against such institutions, it is asserted that the experience of Mulhouse entirely dispels the doubts raised; the *cités* have existed through terrible crises without their development and prosperity having been suspended; the value of the houses has increased from year to year, and the first purchasers found, when they desired to quit the place, that they could sell with a profit. Of the 200 houses in the old *cité*, 108 are still occupied by their original purchasers, 82 have been sold once, and the rest two or three times, so that although the possessors of these houses certainly become less wandering in their habits, they are in no way bound to the spot.

The coal mining companies in the Nord, eighteen out of twenty-three of whom have contributed miners' houses, amounting in all to 7,000, representing a capital of eighteen millions of francs, and housing 31,500 persons, of whom 11,500 are miners; and at the great works of Creusot houses in complete condition are let to the men at the rate of thirty-six francs per annum.

There are in the outskirts of Paris a few villages or collections of cottages for workmen, and in the quartier St. Antoine there is a *cité* for artisans who work at home, each habitation having a shop supplied with steam or other power. The difficulty connected with *cités* at some distance from Paris or any other great city is, of course, that of transport, but it is said that a number of intelligent capitalists have determined, if possible, to overcome it. It is to be hoped they may succeed.

BAMIA COTTON.

A great amount of public interest has recently been drawn to a supposed new variety or species of cotton from Egypt. Not only those immediately connected with cotton cultivation abroad, or with the cotton industry at home, but the public generally, have heard of and discussed the merits or demerits, so far as they are at present known, of "Bamia" cotton. The accounts given in the daily papers of the productiveness of this particular cotton have been somewhat extravagant. Thus, the *Times* correspondent at Alexandria, writes, "If, as is stated, there are 400 ardebs of seed ready for sowing this March, and it multiplies itself by 60, as it is said to do, we shall have for the following crop about 24,000 ardebs, and for March, 1879, there will be enough to sow the cotton country ten times over, as there are only 700,000 peddans in the whole of Egypt which are fit for cotton culture. Going one step further, and supposing that the new plant supplants the old, we should have a crop of 7,000,000 cantars of cotton, and 5,000,000 ardebs of seed, while the largest crop ever known hitherto was produced last year, and only reached 3,000,000 of cotton and 2,250,000 of seed. To put the comparison in the money form, we should have £21,000,000 instead of £9,000,000. The prospect is really intoxicating." With such a statement made so widely public in the *Times*, and equally favourably notices in other leading papers, the interest in Bamia cotton has become deep and widespread. Some of the advantages of this over ordinary cotton are said to be in its habit of growth and greater productiveness; thus, while a single plant of the common kinds of cotton bears only from 25 to 35 pods, the Bamia is credited with bearing on an average from 45 to 60. Another advantage is said to be in the height the plant attains, running up, as it does, to ten or twelve feet, and with little or no branching. This habit, of course, allows a greater number of plants to be raised on a given space of land, inasmuch as they can be planted more closely together but it seems questionable whether the crowding together of plants growing to the height this cotton does, can in the end be profitable, for much light and air are necessarily excluded from among the plants, which, if admitted, must be beneficial to them, and would probably help the crop. Judging from the specimens recently received at the Kew Museum, some of which are fully ten feet high, the prospects of a revolution in the cotton culture by the introduction of this novelty seems far off. The plants seem to have been drawn up, or to have outgrown their strength, and the pods, which of course are the chief point in a commercial aspect, are small, not more than 1¼ inches long by 1 inch broad; the cotton is not abundant, and is of short staple. These are the conclusions arrived at after examining two Kew specimens. It may be that these specimens do not fairly represent the plant in full vigour of bearing, for it is certain that the seeds contained in the pods have, for the most part, decayed, and the pod and cotton itself become deteriorated. The true value of the cotton, therefore, can only be judged upon receipt of further specimens, more especially of the pods containing cotton, or of a fair sample of cotton, taken from the pods. This material will, no doubt, shortly be forthcoming, and, until then, the fate of Bamia cotton, whether for extensive cultivation or for absolute rejection, remains in abeyance. Unless there is a great gain over the old plants at present in cultivation, both in quantity and quality of cotton, it is doubtful whether planters will ever take to it, for it is stated to require a larger amount of irrigation, so that it impoverishes the soil, to remedy which, it "would be necessary to sow, alternately, year by year, a crop of grain or vegetables." With regard to its botanical relationship with other cottons little or nothing can yet be said, though the bulk of the cotton grown in Egypt is derived from a hardy coarse kind of sea island. The plants now growing at Kew, which have been raised from seeds sent home by Mr. H. H. Calvert, our Consul at Alexandria, will be watched with interest.

LOCAL MUSEUMS.

These institutions are being gradually established throughout the country in different forms. In some places they are connected with Schools of Art, and to some degree indirectly subsidised from the public funds. In other places they are supported by a rate obtained under Ewart's Act. In other places, again, they are partially endowed, as at Liverpool. Rules for admission vary. Birmingham is, perhaps, distinguished above other places by opening both its Public Library and its Museum on Sunday afternoons, after three o'clock. For two years past returns relating to Local Public Libraries, ordered by the House of Commons, have been in preparation, and it may be hoped that in the next session of Parliament they will be printed and circulated. In the meantime the Council of the Society of Arts request that any information about local museums, especially as regards the number of visitors, may be furnished, in order that it may appear monthly in the *Journal*.

ADULT INSTRUCTION THROUGH PUBLIC MUSEUMS.

(Subsidised by Parliament.)

The following results, giving important information bearing on public education, are obtained as correctly as possible, from inquiry and Parliamentary returns, in the hope that they may hereafter be officially collected and published periodically, like the Registrar-General's returns. The number of visitors for the month of February, 1877, is stated. When they are counted by sight the letter "S" is used, when by turnstile the letter "M":—

Institutions.	Amounts voted in 1876. £	Number of Visitors in February.	How counted.	Observations.
1. British Museum	108,947	24,758 (1)	S	Return refused. Open Mondays, Wednesdays, Fridays, and Saturdays. Closed, except to students, on Tuesdays and Thursdays. (1)
2. National Gallery, Charing-cross	6,898	135,623	S	Open Mondays, Tuesdays, Wednesdays, and Saturdays. Closed on Thursdays, and Fridays. Open from 10 to 5. (2)
3. Kew Gardens and Museum	22,622	..	S	Open on Sundays and week days. (3)
4. South Kensington Museum	39,058	60,158	M	Open Morning and evening till 10, on Mondays, Tuesdays, and Saturdays. Students' days—Wednesday, Thursday, and Friday, 6d. entrance. Open from 10 till Sunset.
5. Bethnal-green Museum	7,200	65,666	M	Ditto. (5)
6. National Portrait Gallery, South Kensington	2,000	..	M	Return refused. Open daily except Sundays. (6)
7. School of Mines and Mining Record Office, Geological Museum, Jermyn-street	8,947	4,120	M	Open daily, except Sundays and Fridays, and in the evenings till 10 of Monday, Tuesday, and Saturday. (7)
8. Patent Office Museum, South Kensington	..	16,272	M	Open daily, except Sundays. (8)
9. Edinburgh National Gallery	2,100	5,276	M	(9)
10. Edinburgh Museum of Antiquities	..	5,558	M	(10)
11. Edinburgh Museum of Science and Art	10,320	23,884	M	Open daily (10 a.m. to 4 p.m.) except Sundays, and Friday and Saturday evenings (6 to 9). Students' days—Monday, Tuesday, and Thursday; admission 6d.; other days, admission free. (11)
12. Edinburgh Botanic Gardens	1,750	3,539	M	(12)
13. Dublin Museum of Natural History	1,742	8,141	M	Open daily, and in the evening. (13)
14. Glasnevin Botanical Gardens and Museum	2,224	13,490	M	Open daily, including Sundays. (14)
15. National Gallery of Ireland	2,339	6,567	M	(15)
16. Museum of Royal Irish Academy, Dublin	300	..	M	(16)
17. Zoological Gardens, Dublin	500	5,432	M	Open daily, including Sundays. Number of visitors in July, 15,281. (17)
18. Tower of London	1,590	..	S	Open daily, except Sundays. (18)
19. Royal Naval College, including Greenwich Painted Hall	38,051	17,179	S	Open daily, including Sundays. (19)
20. Royal Naval Museum, Greenwich	1,055	1,987	S	Open daily, except Fridays & Saturdays. (20)
21. India Museum, South Kensington	..	1,434	M	Paid for by Indian Government. Open on Mondays, Tuesdays, Fridays, and Saturdays, 1d. admission; on Wednesday and Thursday, 6d. admission. (21)
22. Hampton Court Palace	7,475	..	..	Open on Sundays, and on week days except Fridays. (22)

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(1) The numbers are those for the corresponding month of last year, as given in the Parliamentary return.

(9) (10) (12) (16) No information as to opening.

(22) As far back as 1855 returns of the number of visitors were made to Parliament and printed, but this practice, for the present at least, has been suspended. The statistics published by the Board of Trade every three years give returns.

CITY GUILDS INDUSTRIAL UNIVERSITY.

For some months the Civic authorities have been contemplating the establishment of a National Industrial University of Scientific and Technical Education, under the auspices of the Livery Companies of the City of London. The intention is first to form a Central University, with affiliated schools of technical instruction in connexion with the various industries carried on in the suburbs of London, and the manufacturing districts of the country generally; secondly, to establish a system of technological examinations and degree certificates of various grades and denominations to be granted in connexion with the science and technology of the several arts and manufactures of the country; such examinations to be conducted on behalf of the Central University by examiners capable of testing the practical knowledge and skill required in the application of the scientific principles involved in each art or manufacture, as well as the theoretic principles of those branches of science which are requisite as a foundation for mechanical instruction in any particular industry; the Society of Arts being asked to merge their tentative organisation on that behalf. Prizes, exhibitions, and other rewards, as well as incentives and adds to further educational progress, would be given, it is assumed, by the Central Technical University, who might in course of time apply for chartered authority to grant degrees in arts proper, similar to those given for arts in the secondary sense of the term, by what are called in the programme under notice the Mediæval Universities of the præ-scientific age. It is also assumed that the Council of the Technical University would delegate its duties of organising special instruction for individual industries, to be carried out in the localities where such industries are found to be most largely developed, to departmental sub-committees of Council who might hold their meetings at the various halls of the Companies whose chartered associations, it is thought, would give them a cognate interest in the special sections of industrial activity referred to the management and supervision of such sub-committees, or who might arrange to take especial interest in some other departments of industry, more or less akin to that with which their Guilds were associated by the terms of their charter, but the functions of which, having passed into wider spheres, might now receive a more comprehensive interpretation. It is also suggested that the co-operation of the Science and Art Department should be secured in connection with the project of establishing local schools of technical instruction throughout the country; a course which, it is said, is being adopted at Stroud, where the Clothworkers' Company is organising a school of technical instruction, with especial reference to the cloth-working industry of the district, affiliated to the Bristol College of Science, and the Chair of Chemistry, which they have partially endowed there.

It is proposed to erect a building as the central hall of the City Guilds' Industrial University, on a plot of ground between the Temple and Blackfriars, on the Thames Embankment, consisting of a large amphitheatre or lecture-room, a council-room, with library, a museum of trade examples, and a room for models. It is held that to begin the movement on a scale commensurate with the necessities of the times, and the wealth and intelligence of the associated Livery Companies, not less than £10,000 per annum should be guaranteed over and above the provision for a building fund. As a first example of the local schools to be thus affiliated to the Central University, the Clothworkers' Company would contribute the School of Textile Industries established by them at Leeds; and as an example of other existing local institutions which might be utilised and extended as secondary schools for the purposes of trade instruction, the Horological Institute, Clerkenwell; the Artisans' Institute, St. Martin's-lane; the School of Art and Design, Spitalfields, and many others might be mentioned. Such is an outline of the proposed Industrial University in connexion with the City Guilds, and the result remains to be seen. Meanwhile, it has been suggested that the Gresham College foundation could be utilised as a wing of the greater technical institution, in which case the lectures established in connexion therewith might be modernised and extended, and made more applicable to the practical, as well as intellectual necessities of the present day.—*Times.*

SANITARY CONDITION OF LONDON.

The following extracts, from the *Sanitary Record* and the *Civil Service Review*, give a pleasing idea of the present sanitary state of the metropolis.—

Architectural Molochs.—Universal regret is felt in all the departments of the Admiralty at the death of Deputy Inspector-General Mackay from typhoid fever. He was one of the ablest and most valued of all the servants of the Government at the Admiralty, and his experience and special knowledge were such that it will be well-nigh impossible to adequately supply his place. This feeling of sorrow is much increased by the well-authenticated fact that Dr. Mackay's death is directly traceable to the insanitary condition of the offices which he occupied in Spring-gardens. It was his custom to drink water freely during the progress of his work at the office, and since his death it has been discovered that the water was procured from a cistern which also supplied the conveniences, and that the waste-pipes from it communicated directly with the sewers. Not only has the insanitary condition of these buildings, and the neglect of proper sanitary precautions thus robbed the public service of one of its most valuable and efficient servants, but to this cause is due the serious illness of another illustrious official, Sir Francis Festing, K.C.M.G., who has just recovered from typhoid fever, and who occupies offices in an adjoining building. In addition to the above cases, the messenger and his wife in charge of the Accountant-General's Office have both suffered from typhoid fever, which in the wife's case proved fatal. On the opposite side of New-street, especially at the offices Nos. 22, 23, and 24, much illness has occurred among the staff; and boils and other evidences of blood-poisoning have, we are informed, attacked more than one of the officials, who are or have been absent on sick leave. The sanitary condition and health arrangements of the majority of the offices occupied by the Admiralty in Spring-gardens are such as reflect little credit on the Commissioner of Works; the character of the buildings, the overcrowding, the absence of proper ventilation, the evident pressure of sewer gas, and the complexity of passages and chambers, certainly rival, if they do not surpass, the characteristics of the condemned War-office building.—*Sanitary Record.*

The State of Government Offices.—Since we wrote last week of the sanitary condition of the Admiralty, we have heard with regret that the condition of certain portions of the main building in Whitehall is even worse than we had been originally led to believe. At least one gentleman is at the present time absent from blood-poisoning brought on by the unhealthy state of the room in which his official work is performed; and although this is an unusual, we believe that it is not an isolated case. Grave rumours reach us, too, as to the health of the Audit-office, Somerset-house. We hear that one of the members of the staff of that department is at the present time laid up with typhoid fever, contracted in the discharge of his official duties; that others have been or are suffering from ulcerated sore throats; that strong representations have been made regarding the drainage of a portion of the building in which the department is located; and that to the evils incident to defective drainage may possibly have to be added those arising from the proximity of a school of anatomy in King's College, regarding which some discoveries, unpleasant, at any rate, to the Audit-office staff, were made a few months ago. Is it too much to ask the Government to order a thorough overhaul of the sanitary arrangements of all the buildings in which Civil servants have to work?—*Civil Service Review.*

City Offices.—For months past the smells emanating from the basement stories of City offices have in many cases proved almost unbearable. On one side of Birchin-lane, for instance, the foul air arising from the areas has, we are informed, caused much sickness among the *employés* of one large City firm, at any rate. Within the last few weeks, the directors of one of the chief London assurance companies were at last moved to action by the serious complaints made to them of the insanitary condition of the basement in which the conveniences and lavatories for the clerks were placed. On the workmen removing the floor of the room in question they discovered that the whole of the earth underneath was saturated with sewage, and that it was quite black in colour from the impurities it had absorbed. Further investigation proved that the soil-pipes, in some instances, were not even connected with the sewers, and that the whole of their contents was thus forced to percolate as best it could through the soil into which the pipe drained. It is not surprising to hear that much sickness had occurred in the office in question, and that typhoid fever was not unknown. Surely it is time that each conscientious employer, having an office in the City, should take steps to investigate the sanitary condition of the whole of his premises.—*Sanitary Record.*

CORRESPONDENCE.

THE PATENT-OFFICE EXAMINERS.

It appears to me that scarcely sufficient attention has been paid to one point in the new Patent Bill—the utter inadequacy of the staff of examiners to do the work set down for them. It is proposed to appoint 2 examiners and 4 assistants, 6 in all. Allowing for 52 Sundays, 6 general holidays, and 36 days leave, there would be 271 working days. This is without reference to Saturday half holidays or sick leave, which is not unknown in Government offices.

Each examiner would have 5,400 ÷ 6 = 900 specifications a year, or $3\frac{1}{3}$ per diem (10 in 3 days); all of those that passed the provisional stage would require two examinations. The examiners also are to prepare abridgments and indexes. Now, eight abridgments per diem is certainly more than would be done in practice. At that rate, one man would do 2,160 in a year, doing nothing else, *i.e.*, it would take more than two men to do the work. I should doubt if any abridger as now employed has sent in more than 1,200 in any one year. The indexing, being work of a more mechanical nature, could of course be done by a proper staff, under the superintendence of one of the examiners, but it would occupy a good portion of his time if it is to be done properly.

How soon the new scheme could be set to work it is not easy to say. The existing indexes are certainly not in a fit state to allow of proper examination. The index to Patents granted the Old Law, previous to 1852, is useless. It was made from the titles only; and these, as is well known, offer but a slight clue to the contents of the Specifications. Literally, there is more omitted than there is put in. The first year or two of the New Law is not very good, but after that the index is uniform to 1871; 1872 and 1873 are on a different plan, and bad; 1874 and onwards are tolerably good.

The volumes of classified abridgments stop at 1866. Owing to the imperfections of the indexes all are more or less imperfect. Some series are still wanting. Some are good, some very bad. There is no uniformity about them.

The abridgments sent in since 1866 by the applicants, and published chronologically, are practically valueless, or of very small value. These have been discontinued, but nothing has been substituted for them.

O. P. Q.

OBITUARY.

Sir Edward Belcher, K.C.B.—Admiral Sir E. Belcher died on the 18th March, at the age of 78. He entered the navy at thirteen, and after seeing service in the West Indies, at the bombardment of Algiers and elsewhere, he was sent out (in 1825) under Capt. Beechey, in the *Blossom*, on a voyage of discovery in the Pacific. After this he made his well-known voyage in the *Sulphur*, surveying the Pacific. He commanded the expedition in search of Sir John Franklin from 1852 to to 1854. Sir Edward Belcher did not again serve afloat after his return from Arctic service; he was awarded the good service pension as a captain; he became a rear-admiral in 1861, a vice in 1866, and a full admiral in 1872, having been advanced to a Knight-Commander of the Bath in March, 1867. A pension of £250 a year for wounds was awarded him in 1844, and a few months before his death he received also the Greenwich Hospital pension. Besides his "Treatise on Nautical Surveying," Sir Edward Belcher published his "Narrative of a Voyage Round the World in the *Sulphur*," and "The Voyage of the *Samarang*," also an account of his own Arctic Expedition. He became a member of this Society in 1859, and for some time took much interest in its work. On several occasions he occupied the chair at meetings, and he also contributed to the *Journal*.

NOTICES.

PROCEEDINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday evenings, at 8 o'clock. The following arrangements have been made:—

April 11.—"Compensation for Injuries received in Industrial Occupations," by T. Attwood Brockelbank. Lord De La Warr and Buckhurst will preside.

April 18.—Lecture by E. J. Reed, M.P., C.B., F.R.S., "The Modifications which Ships of War have undergone during the last Twenty Years."

April 25.—"Deaf not Dumb," by B. St. John Ackers, Esq.

African Section.

Tuesday evenings, at 8 o'clock. The following arrangements have been made:—

April 10.—"The Social State and Prospects of the South African Communities," by Robert Richards, Esq., of Grahamstown.

April 24.—"The Trade and Resources of Morocco," by Dr. Arthur Leared.

Indian Section.

Friday evenings, at 8 o'clock. The following arrangements have been made:—

April 20.—"The Existing and Possible Commercial Communications between Persia and India," by Major-General Sir Frederick John Goldsmid, C.B., K.C.S.I.

May 4.—"Thaumato-dendra, or the Wonders of Trees," with illustrations from life, by Wm. Tayler, Esq.

Chemical Section.

Thursday evenings, at 8 o'clock. The following arrangements have been made:—

April 12.—"The Cinchona Alkaloids; their Sources, Production, and Use," by Dr. B. H. Paul.

April 19.—"Spontaneous Combustion in Factories and Ships," by C. W. Vincent, Esq., F.C.S.

April 26.—"Phosphor-Bronze and its Applications," by Alexander Dick, Esq.

Cantor Lectures.

Monday afternoons, at four o'clock. Third Course on "The Connection of Greek and Roman Art with the Teaching of the Classics," by Sidney Colvin, Esq., M.A., Slade Professor of Fine Art at the University of Cambridge.

Lecture I.—April 16.

Introductory.—Definition of a classical education—the training of the mind by a systematic study of the genius of ancient Greece and Rome. Two kinds of remains left by ancient Greece and Rome, viz., remains of literature and remains of art. In England, classical literature and language studied to the neglect of classical art and archæology. Not so in Germany. Place and value of the study of art and archæology (1) as illustrating the study of art and archæology, (2) for its own sake, as an independent training. Examples.

Lecture II.—April 23.

Range of the Study.—Architecture—not to be specially considered in the present course. The imitative arts. Subjects of imitative art in ancient Greece and Rome, co-extensive with the whole field (1) of imagination, (2) of life. Subjects of imagination—deities, personifications, heroes. Subjects of reality—history, portraits, ceremonies, sports and pastimes, family life, death.

Lecture III.—April 30.

Material of the Study.—Division according to the art employed, as sculpture, painting, and their subordinate arts. Division according to the nature of the work produced, as statues in wood, gold and ivory, bronze, marble, terra cotta, free and decorative statues, reliefs, wall-paintings, vases and vase-paintings, coins, gems, gold ornaments, bronze armour and implements, glass, &c. Historical sketch of the accumulation and distribution of the materials. Excavations and museums.

Lecture IV.—May 7.

Methods and Development of the Study.—Archæology at the Renaissance. Archæology in the seventeenth century. Modern archæology. The eighteenth century. English travellers and German cities. Stuart and Hewth; the Society of Dilettanti. Heyne, Winckelmann, Lessing. The mystical school; Crewzer. The comparative and historical school: K. O. Müller. Subsequent progress in the interpretation of monuments. Examples of method.

Lecture V.—May 14.

Future of the Study.—Importance of its systematic recognition in England. Unlimited results possible from future excavations. The French and German schools at Rome and Athens—an example to be imitated. National museums; provincial and university museums. Facilities offered by casts and reproductions.

Each member can admit one friend to these lectures. No special tickets are now required for the purpose; the tickets issued to members at the commencement of the session are available for the Cantor Lectures, as well as for the Ordinary and Sectional Meetings.

Members are specially requested to take notice that the hour for this course of lectures is 4 p.m., not 8 p.m.

MEETINGS FOR THE ENSUING WEEK.

Mon.... Victoria Institute (at the House of the Society of Arts), 8 p.m. Rev. Professor H. Wace, "The Ethics of Belief."

Farmers' Club, Caledonian Hotel, Adelphi, W.C., 5½ p.m. Mr. R. Russell, "Sheep, their Breeding and Management."

Society of Engineers, 6, Westminster-chambers. 7½ p.m. Mr. William Major, "The Priming of Steam Boilers."

British Architects, 9, Conduit-street, W., 8 p.m. "Notes respecting some of the Condemned City Churches." By a Sub-Committee appointed by the "Committee for the Conservation of Monuments."

Medical, 11, Chandos-street, W., 8.30 p.m.

Tues....**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (African Section.) Mr. Robert Richards, "The Social State and Prospects of South African Communities."

Royal Institution, Albemarle-street, W., 3 p.m. Prof. J. H. Gladstone, "The Chemistry of the Heavenly Bodies." (Lecture I.)

Medical and Chirurgical, 53, Berners-street, Oxford-street, W., 8½ p.m.

Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Discussion upon Mr. Redman's Paper, "The River Thames," and, time permitting, Mr. Robinson Souttar, "Street Tramways."

Anthropological Institute, 4, St. Martin's-place, W.C., 8 p.m.

Wed....**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. Mr. T. Attwood Brocklebank, "Compensation for Injuries Received in Industrial Occupations."

Sanitary Institute of Great Britain (at the House of the Society of Arts), 3 p.m. Adjourned Discussion upon "The Local Government Report on the Disposal of Town Sewage."

Geological, Burlington House, W., 8 p.m. 1. Rev. J. Magens Mello, "The Bone-caves of Creswell Crags." 2. Prof. W. Boyd Dawkins, "The Mammal-fauna of the Caves of Creswell Crags." 3. Prof. W. Boyd Dawkins, "The Exploration of the Ossiferous Deposit at Windy Knoll, Castleton, Derbyshire, by Brooke Pennington and Prof. W. Boyd Dawkins."

Graphic, University College, W.C., 8 p.m.

Royal Literary Fund, 10, John-street, Adelphi, W.C., 3 p.m.

Royal Society of Literature, 4, St. Martin's-place, W.C., 8 p.m.

Thur....**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Chemical Section.) Dr. B. H. Paul, "The Cinchona Alkaloids; their Sources, Production, and Use."

Royal, Burlington House, W., 8½ p.m.

Antiquaries, Burlington House, W., 8½ p.m.

Royal Institution, Albemarle-street, W., 3 p.m. Prof. Tyndall, "Heat." (Lecture I.)

Royal Historical, 11, Chandos-street, W., 8 p.m. 1. Lieutenant-Colonel Henry Fishwick, "Lancashire in the Time of Queen Elizabeth." 2. Mr. William Kelly, "Visitation of the Plague at Leicester."

Royal Society Club, Willis's Rooms, St. James's, S.W., 6 p.m.

Mathematical, 22, Albemarle-street, W., 8 p.m.

Civil and Mechanical Engineers, 7, Westminster-chambers, S.W., 7 p.m. Mr. V. J. Feeny, "Cold Producing Machinery."

Fri.......Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting 9 p.m. Mr. William Spottiswoode, "Experiments with a Great Induction Coil."

Astronomical, Burlington House, W., 8 p.m.

Quekett Microscopical Club, University College, W.C., 8 p.m.

Clinical, 53, Berners-street, W., 8½ p.m.

New Shakespeare Society, University College, W.C., 8 p.m. Mr. Peter Bayne, "The Character of Brutus in the play of 'Julius Cæsar.'"

Trades Guild of Learning and National Health Society (at the House of the Society of Arts), 8.30 p.m. Prof. W. H. Corfield, "The Laws of Health." Part II. (Lecture X.)

Sat.......Physical Science Schools, South Kensington, S.W., 3 p.m, 1. Dr. E. J. Mills, "A Portable Colorimeter." 2. Mr, W. H. M. Christie, "A New Form of Spectroscope."

Royal Botanic, Inner Circle, Regent's-park, N.W., 3¾ p.m.

Royal Institution, Albemarle-street, W., 3 p.m. Mr. E. Dannreuther, "Chopin and Liszt," with many Illustrations on the Pianoforte. (Lecture I.)

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,273. Vol. XXV.

FRIDAY, APRIL 13, 1877.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

HEALTH AND SEWAGE OF TOWNS.

The Annual Conference on Health and Sewage of Towns will be held on Thursday and Friday, 3rd and 4th May next, the Right Hon. James Stansfeld, M.P., late President of the Local Government Board, in the chair. The Conference will meet each day at 11 a.m., and will sit till 1.30, then adjourn till 2; sit again till 5 p.m., and, if necessary, meet again at 8 p.m.

Thursday, 11 am.—Opening of the Proceedings by the Chairman. Papers and discussions on—

1st. Dry Systems.
  Pails, Pans, Boxes, Earth, Middens, Cesspools, Ash, and other Closets; their influence on health, cost of collection, commercial value of products, &c.

2nd. Water-carried Sewage.
  a. New facts about Sewage Farms, with or without precipitation or subsidence, profit and loss thereon.
  b. Effluent Waters.
    Subsidence.
    Precipitation.
    Filtration.
  c. Possibility of producing an effluent harmless to health.

3rd. Escape of Sewage Gas into Dwellings.

4th. Discharge of Sewage into Sea.

5th. Additional Facts to those stated in the Report of the Local Government Board on Disposal of Sewage.

Friday, 11 a.m.—Proceedings will be resumed. Papers and Discussions contiued.

The object of the Conference is to discuss existing information in connection with the results of the systems already adopted in various localities; to elicit further information thereon; and to gather and publish, for the benefit of the public generally, the experience gained. The introduction and discussion of untried schemes will, therefore, not be permitted. Special papers, which have been prepared at the request of the Council, will be printed and circulated at the Conference.

An exhibition of sanitary appliances will be held during the Conference. Only such apparatus will be admitted as have a distinct bearing on the subject of the Conference. Intending exhibitors should at once communicate with the Secretary.

A prize of £20 is offered for "The best Sanitary Pan for collecting pure excreta, unmixed with ashes or refuse, having regard especially to cleanly use, the separation of the urine from the fæces, and a ready and cleanly means of removal and transport." These pans will be exhibited at the Conference. The system must have been in use six months previous to the 31st March. The Council reserve the right of withholding the prize, should nothing be submitted which is considered worthy of reward.

Arrangements have been made for those attending the Conference to dine together at Simpson's, 101, Strand, at 6 o'clock each day. Tickets, 6s. 6d. each, without wine, may be obtained at the Society's office, on the morning of each day. To secure places, applications must be made to the Secretary on or before Tuesday, the 1st May.

BLOWPIPE ANALYSIS.

The Society of Arts are prepared to offer Prizes of £5, £3, and £2 respectively, and Certificates, for Proficiency in Qualitative Blowpipe Analysis. The competition is open to any person, but as it is intended principally for those interested in the mining industries of Devon and Cornwall, the examination will be held in the centre of the mining districts. The arrangements will be in the hands of the committee of the Miners' Association, and intending candidates should apply to the Honorary Secretary of the Association, Mr. J. H. Collins, Lemon-street, Truro. The examination will be held at Redruth, from 5 to 9 p.m., on Tuesday, 5th June, 1877, and will be conducted by Dr. Clement Le Neve Foster, H.M. Inspector of Metalliferous Mines. The examination will be entirely practical, and the following will be the conditions:—

1. No Prize or Certificate shall be given unless the candidate has taken a Certificate in the Science and Art Department Examinations in Inorganic Chemistry and Mineralogy.

2. The candidates will have to determine the composition of several minerals and simple artificial products, writing down each experiment, its result and the inferences drawn from it. The examiner will have the right, during the practical examination, of putting questions to the candidates to test their ability.

3. Each candidate will have to bring his own blowpipe, lamp or candle, platinum forceps, reagents, platinum wire, charcoal, spirit lamp, glass

tubes, &c., and any other blowpipe apparatus he likes. Any dry reagents may be used, but the only wet reagents allowed will be nitrate of cobalt and water. The use of gas and blowing machines will not be permitted.

4. If two or more competitors for prizes are equal, their respective merits will be decided by a second examination.

5. Persons who have not passed the Science and Art Department Examinations may present themselves for examination in Blowpipe Analysis, but they will not receive a Certificate until they satisfy Condition No. 1.

NATIONAL TRAINING SCHOOL FOR COOKERY.

The following are the names of the successful candidates at the competitive examination for the Society of Arts Scholarships, held March 17:—

	Theory.	Practice.	Total.
1. Miss Steet	660	85	745
2. Miss E. A. Price	590	125	715
3. Miss Dodd	522	160	683
4. Miss Wilmot	515	135	650
5. Miss Colborne	491	115	606

The remaining competitors passed in the following order:—

	Theory.	Practice.	Total.
6. Miss Hutt	470	110	580
7. Miss Christie	485	105	590
8. Miss L. F. Gunton	414	110	524
9. Mrs. Williams	390	165	555
10. Miss Withall	365	50	415
11. Miss Berrill	305	85	390

Maximum marks obtainable:—Theory, 660; Practice, 165.

AFRICAN SECTION.

Tuesday, April 10th, 1877, A. R. Campbell-Johnstone in the chair.

The paper read was—

THE SOCIAL STATE AND PROSPECTS OF THE SOUTH AFRICAN COMMUNITIES.

By Robert Richards.

I have been invited to read a paper upon "The Social Condition and Future Prospects of the South African Colonies." When Prince Alfred was making a royal progress in those parts in 1859, the citizens of a town noted for a warm and exuberant loyalty were divided upon the reception that should be given to his Royal Highness. In other places, a ball had been always conspicuous amongst the festivities, and it was thought that there should, in this instance, be no departure from the custom. But the proposer reckoned without his host. The professors of religion maintained that their loyalty was second to none; they were ready to spend and be spent for the Prince, but they could not and would not go to a ball or tread the mazes of the worldly dance for him. How to reconcile conscience and loyalty became the great topic of the hour, in view of which even such questions as the quadrature of the circle paled. Every suggestion was found to be inherently weak. No common ground seemed to exist. Religious people objected to a ball, and ball-goers objected to a public dinner. The knowing ones were non-plussed and in despair, when light came from an unexpected quarter. In a certain part of the room sat an old gentleman, equally renowned for his devotion to the Throne and for the unbending character of his religious principles. "I'll tell you what!" exclaimed this old gentleman, "Let's invite the Prince to a *soirée*. At a *soirée* you do not dance or gourmandise. It is, in fact, neither a ball nor a dinner, but a happy medium territory, upon which conscience and loyalty, like righteousness and peace, may kiss each other. Let it be a *soirée*." The old gentleman, who was as good as gold, and has long gone to his reward, spoke with so much fervour in support of this view that all opposition was overcome, and from every side the refrain came, "Let it be a *soirée!*" But, when was there wheat without a tare, or an assembly of the just without one imp of Satan? In yonder corner sits a man, in whose heart is malice, and in his eye not the "light of stars," but the lurid glare of evil. "I wish to ask a question," softly said the evil one, than whom no Ignatieff knew better the value of polite language. "I am all in the dark. My education has been sadly neglected, and I should like to be informed what a *soirée* is." A simple question, but it made a profound impression. Hearty congratulation at a vexed question solved was now succeeded by profound stillness. You could have heard a pin drop, as all faces, every eye filled with a note of interrogation, were turned to the quarter from which the suggestion had proceeded. "Yes, what is a *soirée?*" Now, several courses were open to the ancient orator; either, in the plain and straightforward language of Mr. Weller, he might have said that a *soirée* is a boiled leg of mutton with trimmings, or he might have fallen back upon evasive generalities. The sequel will show that he scorned subterfuge. Standing up boldly, as became his character, he said, "A *soirée*" (here he took out his pocket handkerchief, to give more emphasis to his definition) "a *soirée*—a *soirée* is" (here he wiped his brow) "a *soirée* is" (now he mops his face) "a *soirée*—why," he indignantly exclaimed, "every Englishman knows what a *soirée* is!"

Apart from the social light afforded by this trifling circumstance, there is in it a suggestion of occasional difficulty in explaining very common words. "Social condition" is a phrase in use every day, and yet the state implied results from causes so numerous and complicated, and the meaning is altogether so comprehensive, that I should hesitate to give a more exact definition than that every Englishman knows what "social condition" is. The words would justify reference to Church, State, and every form of material surrounding; and, in conjunction with the "future prospects" of my topic, comprehend almost every conceivable form of influence. Within the limits of a sixty minutes' address, I have no intention to treat such a subject exhaustively, or in any but the most fragmentary manner.

Cape Town is the capital of the Cape Colony, with a population of 30,000, principally consisting of

Dutch, English, and Malays. Add a few hundred Kafirs, Mozambiques, and half-castes, and the remnant will be made up of the waifs and strays usual to a port of call. Mahometan, cleanly, copper-coloured, and handsome, the Malays are a very interesting people. In their bell-shaped hats, the men command your attention. The women vend the splendid Cape fruit, and as they move about, and click-clack upon their pattens, kept to the foot by the simple contrivance of a button between two toes, their drapery always gracefully disposed, it is no exaggeration to say that they sometimes reach a very considerable degree of beauty. The capital of Natal is Pietermaritzburg, a name that is historical, if uneuphonious, being compounded of Piet Retief, and Gert Maritz, men of the brave days of old, who succumbed to the treachery of the Zulu chief Dingaan. Its population is not less hybrid than that of Cape Town; but instead of Malays we now have a slight sprinkling of Hindoos—say one hundred in the whole city. The dusky Kafir everywhere abounds, and the population is about one quarter of that of Cape Town. The remaining English colony is Griqualand West, better known as the Diamond Fields, of which Kimberley is the capital. A population of about 14,000 consists chiefly of Kafirs labouring in the mines—the remainder embracing every nationality to be found in South Africa. Potchefstroom, and Bloemfontein (that is, the fountain of flowers) are the capitals of the two Dutch States. Each has a population under 6,000, composed of Dutch, English, and Kafirs. The English are always a strong and active minority. The capital cities are the only considerable towns in Griqualand West and the Republics. In Natal a flourishing seaport must be named; while in the Cape Colony there are King William's Town, Grahamstown, Cradock, Port Elizabeth, Fort Beaufort, Graff-Reinot, Beaufort West, Swellendam, and, if you like, Stellenbosch.

If I were asked to name the prominent differences between these towns and an equal number of English places, I should point to the absence of railways and the presence of the blacks. Climate presents a third very important distinction. A man's comfort is largely influenced by temperature. There are people who in hot weather "die daily." The Cape, Griqualand West, and the Republics, possess a warm, dry climate, which is perhaps as healthy as any in the world. The climate of Natal is essentially different. The word Natal brings up a notion of sugar and coffee, and the mind incontinently associates such productions with a terrible tropical heat. But several important facts are often lost sight of. It is forgotten that tropical successes are entirely due to the warm current of the Mozambique Channel, and that they are rigidly confined to a littoral strip some twelve miles in width. It should also be remembered that Natal consists of a series of terraces, which ensure the sea-breeze for every part, so that Mooi River district, on the fourth terrace, possesses a climate probably unsurpassed for bracing, delightful, and altogether healthful influences. These conditions have their effect upon social habits. While the coast people are fanning themselves upon their stoops, those of the upper districts are shivering over their fires. A friend residing near the Umgeni Falls has told me that he has a fire all the year round, with the exception of about three weeks; while I have just been told that a Mooi River acquaintance never "covers fire" at all. It seems to be forgotten that Natal is only a few hundred miles nearer the equator than the Cape, and that this slight advance secures for its summer the cooling effects of the tropical rains. As a rule, three hot days produce a thunderstorm, which ushers in a week's rain, or a number of cool, because cloudy, days. A tropical thunderstorm is one of the grandest things in nature, and it is more refreshing than a mint-julep. I have witnessed many in Maritzburg. The sun has probably for the third day been beating on us with the power of a burning glass, and as it disappears behind the town hill, it lights up a cloud from which much is expected. As night comes on, a rumbling noise begins, and grows until it has all the ubiquity, variety, and volume of the noises at Highbury Station. The air becomes filled with roaring lions and clanging cymbals. Vivid blinding light is everywhere. A considerable interval separates the earlier flashes and reports, but this diminishes rapidly, until it becomes extinct, as the cloud, careering exactly overhead, makes a discharge, heard as soon as seen, and then passes rapidly away, leaving people to draw a sigh of relief and to open their lungs to the refreshing breezes that are abroad. I have said that the terrace form opens every part of Natal to the sea-breeze. A distinction requires to be made as to divers localities, such as some valleys within the terraces themselves. Easy to be imagined, it is not necessary to describe how certain hollow or protected grounds are not accessible to the general air. In such cases, the contrasts of temperature are both curious and amazing. Maritzburg is one of the places that lie relatively low, and in that city I lived for many years. But, for two months of mid-winter, in 1868, I took a house some five miles off. Fox-hill is, probably, not more than 150 feet higher than the city, but there is nothing between it and the sea-breeze. At night, we felt an almost prickly sensation of heat, and had to throw off a blanket; and in the morning, a mile's walk through the grass would not have damped a boot-toe, while not even a suspicion of mist appeared in the air. The experiences of the city were very different. A fleecy cloud could be seen hanging over it till eleven o'clock, and as I rode into it, about half-way down the last slope, there was grass which seemed to have been sluiced with innumerable buckets of water. *Punch* says you must draw the line somewhere; but so rigidly was it in this case defined, that it seemed possible to put one foot on dry ground and another on the wet, and when I got into Maritzburg I found that morning tubs had been covered by ice an inch thick, and that the night was generally pronounced one of the coldest upon record. From all which we learn that much local cold and heat spring out of special local causes. The formation of surrounding ground is favourable to reflection, or the contents of valleys produce cold by evaporation. The range of temperature is shortened to a wonderful extent, for the higher place is not only warmer in winter, but cooler in summer, and this is a very important fact in a colony whose climate is remarkable for its rapid alternations. I prefer the climate of Natal to that of any South African colony. Lady Barker, however, writes of it in the following strain:—

> "In some respects I consider that this climate has been rather over-praised. Of course, it is a great deal—a very great deal—better than our English one; but that, after all, is not saying much in its praise. Then we must remember that in England we have the fear and dread of our climate ever before our eyes, and consequently, so to speak, are always on our guard against it. Here, and in other places where civilisation is in its infancy, we are at the mercy of dust and sun, eccentric wind and rain, and all the elements which go to make up weather; consequently, when the balance of comfort and convenience has to be struck, it is surprising how small an advantage a really better climate gives, when you take away watering carts and shady streets for hot weather, and hansom cabs and sheltered railway stations for wet weather, and roads and servants, and civility and general conveniences everywhere. This particular climate is both depressing and trying, in spite of the sunny skies we are ever boasting about, because it has a strong tinge of the tropical element in it; and yet people live in much the same kind of houses, only that they are very small, and wear much the same sort of clothes, only that they are very ugly, and live much tho same sort of lives, only that it is a thousand times duller than the dullest country village, as they do in England."

Had the writer of these interesting letters kept in view the distinction above referred to, she would not have spoken of Maritzburg as though it were Natal. Nor is it possible to over-praise the climate in relation to the poor. When in London I see old women moving over the wet pavement in thin shoes, the east wind blowing through their thinner tatters, I praise God for the South African climate, which is boots, and clothing, and physic—in a word, health and wealth—to all such.

Bright sunshine and superabundant moisture have set their seal upon the social habits of the people. The writer already quoted says the latter has killed society.

> "You must understand that there is no society at all —absolutely none," she says. "We are not proud, we Maritzburgians, nor are we inhospitable, nor exclusive, nor unsociable. Not a bit. We are as anxious as any community can be to have society or social gatherings, or whatever you like to call the way people manage to meet together; but circumstances are altogether too strong for us, and we all in turn are forced to abandon the attempt in despair. First of all, the weather is against us. It is maddeningly uncertain, and the best arranged entertainment cannot be considered a success if the guests have to struggle through rain and tempest, and streets ankle-deep in water, and pitchy darkness, to assist at it. People are hardly likely to make themselves pleasant at a party when their return home through storm and darkness is on their minds all the time."

It is not my purpose to contest these views. Measured by London standards, conventional "society" may have no existence in Maritzburg, or there may be as many cliques as in any place in the world. *Prima facie*, I should not go to a little garrison town, especially to a garrison town in a colony, to find an obliteration of those class-distinctions which seem to come everywhere as the sparks fly upward. It is enough for me that the weather is here said to hinder one usual form of social gathering. This is a negative work. It has set its mark upon things in a positive way also, and of this the all-round verandah, with stoep slightly raised from the ground, is the most conspicuous proof. The verandah is, in fact, a great institution. Lady Barker calls it "the comfort of her life." It protects the foundations of a house. It is a lounge in hot weather and an exercise ground in wet. To sit in it and watch the evening sky—its blue so deep and its stars so bright,—to mark the trees and hills outlining the Western horizon,—to listen to no noises but those of chirruping insects and bubbling brooks as they "go on for ever," and all the while to drink-in the cool breezes which have succeeded the great heat of the day, is a luxury to which the inhabitants of colder climates are strangers. It is within the mark to say that the verandah is the best and most popular department of any house. In other respects, the houses are furnished and decorated largely in imitation of English houses. There is, however, one radical difference. English houses reach a great altitude. Ground is plentiful in the colonies, and the conditions of weather make unnecessary exertion distasteful. The habit is, consequently, to build houses the rooms of which are all on the ground floor. Putting merchant stores out of the question, all the African houses with more than two storeys could probably be counted on the fingers of one hand, and there is hardly a single kitchen below the level of the ground.

Snowstorms are of rare occurrence anywhere but on the mountain-tops. I have probably seen half-a-dozen during my African experience, which has been almost co-equal with my life. Grahamstown was the scene of one of these, and that was like a thin fall of blossom, and left no trace upon the ground. I witnessed a heavier fall on the summit of the Katberg in 1875; but the largest fall was at Kimberly in mid-winter of the same year. The snow covered a depth of six inches, and lay upon the ground and house-roofs for two days, during which there was snow-balling, slush, and discomfort, for as the six inches of snow was trampled into half-a-foot of soil, the result was a compound which no unmacadamised English town could supply. It is only natural that hailstorms should be more common than falls of snow. The noise of advancing hail is peculiar, and can be heard for several miles. It has been compared to the rattling of a thousand shields, but is more like the subdued roar of the distant sea. Perhaps not a drop of rain is falling. Then something strikes through the leaves and thuds upon the ground. Next, a stone comes crashing upon or through your own roof. In five minutes the storm is at its height. The stones descend in myriads, and if you look at your neighbour's sloping tiled roof, as I have under such circumstances done, you will see something very like perpetual motion, for as the hail rolls down, and the tiles break into fragments, the whole roof seems to be in movement. It is soon over, and the sun at once comes out as brightly as ever. But the ground is covered with a white and glistening mass. On roof-tops the hail lies a foot deep. Houses are looking battered and trees dishevelled. Here and there, on the causeways, a coating of fragmentary tile and window-glass is to be seen. In such a storm, not many years since, I had 75 panes of glass broken, and upwards of 750 tiles. I had often heard of hail as large as hen's eggs, but never saw it till 1858. I was then residing at King William's Town. The witch doctor was at work amongst the Kafirs, and there was talk of war. I therefore determined betimes to pay a visit to a friend in the Beaufort district—that is, right across the frontier. Mounting my horse, and accompanied by a Hottentot boy, by way of what is locally called an "after-rider," I left King William's Town in the afternoon. Dined and slept at Middle Drift, in a road-side inn, constructed of wattle-and-daub, and having a ground floor. I could touch the thatch roof with my hand. Continued my course next morning at 6 o'clock, reaching a little village called Alice for breakfast. Then mounted again, and in less than three hours passed though Fort Beaufort, a township of about 3,000 souls. Reached my destination on a hot summer's afternoon. The boy took off the saddles and turned the horses loose to graze and get cool; but scarcely had he done so when I heard the ominous roar of advancing hail. I told him to drive the horses sharp into the stable, and while he was doing so the hail began. It descended in perpendicular lines, in jagged masses of ice as large as the fist, which bounced up from the ground as high as the roof-tree. I have never seen anything like it since. The vines were beaten to pieces, and in the iron covering of the room in which I slept were two ragged holes, through which I could thrust my hand. A single stone would have killed the boy, who had the good sense to put a saddle over his head. It is surprising that tiled roofs should abound (as they do in Maritzburg) in any town subject to such visitations as these, which, however, are confined to the summer months. The Natal winter is a bright and bracing, although somewhat dusty, season of the year. It is distinguished by an almost Egyptian absence of rain. Thunderstorms occur, only much less frequently, in the other States and colonies, where fine weather is the normal condition. On the Cape frontier, February and October are spoken of as "flood months;" but I have seen many perfectly dry Februaries and Octobers, and fancy that the reputation arose out of the pluvial antics of some particular year in the early history of the colony. Owing to the greater volume and violence of the rainfall, it has been found necessary, in Natal, to build roofs with a steeper pitch than elsewhere suffices. The weather is generally favourable to outdoor amusements, which are further stimulated by the absence of art galleries, scientific exhibitions, theatres, and the thousand-and-one entertainments which spring out of a thickly-populated civilisation. Cricketing, pic-nics, horse-riding, shooting, croquet, and a little archery, are the forms which these pleasures generally take. Owing to the absence of water, river boating may be said to have no existence. No matter how hot the day, a public rifle match is always popular enough to draw a considerable crowd. I have such an event in my mind's eye at present. Place, Maritzburg; object of competition, a fine gun, the present and memento of Prince Alfred's visit. Counties having contested for the honour of representation, about a dozen men assembled to shoot off the final match, the interest of which was intensified by the presence of two or three first-rate shots from the camp. The day was blazing hot, but the whole town emptied itself into the valley. Black pedestrians were first on the scene, with baskets of family provisions, or coming on their own account. Here and there might be seen a Kafir, minus every article of dress but a soldier's old coat, looking proud and comfortable under a gingham umbrella. Then followed some Europeans, also on foot, the upper ten thousand arriving later, in carts drawn by two horses or four bullocks, in waggons with teams of a dozen oxen, in small traps drawn by a single horse, and not a few on "horseback." In most instances, the animals would be released from yoke or harness, and driven half-a-mile away to graze until required for the return, the vehicles themselves being scattered on the sward, heavily cropped with coarse stubble a foot long, anywhere out of the line of shooting. No list is complete until the military band has marched upon the ground. It is hardly necessary to say that, in colonial communities, which are all small, everybody knows everybody, and that this fact has its appropriate influence upon the good-fellowship of such a gathering. As noon approaches, the rifles begin to pop; but hampers absorb attention until it is found that three men have distanced all others, and that one of these is a military sergeant, the remaining two being an old colonist and his son. The battle at once became a contest between military and civilians—all military men sympathising with one side, and all civilians with the other side. As the last round approaches, excitement becomes intense. The sergeant's final shot gave him a total of 17. The old colonist retired with a well-earned credit of 16, and now all hopes hang upon his son, who is sitting on the ground taking steady aim. At that moment, a dog comes into the line of sight, no policeman being charged with the duty of keeping the road clear. The gun rises, and at an angle of 45° provokingly goes off. Military men contend that it is a shot according to the "musketry regulations." Civilians say it would be unfair to apply rules of which they have only retrospective information; while the committee reserve the point for reference to England. The young colonist again comes forward, and eventually scores one more than the serjeant. The accidental shot is referred to the Council of the Rifle Association in England, which distant and benighted country enjoys the privilege of monthly communication with South Africa. A good portion of a year rolls by, and one day there arrives an ominous-looking official envelope. It is opened, and while the sages advise, let no colonist speak. The decree is that the accidental discharge is not to count as a shot. Civilian hats fly into the air, and all men feel that a Daniel has come to judgment. Military men hide their diminished heads as the gun is presented, with every circumstance of honour, to the young hero, whose portrait is at once despatched to England, and subsequently appears in all the glory of woodcuts. A month goes by, and the circumstance has ceased to be thought of, when another ominous official document comes by the mail steamer. The statement now is that the former document contained one word too many—the word "not" requiring to be eliminated. In other words, the discharge was to be considered as a shot, and consequently the gun must be taken from the civilian and given to the military man. This time, the soldiers fling up their hats, while the colonists only said, "Bother," adding thereto an expression of opinion anything but complimentary to the committee in London. When James Ratcliffe was asked by the magistrate to describe his occupation, he said:—

> "Me describe! and to your honour! far be it from Jemmie Ratcliffe!"
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> "Come on," said the magistrate, "no trifling. I insist on an answer."
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> "Weel, sir," said the declarant, "I maun make a clean breast, for, ye see, wi' your leave, I am looking for favour. Describe my occupation, quo' ye? Troth, it will be ill to do that, in a feasible way, in a place like this; but what is it again that the aught command says?"
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> "Thou shalt not steal," answered the magistrate.
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> "Are you sure o' that?" replied the accused. "Troth, then, my occupation and that command are sair at odds, for I read it, thou *shalt* steal; and that makes an unco difference, though there's but a wee word left out."

And with candid Jemmie, the colony said "that makes an unco difference," though there's but a "wee word" put in.

The absence of railways makes the social condition of the Cape vastly different from that of England. However big-boned or large-horned, oxen are no match for the steam-horse. They cannot, therefore, effectively take its place. A family visit to the local Brighton is a matter of two days' journey, and involves as much previous consideration as the locomotion of a regiment. It is a tedious spectacle to see all the produce and imports of an extensive territory moving to and fro at snail's-pace, and in a cloud of dust, in heavy vehicles drawn by eighteen and even twenty oxen. It is a distressing thought that the same team, except as to individuals removed by death, will continue their plodding way, ever enveloped in the same dust-cloud, for upwards of 600 miles. In 1875, duty called me to the Diamond Fields, and if I give a brief account of that trip, a fair idea will be afforded of the best locomotion open to a man burdened with no *impedimenta*. My starting point was Grahamstown, about 450 miles from the fields, and £17 10s. was the amount of my fare. Immediately surrounded by green little hills, Grahamstown is beautiful for situation. Laid out at right-angles with iron-stone streets half as wide again as Regent-street, with causeways bordered by green lines of black wattle, art has seconded the kindly work of nature, so that the spirit of beauty pervades everywhere. Sleep reigned universally as I hastened to the booking office, at half-past five a.m., on the 19th May. Gas being still an unknown luxury, a dozen street lamps made darkness visible. According to advertisement, six o'clock was the starting hour, but not till an hour later did our vehicle dash up to the hotel door. A few minutes sufficed for weighing and packing, and at 7.15 our coach (not unlike a Trosachs coach, except that it was all inside accommodation), was bowling along at six miles an hour. The team numbered six stout horses, who had no rest till they had done some two dozen miles of hard travelling Breakfasted at the Fish River Hotel at about 11 o'clock. Were off again in an hour, but had to walk 200 yards to the river, and cross by some planks, an excellent bridge having been swept away by recent floods and the ford being very steep. Two young ladies, fellow-travellers, crossed under experienced guidance, and after the new team had been loudly urged up the opposite bank, we once more took our seats. One of the young ladies, rallied upon her appetite at breakfast, had said she could eat all day long when she was travelling, a remark which provoked the reply that we were going into the wilderness where locusts and wild honey would be at her order. Scarcely had the ascent of the Fish River Randt been commenced, when a few odd locusts came across our path. These rapidly became a thousand; the thousand was converted into a million; and, in less than half an hour, the million had become a myriad. They looked like a dust-cloud a-head; the green grass had become russet-brown, and was everywhere in movement. I swung round my stick, and fifty locusts bit the dust. They struck the trap like hail. They came into the 'bus, and got into the ladies' veils. More than one impudent fellow did his best to get into the hungry young lady's mouth. I reminded her that honey would now complete her happiness. We drove on. If anything, the swarm waxed more numerous. We had been driving through it for miles; we turned a corner at the very thickest, when, straight before us, stood a stalwart Hottentot, on whose head was a large bowl, and in that bowl newly-gathered honeycomb piled high above the brim. The coincidence was amusing and interesting, and was perfected by the gratuitous offer of honey all round, which was accepted by the driver and most of the passengers, not excluding the hungry young lady. Our next change of horses was on top of the randt, or range, and this team carried us to our sleeping-place at the Goba, where we arrived at about 7 p.m., having done well on to seventy miles. For the rest of the five days' journey, it became a practice to change our horses every fifteen or twenty miles. At three o'clock next morning we were off again, and breakfasted at the hotel at Dagga Boer's Nek. Two more stages brought us to the town of Cradock, where the Dutch have a church, built for over £20,000, and where we hungry mortals dined on venison pasty. Costly churches are a frequent outcome of Dutch piety. We travelled late into the moonlight night, reaching Mr. Phelps's hotel at about 11 o'clock, having done over 100 miles during the day. Mr. Phelps must be a great lover of dumb animals. Dogs of every breed and size were there. If there was one there were fifty. They filled the place inside and out. A greyhound, a poodle, and a terrier monopolised the best sofa, and when our guard blew his horn, such a chorus of yells sprung up as only Pandemonium can surely equal. At dawn we were again moving, and in half-an-hour pulled up for a two minutes' chat with the down coach, conspicuous among whose passengers was the Kafir Tom Thumb, General Coffee, now on exhibition somewhere in England. Colesberg, where we found comfortable quarters, was reached that night. Early next morning crossed the Orange River on a pont. The largest stream in South Africa at this point is probably 400 yards wide. Slept at Fauresmith, and at eight o'clock next day (Sunday) entered Kimberley, aided by a moon that gave a light almost as bright as the day, having been driven for five days with as little jolting as if enjoying the air in a gentleman's carriage on the Grahamstown flats. During our journey, we passed through four little towns, and saw not more than fifty farm-houses. Grass and bush prevailed during the first day; prickly pear, an exotic, showed for a few miles next day, looking like a flock of sheep as its leaves glinted in the sun. After that, grass, and a small dark bush called karoo, a few inches high, and very fattening for sheep, prevailed to the fields. It is not my purpose to describe the diamond mines, of which Kimberley is the principal seat. They have disturbed South African society to its very depths—disjointing many old interests and giving new distributions to wealth; and yet they are like nothing in the heavens above or the earth beneath. The country in which Kimberley is situated is more level than Epsom Downs. It is a natural race course, clothed with thin grass and a little karoo, for hundreds of miles. At the date of my visit, the population of the town was about 15,000, wholly housed in iron, wood, and canvas. The issue of titles has now justified a freer expenditure, and green-brick linings are largely resorted to; two years ago, there was nothing but an iron plate between a man and the weather, and that in a place where the temperature, continuously considered, is both higher and lower than in England. The streets radiate from the mines, which rise to a high mound, on the summit of which horses and windlasses may be seen, against the clear sky, describing never-ending circles. Ascending this mound, we find that connected with the windlasses are wire ropes, which travel to and from the mine with heavy buckets, chokeful of blue diamondiferous soil; that is to say, the up-coming bucket is full, the descending bucket being empty. Horses turn the higher class machinery; the usual motive power is Kafirs, three or four of whom turn a sort of grindstone, sitting down to snuff while their buckets are being filled. The mine itself has become an immense basin, 150 feet deep and about 400 yards in circumference. From the rim we can see the entire mine, which has everywhere been honey-combed with rectangular workings of about 8 feet square, and all the labourers, some thousands of whom, as black as bees, look not unlike those active insects. Some parts of the mine are worthless; the market price in other parts was £7,000 for a bit as large as a dining-table. No two occupations could be more opposed than diamond-mining and sheep-farming—one being the quintescence of indolence, and the other demanding the highest exercises of energy; and it was suggestive to see men who had been wool-growers all their lives now superintending mining labourers as if to the manner born. Not a few drapers, who in England would have jumped counters till their dying day, have obtained large fortunes in the course of three years. From all which I deduce the conclusion that there is an infinite adaptability in the English character and constitution. But I must move on, with the remark that the Kimberley Club was the only place at which a stranger could find comfortable board. I reached Kimberley by the Cobb and Co. line. I returned by Geering's and Wolhuter's carts—leaving by a point exactly opposite to that at which I had entered. An attempt to cram nearly a dozen people into a two-wheeled cart being successfully resisted, a large four-wheeled coach was substituted, and that night we slept at Boshof, a village within the jurisdiction of President Brand. Our journey next day was through the region of the spring-buck, which was scattered about in small groups, probably numbering 2,000 in view at one time. At Blœmfontein, reached at 6 p.m., we had a good dinner and comfortable sleeping quarters at the hotel. The houses are well-furnished, but scarcely any attempt has been put forth in the way of street-making. There are some good fruit-gardens, and a few fine weeping-willows furnish the only large vegetation in the neighbourhood, which, except after rains, is bare, rocky, and uninteresting. Our third night was spent at Rustenburg, a small Dutch village, made up of dimunitive flat houses, of the packing-case order, nearly all unoccupied except at Nachtmaal or sacrament season. Again crossed the Orange River, at Aliwal, so named in honour of Governor Sir Harry Smith's well-known Indian victory, and there we slept for the night—the presence of a small opera troupe compelling us to hunt for quarters in different directions. On the fifth day passed through the little village of Dordrecht, and, after a bitterly-cold drive on the Stormberg heights, reached Queenstown at 10.30, almost dead with cold and hunger. The inn-keeper would give us nothing more comforting than a knuckle of cold turkey, while mine host's wife expressed surprise that we had not satisfied ourselves at the toll-bar, some eight miles back, where a demand for coffee was met by the remark that passengers never took anything there. Shaking off the dust of our feet, we mounted a two-wheeler on a wild, bitterly cold morning to cross the Katberg—a task which was accomplished towards afternoon by the skin of our teeth. Eight gallant horses mounted the hill before us. Being on the box-seat, I was required to hold the whip, sixteen feet of thong fixed to ten feet of bamboo. A passenger sat between me and the driver, and three others were in the back-seat. We were warned that the day was not suited to our enterprise. Rain began to fall as the summits came into view. Sleet then peppered us, and soon my face felt like a nutmeg-grater. The wind, troublesome all the morning, became a violent hurricane. It tugged with a giant's force at my whip. The snow flew by in long horizontal lines. Our team showed a disinclination to advance, and it was only occasionally that I could administer the thong. I looked behind, and found that the other passengers had disappeared under a waterproof covering. Our experienced driver feared that the Devil's Bellows would be dangerous and insuperable. We approached that spot—narrow, uninviting, and precipitous. All the forces in nature seemed to be let loose. We could almost see the wind. "Now, whip them up," cried Jehu. I hallooed and whipped, and clapped, and screamed to the best of my ability, pausing to hold on with every muscle, exactly in the throat of the bellows, and in a minute we were safe. A little more battling brought us to the summit, from which we had a glorious view of bush and dale, and whence we descended rapidly to the warm hospitality of Mr. Green, of Balfour. The night was spent at Fort Beaufort, and next day being the seventh from the Fields, we reached Grahamstown.

The great distinctive social fact is the presence of the Kafirs, the universal source of labour supply. Dignified, independent, and warlike, the Cape or frontier Kafir exactly realises the conception of Cooper's Indian. The traits which make him a good warrior, however, add nothing to his efficiency as a servant. Instinctive in his love of cattle, he makes a tolerable groom; but, having a constitutional repugnance for more menial work, domestic service is delegated to trolloping women. Moving slowly about his duty, his appearance is sullen, and if he makes way for a lady it is done with a bad grace. He would rather spill than nurse a baby, and as for laughing or chirruping at one, like the Natal Zulu, he would simply scorn the action. The Zulu may not be dignified, but manliness and good temper are written on his cheerful countenance. He is not only groom and cattle herd, but domestic servant, and performs with alacrity the least honourable services about a house. If "Natal lambs don't skip," as the Surveyor-General once said, at least the Natal servant does, for his errands are done at the trot, cutting capers as he sings, with an appearance of great enjoyment in his own music. Brimful of humour, he is an essentially laughing animal; and, having few wants or comforts, he rivals Mark Tapley in being jolly under creditable circumstances. All things considered, the Natal Zulu is both a cheaper and better servant than the frontier Kafir. Hating the restraints of contract, the latter has at any time preferred to meet necessity, not by toil, but by a raid upon the frontier farmer. The excitements of the process, which is generally profitable, have for him a constitutional charm. It was so in the earliest days; it is so now. Only frontier farmers know the weight of taxation thus imposed upon them. By way of illustration, I take up a Grahamstown paper of Aug. 19th and 26th, 1870, and in it are three letters from as many farmers. One says:—

> "In my own neighbourhood, farmers have had from 10 to 60 goats killed," [meaning by Kafirs] "not for want of food, but for satisfying the thirst for brandy."

These animals were killed for their skins only, and so prevalent had the practice become that the *Journal* called it a "new skin disease;" and one particular importation of Angoras was a failure, not because the farmers were unwilling to buy, but that they feared to own an animal worth £50 or £60, which might be slaughtered for its skin. This naturally led to legislation, in which judges had no option but to give stringent sentences. Another farmer writes:—

> "The facilities for the removal of stolen property have been curtailed, it is true, but it is apparent that the thing still goes on, not so much for the carcases, perhaps, as for the skins. Only let your readers refer to your issue of the 5th inst., where "One-who-would-farm-Angoras-if-he could," says that in one month alone, in the Great Winterhoek Field-cornetcy, 284 goats were stolen. Again, in a former issue of your paper, a Mr. Van Aardt, I believe, . . . was stated to have lost several head of cattle, and found the skins only. And it is within the last month that I have lost five head—one taken at first, then another, and, last, two fine cows and a bullock at once, and the latter when the police were actually in the neighbourhood on what is called patrol duty. . . N.B.—The same vagabonds, or some others of the same class, paid me another visit last night, and helped themselves to two more of my fat bullocks."

Then follows a jeremiad from Mr. Weale, "late of Trinity College, Oxford," who farmed for a whole month without any servants at all, and then got a Kafir, who emphasised differences of opinion by flourishing a knobstick over his master's head. Experiences like these greatly mar the local influences of a sentimentality which is popular 6,000 miles away. On the other hand, the Zulu is not without his faults. Cattle have occasionally been ham-strung, and more white women have been outraged, for reasons not necessary to be discussed here, than in all the other communities put together; but the fact still remains that the Zulu, upon the whole, is a trustworthy servant, and that his thefts of cattle are by no means frequent — a happy circumstance, partly resulting from natural character, but chiefly, perhaps, from the fact that Natal offers inferior facilities for successful cattle-lifting. The frontier Kafir who condescends to "take" a master, looks for high wages with creature comforts, and often expects the same fare as his master. For stabling two cows and running errands, a frontier friend pays his man £3 per month. True, John is supposed to find himself in food, but that is only in theory, for all the inmates know that in his need, which recurs about three times a day, he has in the Irish cook a friend indeed. John despises rice. In his view it is a poor vegetable, suitable to a mean white man who gets wages; but a gentleman like John draws "pay," and must be correspondingly fed. Hannah was a nursemaid, and native girl of more than average merit, but in the article of food she was of John's kidney. Nothing common was permitted to pass her mouth, and she formally complained that cook had served her with a warmed-up apple pie of the day before. Hannah not only complained, but refused to eat it too.

In many respects the Kafirs are but children of larger growth. They love the fine clothes of civilisation, and no bliss surpasses that of a marriage party, six couples strong, bedizened in silks and satins, oh! so fine! and, like the lion and the unicorn, marching up and down the town. I have already made passing allusion to the partiality for umbrellas. Loving property as a means to an end—it being the great duty of every good Kafir to accumulate wives—he is, like other Africans, a great beggar, and would any day run a mile for a pennyworth of *bucksheesh* rather than perform the same labour under contract for six times as much. Records of service are notched on a tally-stick with great neatness and accuracy; but the irregularity of the months, as compared with his favourite "moons," are a hard nut, leading to many amusing but not altogether pleasant discussions. Their notions of the ability of Englishmen, in connection with the mystery of writing especially, is very exalted. A story is told of a Kafir being entrusted with a package and a letter. Meeting a friend, they determined to purloin some of the contents; "but," said one of them, "we must first put the letter under a stone, where it cannot see, or it will tell." After the theft, the letter was taken out, and, with the diminished parcel, duly delivered; but, great was the surprise when it was found that the letter was still able to "tell." They think that Englishmen can do all things but impart life; and, when a friend wound up a musical box, setting a cascade in motion and birds hopping from twig to twig, it was admitted that the last great difficulty had been overcome. It is no uncommon spectacle, on the borders of a town, to see men donning their trousers, as the bye-laws require them to do. They love school and church, but there is no rule without an exception. I once had a raw kitchen-boy, named Inyokaan, or "Little Snake." In the adjoining house lived an old missionary, who took a lively interest in the religious condition of the neighbourhood. Seeing Inyokaan squatting at his pipe instead of being at church, he delivered his conscience upon the subject, winding up with the solemn warning that all who do not go to church will inevitably find themselves in warm quarters. Unfortunately, it was a very cold day, and Inyokaan replied that a warm fire was the desire of his heart. In summer, large draughts of beer and sour milk cause a feeling of heaviness, of which one of the outward signs is sleeping in church. I knew an old missionary who kept a man moving about church with a long stick, knocking delinquents on the head. Lady Barker, from whom I have already quoted, says that perhaps Kafirs are more behindhand in medical faith than in any other respect. Such is not the impression of many experienced men. Dr. Fitzgerald, of King William's Town, traces his influence to skill in diseases of the eye, Kafirs coming from great distances to consult him. The Rev. J. Ahlson, than whom no one had a better knowledge of native character, used to say that the nastier the better was a medical maxim with the Kafirs, who often consulted him in their ailments, for which he usually prescribed a nauseous emetic. Their graphic descriptions, subsequently, of the virtues of this horrible dose were among the most amusing incidents of his life. Of Baynes's nocturnal outspans, it is said that—

> "His great pleasure was to amuse his followers by tricks, sleight-of-hand, and conjuring. The magic-lantern and microscope were not forgotten; and also he composed for them comic songs of the Christy Minstrel school they all could join in; so that, in connection with the cures he often effected, of sometimes imaginary complaints, his followers seemed often to look on him as a being more than human."

Indeed, Lady Barker immediately proceeds to tell, in her own lively way, a good story, from which a conclusion the very opposite of her own must be drawn. She says:—

> "The other day one of our Kafirs had a bilious attack, and, declining all offers of more civilised treatment, got one of his own physicians to bleed him in the great toe, with, as he declared, the happiest effect. But quite the most extraordinary remedy came before me lately. Tom had a frightful headache, which is not to be wondered at, considering how that boy smokes the strongest tobacco out of a cow's horn, morning, noon, and night—to say nothing of incessant snuff-taking. The first I heard of Tom's headache was when Charlie came to ask me for a remedy, which I thought very nice on his part, because he and Tom live in a chronic state of quarrelling, and half my time is taken up in keeping the peace between them. However, I told Charlie that I knew of no remedy for a bad headache except going to bed, and that was what I should advise Tom to do. Charlie smiled rather contemptuously, as if pitying my ignorance, and asked if I would give him a box of wooden matches. Now, matches are a standing grievance in a Kafir establishment, and go at the rate of a box a day if not carefully locked up. So I, failing to connect wooden matches and Tom's headache together, began a reproachful catalogue of how many boxes of matches he had asked for lately. Charlie, however, hastily cut me short by saying, 'But, ma, it for make Tom well.' So, of course, I produced a new box of Bryant and May, and stood by to watch Charlie doctoring Tom. Match after match did Charlie strike, holding the flaming splinter up Tom's exceedingly wide nostrils, until the box was empty. Tom winced a good deal, but bore this singeing process with great fortitude. Every now and then he cried out, as well he might, when Charlie thrust a freshly-lighted match up his nose; but on the whole he stood it bravely, and by the time the matches were all burned out, he declared his headache was quite cured, and that he was ready to go and chop wood.'

I should say that a people who, for biliousness, bleed the great toe or apply lucifers to the nose, may be very ignorant of medical science, but they must have enormous faith in its powers. In fact, the Kafirs are admitted to be such a medicine-loving people, that a degree in medicine is now recognised as the necessary supplement to a missionary's education. The modern teacher approaches the savage, therefore, with a substantial good in his hand, and, having cured the body, the way is made plain for a kindly discussion on the higher needs of the soul.

Witchcraft or witch doctoring is probably less a medical art than a police and executive institution. The chief Fakir on one occasion put its merits in a light that exhibited him as a very capable thinker. "You ask me to put down the witch-doctors," he said, "but you forget the circumstances of my country. You Englishmen have gaols, and policemen, and soldiers; I have none of these things; and if I were to prohibit 'smelling-out,' there would be no check whatever upon the criminal classes." Kreli, in 1856, used the witch-doctor as a political engine, to stir up the warlike spirit of the nation. The institution is based upon the ignorance of the crowd, but as no great influence can be maintained without superiority of some kind, so in this case the performers are remarkable for great acuteness and quickness of observation. A servant had lost his savings, and "suspected one of his fellow-servants of being the thief. . . . All the other servants were bidden to assemble themselves, and to do exactly what the witch-finder bade them. She had them seated in a row in front of her, and ordered them, one and all, to bare their throats and chests. . . . This they did, the guilty one with much trepidation, you may be sure, and she fixed her eyes on that little hollow in the neck where the throat joins the body, watching carefully the accelerated pulsation. 'It is thou! No it is not. It must then be you!' and so on, dodging about, pointing first to one and then rapidly wheeling round to fix on another, until the wretched criminal was so nervous that, when she made one of her sudden descents upon him, guided by the bewraying pulse which fluttered and throbbed with terror and anxiety, he was fain to throw up his hands and confess, praying for mercy." I quote from *Evening Hours*, page 504. On the same page is a story, told to me also some years ago, concerning Chaka, the Zulu despot. From this it would appear that the biters are themselves subject to be sometimes bitten.

"The political power of these Isinyanga," the story runs, "had then reached a great height in Zululand, and they were in the habit of denouncing as wizards one after another of the king's ministers and chieftains. It was difficult to put a stop to these wholesale murders, for the sympathy of the people was always on the side of the witch-finders, cruel though they were. At last the king thought of an expedient. He killed a bullock, and with his own hands smeared its blood over the royal hut in the dead of night. Next day he summoned a council, and announced that some one had been guilty of high treason in defiling the king's hut with blood. . . . What was to be done? The Isinyanga were summoned, and commanded, on pain of death, to declare who was the criminal. This they were quite ready to do, and named without hesitation one after another of the great inkosi who sat trembling around. . . . The witch-doctors, who named an inkosi, heard to their astonishment that they were to be executed, and the denounced victim kept alive. This went on for some time, until one, cleverer than the rest, yet afraid of committing himself too much, rose up and said oracularly, 'I smell the heavens above!' Chaka took this as a compliment as well as a guess in the right direction, ordered all the remaining Isinyanga to be slain on the spot, and appointed the fortunate oracle to be his one and only witch-finder for ever after."

The intellect of the Kafir, dissipated by no literature, and concerned only about a few material objects, may be said to be perfect within its sphere. Memory is quick, accurate, and retentive. A man will go into his kraal, and, as by intuition, know that a particular beast is absent. Similar results, though in very different directions, are seen in the narrower walks of English life. They exhibit great skill in the discussion of affairs, as may be learnt from an interesting article in the *Gentleman's Magazine*, for last October. In a "Pitso," there described, an uneducated petty chief delivers himself of these lofty sentiments:—"A chief is a chief by righteousness. Moshesh became a great chief by reason of his justice and equity. [Here we have the Bible teaching coming out:—'He that humbleth himself shall be exalted.'] All the greatness that Moshesh achieved was by humbling himself, and thus he became a great nation. Pride, self-will, and rebellion destroy chieftainship." The case of Tyo Soga shows that this intellect is capable of rapid and indefinite expansion under European training. Soga was educated in Edinburgh, and his preaching was distinguished, if not by its strength of thought, at least by the sonorous and scholastic character of its diction.

A particular tribe of frontier Kafirs are called South African Scotchmen, and the Kafirs have many characteristics of the Highlander. In reference to the notch or tally-stick, "Mrs. Shortcake," in the "Antiquary," says:—

"I winna say ony ill o' this Monkbarns; his brother neer brought me any wild deukes, and this is a douce honest man; we serve the family wi' bread, and he settles wi' huz ilka week—only he was in an unco kippage when we sent him a book instead o' the nick-sticks, whilk, he said, were the true ancient way o' counting between tradesmen and customers."

Note B states that each family had its own nick-stick, and for each loaf as delivered a notch was made on the stick. In Prior's time the English bakers had the same sort of reckoning:—

"Have you not seen a baker's maid
Between two equal panniers sway'd?
Her tallies useless lie and idle;
If placed exactly in the middle."

On p. 449, Elspeth says, "I hated what my mistress hated." And, further on, "They stood shouther to shouther—nae man parted from his chief for love of gold or of gain, or of right or of wrang." These words correctly describe the relations between a Kafir chief and his follower, and for the natural reason that Highlander and Kafir were alike the product of the tribal system. You have all heard of cairns in Scotland. A cairn or pile of stones may be occasionally seen in South Africa, it being the custom for each passing Kafir to add one to the number. In the "Fair Maid of Perth," we find the glover speak- of a third person, who was himself,

"Taishatar, or a seer, and supposed to have communication with the invisible world. He affirmed that he had performed a magical ceremony, termed *Tine-Egan*, by which he invoked a fiend, from whom he extorted a confession."

Can you find anything having a closer resemblance to witch-doctoring? Ordinarily, the Kafir has no idea of mechanical adjustments. He would as soon load a waggon with lead as with the same cubical contents of plank. Last summer I saw the Scotch guard allow tourists to distribute themselves in two coaches under his charge in the proportion of 25 to 5; and when I offered to exchange, both guard and driver said it was all right—they would get along very well. It was no surprise to me that it took five minutes to get that coach into motion. By-and-bye, a friend of the guard was added to our number; and, going a little farther, we hailed and picked up a shepherd, whose dog, probably out of respect to the principle of moderation, was compelled to walk. All this springs out of the family feeling engendered by the clannish system, and is exceedingly Kafir-like. Whole pages of Sir Walter Scott would apply, *mutatis mutandis*, to Kafir warriors. I could fancy that these words were uttered by Sandilli or Macome to an Englishman on the Amatola mountains:—

"Saxon! from yonder mountain high,
I marked thee send delighted eye,
Far to the south and east, where lay,
Extended in succession gay,
Deep waving fields and pastures green,
With gentle slopes and groves between.
These fertile plains, that softened vale,
Were once the birthright of the Gael;
The stranger came with iron hand,
And from our fathers reft the land.
Where dwell we now! See, rudely swell
Craig over craig, and fell o'er fell.
Ask we this savage hill we tread
For fattened steer or household bread;
Ask we for flocks these shingles dry,
And well the mountain might reply,
"To you, as to your sires of yore,
Belong the target and claymore!
I give you shelter in my breast,
Your own good blades must win the rest."
Pent in this fortress of the north,
Think'st thou we will not sally forth,
To spoil the spoiler as we may,
And from the robber rend the prey?
Aye, by my soul!—While on yon plain
The Saxon rears one shock of grain;
While, of ten thousand herds there strays
But one along yon river's maze,—
The Gael, of plain and river heir,
Shall with strong hand redeem his share.
Where live the mountain chiefs who hold
That plundering lowland fief or fold
Is aught but retribution true.

The time occupied in getting thus far warns me that I must make no attempt at prophecy in connection with "future prospects." I know that the work I have accomplished will hardly stand the test of friendly criticism. Some may think that in a lecture to a section of the Society of Arts the art platform would have been the proper standpoint. The subject was tendered to me with no such limitations. Others may think that a fuller reference to social habits, embracing allusions to commerce, agriculture, religion, &c., would have found a conspicuous place in my remarks. But, to me it seemed that such a treatment, limited to an hour, would have resulted in two evils—it would have depicted much that is familiar, for, after all, the colonies in the main are very much like England; and it would have produced a catalogue or dictionary—very interesting reading, indeed, but always ending where it began. Finding a complete picture almost impossible, I resolved to confine myself to three or four points, of which a correspondingly fuller treatment would thus be ensured. And here I must make one remark, by way of self-protection, and putting you on your guard. The facts I have touched upon are, to a large extent, exceptional facts. This does not apply to the travelling, which is the best that can be got, but to the storms and the troublesome Kafirs. Fine weather and good servants are monotonous, commonplace facts, which none but an extraordinary pen can graphically describe. There is no part of the world where fine weather is more prevalent than in South Africa. Good servants are also to be found there; and hence, with all drawbacks, progress is, on the whole, continuous. In a novel recently published, by Mr. John Robinson, of Natal, occurs a passage something like this. Mr. Jolliffe, who emigrated to Natal with nothing, complains one day that the lung sickness has broken out among his cattle. "There is nothing but trouble," he says. "If there is not too little rain, there is too much. In fact, it is one of the most cursed countries on the face of the globe." A friend at elbow asks, "Whose is that fine field of cane?" "Mine," says Mr. Jolliffe. "And what is it worth?" "About £1,000." "And those mealies?" "Mine." "And what are they worth?" "£500." "And the arrowroot?" "Mine, too, and I expect to get £400 for it." "And what is the value of those cattle?" "A little over £1,000." And so the enumeration is drawn out, until it is seen that Jolliffe, who came to Natal with nothing, and might fairly have expected to leave it with the same, has, in a few years, become a man with a decent competency. Not having the book at hand, I have made a quotation which is true only in spirit, but it fairly represents the experience of the industrious, economical, average colonist. There may be great ups and downs, but there is progress in the long run. A man may lose twenty cattle today, and hence be poorer than he was yesterday; but he is almost certain to be better off than he was last year. Moreover, these very droughts and floods are perhaps blessings in disguise, as they draw forth the energies of a people living in a climate whose influences naturally tend to indolence. Thus nature checkmates or counterbalances nature. If railways have been hitherto wanting, they are rapidly becoming a fact. In the Cape Colony alone some 500 miles are in course of construction, and from Natal I last Thursday received letters representing that the progress of earthworks is so rapid that there is a fair expectation of the opening of the line between Durban and Maritzburg by the end of the year. The up and down coast lines are proceeding with equal step. The final opening of all these railways will probably be succeeded by a time of depression. Five millions of borrowed money cannot be spent in such a country without trade becoming abnormally excited. When that money ceases to flow in, a source of commercial activity will be cut off, and at the same time will accrue the full responsibility for annual payments of interest. It is for the different governments to be wise in season, and to anticipate this period by a judicious promotion of immigration and other measures. I must conclude with the remark, that neither time nor inclination will serve me to dogmatise about the future of the Kaffirs.

I have now finished my paper, but I should like to add one word in the interest of discussion. That word has reference to the position that the Kafir will take up, not as a mere straw in an irresistible current, but permanently and finally in the economy of the South African States. Will he become to any extent a master, an employer of others rather than being himself employed, an owner of property, exhibiting powers which enable a man to conserve both it and his position? And, as bearing upon this point, I may mention that the Fingoes, who belong to the same family as the Kafirs, have shown a remarkable power for the acquisition of property. Over the Kei, and in the more strictly colonial communities, besides breeding cattle, they own ploughs, and produce both wool and surplus corn. Of the Basutos, it has been said by a capable critic that since their war with the Dutch, when they were saved from national annihilation by the interposition of the British Government, their material progress has surpassed that of France since the Prussian war. Now, will the people displaying these qualities become to any extent masters, or will they contentedly settle down as the hewers of wood and drawers of water? Or, like other savages on their impact with civilisation, will they be found so kicking against fate and the force of circumstances as to leave but one solution—that which has been fittingly called "improving them off the face of the earth," either by the sword or by tho indirect means of their own habits? This is a momentous question, the practical answer to which will be accelerated by the political status to which they are assigned. And here I may mention a fact, well known to most of you, that Lord Carnarvon has constructed a Bill, whose object is the promotion of South African confederation, but one of the clauses in which excludes the natives from the benefits of the franchise. It may also be known to most of you that much opposition has been raised in the colonies to this clause, but whether from a pure and simple love of justice, or from the selfish consideration that the number of electors also determines the number of representatives, I am unable to say. Looking at the thing from an unprejudiced standpoint, and having no disposition to dogmatise, I am disposed to ask you whether Lord Carnarvon is not correct in theory.

What is the franchise? We take a large territory called a constituency, and we accumulate in one lump all the voting power it contains, and that makes a representative. We bring all the representatives together, and put them in one room, and that makes the House of Commons. The majority of that House furnishes the Ministry, and to the latter is delegated matters of peace and war, life and death, and, in fact, all the highest functions of sovereignty. Regarding the franchise in this way, we all see that it is nothing more and nothing less than sovereignty disseminated. There are laws in South Africa with reference to the sale of arms and ammunition, and they are invariably prohibitive as against the natives. These laws have been approved by the Imperial Government, and I am quite safe in saying that all South Africans qualified to have a sound opinion approve of them also. A feeling, chiefly springing from experience in the last Kafir war, exists that the Kafirs are not fit and proper persons to be entrusted with arms, or to be enlisted into a military force. Now, is it right to entrust the sovereign power to people to whom we deny the ownership of a gun? I assert nothing. I put the matter interrogatively. There is an intimate connection between the two questions—ought the Kafirs to be denied the franchise? and do they possess the faculty of becoming civilised?

DISCUSSION.

Mr. Barrett said, as an old South African colonist, it had given him much pleasure to listen to the paper, especially as it had been his lot to hear and read so many accounts of South Africa, which were either very incorrect or superficial. He could, however, endorse every syllable of what had been stated by Mr. Richards. With regard to the medicinal ideas of the Kafir, he might mention that they had a peculiar custom of cutting the skin with bits of glass and putting powder in it, when they felt sick. It had been truly remarked with regard to the weather that the so-called calamities were really blessings in disguise; and the same might be said of the locusts. When he resided in the Free States he was subject to great depredations by these insects; but he once asked one of his neighbours—a Boer—who was complaining very much of their ravages, if he did not see any good in them; was not the grass better after they had been on it, because they deposited a great deal of manure; and he said they certainly were useful in that way, for on his farm he had a great deal of coarse grass, which the cattle could not eat, but after the locusts had been over it this disappeared, and there was good herbage. He would also recommend anyone who was interested in the colony to read the novel which had been referred to, published by Mr. Robinson, of Natal, as it contained a most accurate account of the career of a settler.

The Chairman asked the title of the book referred to.

Mr. Barrett said "George Eliot." Mr. Richards had just touched on the future of the Kafirs, and he wished he had had time to give his ideas about the future of the Boers, because a great deal of nonsense was written about them. Some years ago he read a paper on the subject before the Colonial Society, and it was now coming up again in consequence of a contemplated confederation of their country with Natal; but the difficulties were very great. The Boers were a peculiar people, simple-minded and order loving amongst themselves, but they would not pay taxes if they could help it, and did not believe in any Government being paid for doing what was necessary to protect life and property. He believed the only plan would be—if they would not agree to confederation—for our Government to quietly step in and take the country; because, if they were allowed to bring the British name into disrespect, the consequence would be that the Kafirs would look upon all white men with contempt, and seeing the coloured people were more than 30 to 1, if they only knew their strength, they could drive every white man into the sea. It was only by the prestige of the British name they could govern the country, as was done in India. If the Dutch Boers of the Transvaal misgoverned the country, so that the Kafirs were not kept in proper subjection, the English would be in duty bound, in the cause of humanity, to take possession of it. The future of the Kafirs was a most important question, and he quite endorsed what had been said, having had a great deal to do with them. Some could never get Kafirs to work for them, but he always got plenty, because he treated them justly and kindly, but never granted a favour, always keeping them at a distance, and exacting implicit obedience. The Kafir was a great observer of character; if he saw any mental or physical weakness he took advantage of it. They had great contempt for a man who got drunk, and who did not keep his word. They were a very different race to the Hottentots, who were degenerating and diminishing every year, and, like the American Indians, would in time be swept off. The Kafirs, on the other hand, were physically and mentally equal to white men. They had nearly replaced the Hottentots as waggon drivers, for which occupation their physical powers well qualified them. Mr. Allison was one of the most successful missionaries in the country, and he could name many places where Kafirs had acquired land, either by gift or purchase, had good waggons built, had grown crops, and, in fact, they were in some parts becoming a wealthy community, building chapels for their own ministers which would not disgrace a British community; in one place they had imported £100,000 worth of goods entirely for their own consumption. Twenty years ago, they bought comparatively nothing, but now they were becoming great customers to the British merchants. Indeed, if the people who decried missionary effort, only acted on utilitarian motives, they could not do better than subscribe to South African Missions, for the sake of the custom which would eventually spring out of their operations. With regard to Lord Carnarvon's Permissive Bill, he thought the Kafir was yet so much a child in his mental development, that it would be ridiculous to suppose you could give him an idea of the importance of representative institutions. He was quite sure that if canvassing were allowed it would be a source of moral injury to the Kafir to give him a vote. He would be treated either with drink or with money, and could not possibly judge of the relative merits of the candidates. Until he was educated up to his position, therefore, he believed it would be a great mistake to give him a vote. It was a great error to compare the career of black communities with white; the two could not be placed parallel to one another.

Mr. Hale, while thanking Mr. Richards for his paper, regretted that he had not dealt a little with the trade and commerce of the colony, and thought that if he had given less of the humorous and dealt more with matters of fact, the paper would have been equally interesting and more instructive. With regard to the question of franchise he was inclined to agree with what had been said.

Mr. Glanville did not agree with the criticism of the last speaker, and thought the paper was none the worse for having a little humour in it. It was asked whether it would be right to give the franchise to men who were not entrusted with guns; probably most of the gentlemen present enjoyed the franchise, but he did not know that he should like to entrust each of them with a gun. It was hardly correct to say that the natives of South Africa were not entrusted with firearms, since they now had about 30,000 guns amongst them, so that if a vote went with a gun, a good many of them would be entitled to it. But even assuming that they had not guns, they had ploughs, and as he had before mentioned in that room, they were purchasing them at the rate of 2,000 a year, and it was known that the natives of Cape Colony, and on the frontier, had something like 50,000 ploughs in their possession. Now, the question occurred whether men who had in about 20 years acquired all this property out of their own earnings and savings might not be entrusted with some amount of political power. It showed their aptitude for civilisation and improvement. These ploughs were not like beads or blankets, they showed habits of industry and thrift; the men who owned them used them in agriculture and the proceeds in commerce. These people only twenty years ago were savages, never thought of trade, they made their women do all the field work, and if within this time they had learned to use a plough from commercial motives, they might surely be trusted with some amount of political power. They had also taken to European dress, which was a matter of importance, as it had a great influence on social habits and ideas of decency. They had also taken to build houses, square houses with doors and windows, and to put furniture into them. With regard to the Fingoes, he believed no people in the world had made such remarkable progress. They numbered about 40,000, and at the present moment they were developing amongst themselves social institutions of the greatest importance. They had lately subscribed £1,500 for the establishment of a school, and also towards making a road and building a bridge. Yet thirty years ago they were miserable slaves, not to white men, but to other blacks, their very name signifying dogs, and they were little better. Going farther north, the Basutos again, on the Orange River, numbered about 40,000, and they had a parliament of their own, the debates in which were every year published in the Native Blue-book issued by the Cape Government. These debates were remarkable, first of all for their natural eloquence, and next for their sound common-sense. Might not a people possessing a parliament of their own be allowed to vote for members of another parliament? In some cases he thought the intellectual powers of a few might be taken as a standard of the race to which they belonged. Reference had been made to one Kafir, the Rev. Tyo Soga, whom he had the pleasure of knowing and of entertaining in his own house, and he was as interesting a companion as could be, and preached as good a sermon probably as any gentleman present could do, in admirable language, and with a most dignified manner. He had been sent to Edinburgh to be educated, where he kept pace with all his fellow-students, and when he returned to the Cape he was welcomed to all the best pulpits there. He did not think he was a remarkable exception, for he could name many others of similar abilities. And why should not such men have some amount of political power? But why discuss the question? There was nothing in the laws or constitution of Cape Colony to prevent either Kafir, Hottentot, Basuto, or Fingo, being a voter at the present moment. As a matter of fact, many of them did vote, and he did not know that an inferior man, either morally or intellectually, had been sent to the Cape parliament through the influence of the "blanket" vote as it was called. At the same time he should like to see some restriction imposed; the qualification was at present far too low. Any man who could earn about £25 a year was able to vote, and there were few black men who could not qualify themselves under such circumstances. He should like to see the standard raised, and an educational test applied; but he feared that proposition would not meet with much favour in the colony, because some of the white colonists were not particularly well educated. Lady Barker seemed to think there was no society in Natal, or in any part of South Africa; but this was a great mistake. He had passed many a pleasant hour in Pietermaritzburg, in the house of Dr. Mann; but you could not expect to find a new country the same as an old one. Some people went out there, and, because there were no gooseberries, said there was no fruit, forgetting the oranges, melons, peaches, nectarines, and plantains; and, in the same way, some people, when they found no Rotten Row, said there was no society. In Cape Town you might meet as cultivated men as in any part of the world, and there were peculiar and charming institutions which Englishmen knew nothing about; for instance, the morning market, where men met together and talked in the most pleasant fashion. Some of the happiest hours of his life he had passed round a crackling fire, after a long day's journey. Society, indeed! if you wanted society, you should go to South Africa.

Dr. Mann said the future of the Kafirs was a problem which had pressed continually on his mind for many years as one which he desired to get to the bottom of. He should restrict his remarks to the Kafirs of Natal, and he must confess that the problem was a very important one. In a recent article in the *Times* the number of the white population in Natal was given at 38,000, which was a mistake, the real number being about 18,000, while the Kafirs were over 300,000, and they were increasing day by day. They came into the colony for protection, and you could not keep them out or get rid of them. The question therefore arose, what was to be their future? Were they capable of being elevated into a useful race who should assimilate with the white men, or would they become, in a certain sense, a servile population, well governed, and advancing in civilisation in that form? That they could become one or the other he had not the least doubt. He had once before mentioned the case of a Zulu Kafir who could not read, who borrowed on his own credit £500 to buy a sugar mill, and obtained a further loan of £100 from the Government to get it to work, and who, in three years, paid off the whole loan and became a prosperous manufacturer. He thoroughly endorsed what had been said by Mr. Glanville that in judging of the capacity of the race, you might fairly take the best men as examples. One thing had always weighed immensely with him; if you took young Zulu Kafirs, you found them petulant, impetuous, wild, and unreasonable, but if you took the older Kafirs, they were shrewd, sagacious, and almost political; they had great ability, and even without education seemed a much higher race intellectually than the lower class of the agricultural population in England. In fact, he would rather go to a Kafir for a response to an appeal to his reason than to an English labourer. He thought, therefore, that it would be well if these men could be brought to feel a social and political interest in the community of which they formed part. At the same time, he should like to see an educational qualification for the franchise, if such a thing could be practically carried out, and, indeed, should be himself glad to see the same test applied to the white population as well as the black. Before sitting down, he wished to protest against the clever exaggeration frequently put forward in describing the colony, as illustrated in the writings of Lady Barker. He had lived for nine years in Pietermaritzburg, and though his life had been one of intellectual labour from his earliest days, he reckoned those nine years as some of the most interesting in his life. Some of the best friendships he had ever formed were made in that town, and he could name by the score persons of a higher class of intellect and taste than in any English village of the same population. Lady Barker, who lived close to that town, has said in one passage that the dust lay inches thick on her table, and that was just a sample of the exaggeration which characterised very many other statements, used, no doubt to give literary spice to the narrative. He never remembered seeing more dust on the tables in Pietermaritzburg than was to be found on the tables in London, and a lady friend of long experience, to whom he had pointed out the passage, strikingly confirmed him in this impression. These highly-coloured pictures, therefore, must not be taken as *bona-fide* statements such as had been given them by Mr. Richards.

The Chairman said he had only been a traveller in these parts, and, therefore, could not say much about them, though he had much enjoyed his visit. With regard to giving votes to the Kafirs, he thought all difficulty might be got over by a property qualification; he did not agree with an educational one. A Kafir was naturally idle, and if he would get over that idleness and acquire property he was entitled to a vote, on the same principle on which it had been until very recently conferred in England. This would also allow time for the people to become fit for the exercise of their political rights. Two very important points which had not been touched upon, were agriculture and commerce; and it must also be remembered that there were great differences amongst the Kafirs, and also between them and the Fingoes and Basutos. With regard to the Boers, he thought they might be trusted to govern themselves; they were Christians, which the Kafirs were not, and more than that they were pious Christians. They were deeply attached to the Bible, and such men could not go far wrong, except from narrowness of view, and that was to be overcome by education. He protested warmly against the abuse which was often lavished upon them, which was undeserved, and which they keenly felt. They were not "boors," as they were often called, but Boers or farmers, and he maintained that their objection to confederation arose from the unfair way in which they were spoken of and treated, and that the difficulties now arising sprang from the action of our own Government, who had adopted what had been said against them by men in the colony who were unworthy of the name of Englishmen. They were the backbone of South Africa, which, without them, would have been still in much the same condition as Central Africa now was. He had conversed with many people about the Hottentots, but he feared they were an inferior race in many respects, who degenerated and diminished by contact with white men, and that they would ultimately disappear as similar races did in other parts of the world. He concluded by proposing a vote of thanks to Mr. Richards, which was passed unanimously.

A similar compliment to the Chairman concluded the proceedings.

EIGHTEENTH ORDINARY MEETING.

Wednesday, April 11th, 1877; The Lord De La Warr and Buckhurst in the chair.

The following candidates were proposed for election as members of the Society:—

Ackers, B. St. John, Prinknash-park, Painswick.
Beckingsale, E. W., 2, Thanet-place, Temple-bar, E.C.
Hill, Thomas Rowland, 15, Cedars-road, Clapham-common, S.W.
Lecky, James, 3, Houghton-place, Ampthill-square, N.W.
Nagaoka, M. Y., F.R.G.S., 3, Adelphi-terrace, Strand, W.C.
Stone, Thomas, Gas Works, Weymouth.
Ward, Major David, R.E., care of Messrs. Richardson and Co., 13, Pall-mall, S.W.
Webb, Edward, Greenfield, London-road, Worcester.
Whitburn, Thomas, Milford, near Godalming, Surrey.

The following candidates were balloted for, and duly elected members of the Society:—

Adam, Robert Smith, Leith.
Anderson, John Andrew, jun., J.P. (Mayor of Faversham), Hillside-house, Faversham, Kent.
Ashby, Henry T., 8, Bartholomew-road, N.W.
Barnett, Frederic, 4, Cambridge-gardens, Kilburn, N.W.
Birkbeck, George Henry, 34, Southampton-buildings, Chancery-lane, W.C., and Rock Ferry, Birkenhead.
Blenkinsop, William Edmund Brandford, 29, Royal-avenue, Chelsea, S.W.
Corfield, William Henry, M.A., M.D., 10, Bolton-row, Mayfair, W.
Couper, James, St. Rollox Chemical Works, Glasgow.
Darling, William Howarth, 126, Oxford-st., Manchester.
Hart, George Henry, 54, Wych-street, Strand, W.C.
Pagan, John, Wakefield.

The paper read was—

COMPENSATION FOR INJURIES RECEIVED IN INDUSTRIAL OCCUPATIONS.

By T. Attwood Brockelbank.

During an inspection of the many admirable appliances for the preservation of life exhibited by various nations at Brussels during the last summer, I was much struck with the comparatively meagre results attained in the English Department, not that the English exhibit was as a whole inferior to that of other nations, but, taking into consideration the character for humanity so universally attributed to this country, I was prepared to find England pre-eminently first in such a case.

Finding that I was by no means alone in my opinion, I determined, if I could, to ascertain whether our boasted Christianity is exercised at home, and whether our philanthropy, so incessantly placed at the disposal of foreign countries, has found its place in our own factories and workshops, in fact, whether England's great manufactures and trades are so conducted that the introduction of life-preserving appliances, and improved conditions of work, would be superfluous.

By the courtesy of this Society I am able to-night to address you upon the result of my search.

Few of us fail to notice from time to time in the public press isolated paragraphs telling of some industrial catastrophe, but it is rare that more than a passing expression of sympathy escapes us, unless we should be startled by some overwhelming calamity. It is difficult to realise the true import of the announcement, and we have scant leisure, or we should, far more often than we do now, acknowledge our Christian citizenship, and help those to right who suffer wrong. Still, it would be strange if, with all our pre-occupations, we had not, when reading articles on this compensation question during the past year, asked ourselves the question—Is there really in this country so great a need for such legislation? This question is already answered as regards one section of it in the report of the Railway Accident Commission recently issued; this report, wonderful to relate, is a little disappointing to the general travelling public, but it urges with emphasis the importance of enacting compensation for injuries to railway servants. With that report we have not much concern, excepting so far as we find it to bear on our general subject, my intention being to treat the question as universally applicable to every employment. After taking a glance at various industrial occupations, and selecting some typical forms of casualties, we will examine the statistics and the subject as a whole which I present to you.

The utterance in this room of the word statistics must surely awake an echo somewhat, I fear, to the consternation of some who listen, but unless I am much mistaken, the figures which we shall unearth will be found to possess an eloquence such as will vibrate in our hearts beyond the brief hour of our assemblage here.

Many employments there are by which the community is supplied with the necessaries and luxuries of life at the cost of the health, and ultimately the lives, of the workers—for instance, knife and scissors grinding, looking-glass manufacture, and many other like occupations, in which, although proper precautions would be advantageous, and mitigate much misery and death, the demands of that tyrant, fashion, claim and take the workers' lives. Just a word to you ladies here who use scissors and looking-glasses—and there are few of you who do not use both; when next you buy a pair of scissors, don't purchase one with rounded or oval backs; and when you choose a mirror, take one prepared with silver and not mercury. Thus may you help to lessen the demand for articles the manufacture of which saps the lives of the artisans. I do but refer to these employments that you may distinctly understand that our statistics to-night have nothing to do with them. We deal to-night with bodily injuries, which, in some shape or other, it is in the power of those responsible to prevent. It is with deaths by violence, sudden deaths, deaths after hours or days of agony, sometimes even months of suffering, of mutilations, amputations, or violent injuries of a lesser kind—but all received in the performance of daily duties—it is with such we have to do.

The utilisation of steam power—entering, as it now does, into the manufacture of almost every known article made by civilised man—has undoubtedly, either directly or indirectly, been of vast service to every section of the community; but this enormous power, controlled as it is with an ease that is perfectly marvellous, discerns no difference between effective work and wholesale destruction. As a result of this knowledge on our part, it becomes self-evident that equal solicitude should be employed for averting dire catastrophe as is expended in successfully obtaining useful results. Let us judge for ourselves, whether, in some of England's industries, the deaths and injuries which annually occur from boiler explosions are preventible or not. In 1876 there were 30 explosions from boilers in this country, killing 88 people and injuring 103, or about 4 people every week during that year.

5	explosions	occurred in	iron works.
4	"	"	collieries.
3	"	"	steamships or tugs.
3	"	"	cotton and silk mills.
2	"	"	paper mills.
2	"	"	brick and stone works.
2	"	"	locomotives.
9	"	"	miscellaneous works and factories.
30			

For the 10 years, from 1866 to 1875, the annual average was 53 explosions—64 killed and 101 injured; there were also in 1876, 6 other explosions by which 8 persons lost their lives and 4 were injured, but being steam-pipe and not boiler explosions proper, I do not take them into account.

Now, if we turn to the report of the Manchester Steam Users' Association for December last, we find that:—

> "More explosions occurred during that year from defective condition of these boilers than from any other cause, 13 arising from wasting of the plates or stays through external corrosion, and two from wasting through internal corrosion. * * No cause of explosions are more readily detected in time to avert a catastrophe than defective condition. It may further be noted that only 3 explosions arose from shortness of water, which is but 1 in 10 of the whole number."

Further on in this report we find this important paragraph:—

> "As on previous occasions, not one of the explosions which occurred during the past year arose from boilers guaranteed by this association. As this statement has happily to be repeated time after time in the closing report for the year, it must be considered as a strong argument in favour of the adequacy of competent independent inspection to prevent the occurrence of steam-boiler explosions."

This report goes on to say that, with the exception of one boiler, which was dealt with most injudiciously by the owner, and without the consent of the association, not a single boiler of the 25,000 guaranteed by the association has ever burst, and not a single person been killed or injured from any of them; and we further learn that during the last eleven years there has been, in round numbers, 2,000 people killed and injured in as many as 609 explosions.

Pretty well for the first branch of our subject, dealing with a cause which has absolutely been in the power of some people greatly to mitigate, if not wholly prevent. From a memorial, presented by this same association to the Home Secretary last June, I take the following:—

> "Explosions are not mysterious in their origin, but they arise in the great majority of cases simply from the use of boilers unfit for the pressure at which they are worked, the unfitness being due, in some cases, to original unscientific construction, frequently arising from parsimony, and, in others, to the results of wear and tear, the boilers being worked on long after they have become unsafe. Competent periodical inspection would detect the weakness of the boiler, whether from malconstruction or from wear and tear. Thus, boiler owners have the means of prevention in their own hands, and are, therefore, responsible for the greater number of explosions that occur, with their attendant loss of life. Under these circumstances, your memorialists would urge the necessity for immediate legislative interference, in order to arouse the steam user to a due sense of his responsibility, and, to this end, would recommend that in the event of every explosion, a searching investigation should be made by some thoroughly impartial and competent tribunal, qualified to investigate the cause of the catastrophe, and to bring the blame home to the right party. Your memorialists consider that the Coroner's Court is not competent for the performance of this duty, and of the correctness of this view the past year has afforded additional illustrations. The verdict at Coroners' inquests is, with but few exceptions, one of 'accidental death,' however unfit for use the boiler may have been. The blame is seldom attributed to the owners, even though they may have sacrificed the lives of their work-people and the passers-by by working old and worn-out boilers, but is too frequently thrown on the attendants, who may have narrowly escaped with their lives, or, in some cases, been actually killed. Your memorialists would further urge that inquiries should

not only be instituted in those cases which are attended with fatal results, but that they should be instituted in the event of every explosion, whether fatal or not, as explosions not infrequently occur that jeopardise many lives and call for investigation, but which are hushed up because no death ensues; while, should any one be injured, and death be anticipated, the fragments of the boiler are removed with the greatest possible alacrity during the interval, which renders a satisfactory investigation more difficult when the death occurs."

The following account will give some idea of a boiler explosion at a mine:—

"Two blacksmiths were engaged in repairing a boiler. No. 1 boiler, the one next the one on which the two unfortunate blacksmiths were employed, burst with a fearful noise, carrying death and injury in its train. The blinding and hissing steam and falling *débris*, having sufficiently subsided to admit of an examination being made, the dead bodies of the two blacksmiths were found among the ruins, and near them the corpse of a labourer, who survived only a few minutes. Some of the miners had been blown a considerable distance, and five of them suffered severe wounds, caused by scalds or falling stones. The engine-house was completely demolished, and in addition to the destruction wrought underground, the timber work at the mouth of the pit was partly knocked down, while that which was left standing looked in some places dangerous. The pulleys by which the caps were brought up and down the pit were entirely destroyed, and the effect of this was to imprison the 60 or 70 men and boys who were down about 80 fathoms below the ground."

In the first half-year's report of the Inspector of Factories, 1876, there are, on page 32, a few remarks on engine boilers, to which I would draw attention:—

"Some time ago I directed attention to two disastrous boiler explosions which had occurred; by the former I think 13 persons were killed, and by the latter 7, besides, in both instances, a number of persons severely injured. Verdicts of accidental death were returned, one jury simply recommending that in future engine boilers should be placed under Government inspection. Here the matter has been allowed to rest, and other casualties of a similar character are of frequent occurrence, without any means being adopted to prevent them, either by subjecting the boilers to periodical inspection by competent persons or by placing them in less dangerous positions. In the course of my inspections in England and Scotland I have seen boilers so placed that in the event of explosion the loss of life might exceed ten times over that which occurred at the places referred to."

On the very next page we read as follows:—

"Another very noticeable fact is the ready market for old boilers when taken out to give place to new. They are repaired and patched up, and sold to work at certain low pressures to purchasers of small means, and often equally small knowledge of their proper management. Often in charge of inexperienced firemen, they are not without danger; but alterations of engines, speed, &c., may possibly demand increased pressure, which is exacted without regard to the previous life of the boiler which, from a comparatively safe servant, is transformed into a potential torpedo."

In the October report of factories, at page 87, occurs the following passage:—

"If I am not mistaken, there was a Parliamentary inquiry about 1870 respecting boilers; and the general conclusion was that every boiler should be inspected, but the owner should be left to select who should do it. It is a pity that this has never been enforced by law. This inspector mentions boilers which he is cautioned not to approach, and he says, 'If a man continues, in spite of every caution, knowingly and wilfully to work on old, used-up boilers, and if in addition he places an incompetent person in charge, it appears to me (should any death ensue) to be a case not merely of manslaughter, but of murder. If a man were to fire a gun in a crowded street, though without aiming at any one in particular, I am informed that in the eye of the law he would be guilty of murder if any one were killed. Yet what shall we say of such a person who uses such a dangerous power as steam in the manner in which I have described? We fine a man heavily for employing females and children a few minutes overtime, yet we allow him to blow up the same persons with impunity, as far as the law is concerned.'"

In boiler explosions we have therefore learned that we have a source of catastrophe which may be justly entitled preventible, and when we call to mind that in at least 80 out of every 100 explosions people are killed or injured, the importance of coercive measures so urgently recommended is self-evident.

Let us now turn to our next point—mines. Such are the special dangers of mining operations, that there is no occupation, taken as a whole, surrounded with conditions of work of so deadly a nature, nor one in which certain dangers arising from well-ascertained causes are so thoroughly within the power of man to modify and to prevent.

MINES.

Of more than half a million of miners in England, the great majority toil on from day to day in foul air, which, notwithstanding all our Government Commissions and mining legislation, is simply execrable, and, as is stated in the mining reports for 1875, "such an atmosphere is slow poison." Will it be believed that a Cornish miner's life averages under thirty years of age, and in these mines the chance of explosion is almost *nil*, at all events very much less than in coal mines; and this fatal condition of things arises principally from the want of ventilation. As we may naturally suppose, sickness among miners is something terrible, about 70 per cent. more than the average of the nation—rheumatism, heart disease, and consumption predominating.

Among the sources of sudden deaths may be reckoned—Fire-damp, which may consume him to a cinder; choke-damp, which noiselessly, but surely, extinguishes the spark of life. A rising cage may carry him over a revolving wheel, or a chain allowed to slip, precipitate him down a shaft. In fact, the working conditions of some mines appear so regulated as to give the workers the minimum chance of a long life.

In order to show that the first-mentioned sources of catastrophe may be largely prevented by proper ventilation, I need but to refer to the dreadful accident at the Hartley Colliery a few years since. The miners were suffocated at the very spot they sought for obtaining air. Dr. Phené demonstrated at this particular spot, that had there been air shafts in other directions, not only would the miners not have been suffocated, but food could have been supplied to them until they were released.

It is always interesting to learn what is the opinion of those engaged on the actual work of these occupations. At a meeting of certified colliery managers held in October last, one speaker said:—

> "What really was required was that the gas should be cleared away, and he would sink more shafts, for for they knew there were no safety lamps that were not liable under some circumstances to explode. The earth wanted more tapping, and he would sink more shafts, or let the coal stay where it is, for it was high time that life should be better protected than it is."

But it may be urged that ventilation is provided in many mines by creating a draught of air by a furnace system of ventilation; this is a very common practice because it is a cheap one, but in many cases the remedy is worse than the evil it seeks to cure, often bringing about direct communication between the liberated and exuding terrible fire-damp and that flame which is all that is required to cause an explosion. If mine owners were compelled either by law or in self-defence to use mechanical ventilation in all mines known to be "fiery," hundreds of lives would be saved annually in the collieries of Great Britain.

With respect to mining cage accidents, the following came under my notice a short time since:—

> "Three men were being brought up in a cage out of an iron ore pit, when the cage was not stopped as it should have been at the mouth of the pit, but went right up over the high pulley wheel to the timbers, the rope broke, and the men and the cage were dashed to the bottom of the pit, all the men being killed and fearfully mangled."

Yet there are half-a-dozen well-known means for avoiding such an accident or rendering it harmless.

With regard to the number of injuries or disablements to miners the Government reports are silent, yet it is well known that disablements with mining tubs and corves of all descriptions are sadly frequent, and alone maim a very large number of men and boys annually. The estimate of the late Dr. Andrew Wynter, given in his "Curiosities of Civilisation" some fourteen years since, was that there were at least 10,000 disablements a year. Since that date collieries alone have increased to 130 for every 100 at the time that estimate was made, and we shall see reason before I close to consider the estimate of 15,000 as quite within the mark.

Concerning fatal accidents, it is most unsatisfactory to find that, despite all our mining legislation, the average number of deaths in 1875 was as near as possible the same as in 1864. With 3,220 coal mines working in 1864 there were 867 deaths, and with 4,332 coal mines working in 1875 there were 1,244 deaths.

In mining operations ventilation is the chief point, but the non-appliance of well-known mechanical means largely helps to swell these terrible totals.

Railways.

Railway matters in some shape or form are so constantly before the public that I should but narrate an oft-told tale were I to descant at all fully on this subject. Suffice it to say that accidents to railway servants in collisions form but a very small portion of the total annually shown as sacrificed. In certain classes of railway work accidents are almost looked for, and there are some districts in which you may almost predict that, within a given period, 5, 10, 20, or even 50 railway men will have been placed *hors de combat.*

The railway companies report to the Board of Trade that about nine-tenths of these casualties were in the sufferers own control, and if this be so, the natural love of life in certain classes must indeed be extinct, or they enjoy being slaughtered and maimed. The number of railway servants employed in Great Britain, including everyone from a secretary to an errand or horse boy, are about 285,000. During 1876 about one in 64 were either killed or injured.

Engine drivers and firemen, the goods guards and breaksmen, shunters and ground pointsmen, contribute most of this total, one out of 34, roughly estimated, falling victims; but as we dissect these employments for ourselves our investigation reveals the awful fact that about one out of every 15 goods guards and shunters employed on England's railways is either killed or injured every year.

The 1874 Board of Trade return shows that of eight shunters employed by a single company, two were killed and four injured in that year. The Registrar of Warwick wrote in January, 1876:—"During one week in last month no less than four young employés in this district met their deaths in shunting." Again, on a single day in July, 1876, the *Times* recorded inquests held in London on three servants of one company killed in shunting. Of these men, one in attempting to uncouple an empty coal waggon in motion, fell, and the waggon passed over him; he was taken up in a state of collapse, in which he remained till two o'clock the next morning, when he died—only 20 years of age. The second, whilst engaged in shunting, became jammed between the waggons; he died in a few hours—45 years of age. The third got pinched between the buffers of the two vehicles, and died shortly afterwards, after having previously had his right arm, which was dreadfully crushed, amputated above the elbow.

These dangers are well known, and I will close this section of our subject by the concluding words of the Chief Inspector of Railways extracted from the last annual report presented to Parliament. He concludes his report as follows:—

> "If railway managers and others, who have opportunities of observing the accidents that occur, each in his own sphere, and of devising or applying the remedies, would study the above figures, would consider and discuss with each other the best means of adopting the above suggestions, and others that will naturally occur to them, and would then further devote themselves to the sacred duty of promoting safety in the more dangerous branches of the service, it cannot be doubted that a material decrease in the loss of life and injury above recorded might in future years be happily effected."

May we express a hope that the reduced totals for 1876 are evidence that such a view of what Captain Tyler terms "a sacred duty" is now being at last taken by those in whose power the adoption of remedies rests.

Factories.

The bad conditions of work in England's factories and workshops have been a source of agitation and legislation for a period extending over forty years. Many matters, such as bad ventilation, overwork, restrictions on the employment of women and children, have been legislated for with benefit, not only to the workers, but also the ultimate advantage of the employers. But, in this matter of life preservation, we shall soon find that, of the large number of suggestions and recommendations made by royal commissions, select committees, and responsible inspectors, some of the most effective have been ignored, and others have been enacted in such a form as to be practically impossible of application.

In order to give some idea of the patchwork legislation already effected as to factories, I will just run through the statutes enacted:—Up to 1860 only accidents in spinning and weaving factories were known. In 1860 and 1861 bleach works, dye works, and lace factories were reported. In 1864 another series of works were reported. In 1867, those occurring in all the remaining manufacturing establishments.

Up to this date all accidents were reported which caused bodily injury to any person emyloyed, which was of such a nature as to prevent the injured from returning to their work by 9 a.m. of the morning following the accident—whether caused by machinery or not; but in 1871 it was enacted that only fatal and those caused "from machinery, or explosion of gas, or steam, or metal," which should prevent the injured person from returning to work within 48 hours after the occurrence of the accident, should be reported; and in 1874 there was some further tinkering concerning factories, loss of life and limb from machinery remaining as it was. There are 16 statutes which are now wholly or partially in force.

In the year 1866-7, the accidents, including machinery and all others, were 5,034. Of these, machinery was credited with 4,570.

It was in the 1866 report that the inspector strongly urged the necessity of making the employers responsible for all expenses incurred to the workers by accidents; and we find ourselves in 1876 returns, notwithstanding all our Government inspection with accidents through machinery alone, with an increase in ten years of nearly 50 per cent. on the machinery accidents of 1866. Of course, we must not forget that the inspection is more complete, and that extension of trade bears a part in such increase; but while we find that in consequence of strong measures in other directions, a vast improvement has been effected in these very factories, the alarming increase in this number is of great import.

As I have shown, we are strictly limited to machinery accidents by the enactment of 1871, and we will take a few of these types.

Hoist Accidents.—On page 75 of 1875 returns (October), we read:—

"The increasing frequency of these hoist accidents induces me to draw attention to the circumstances of three terrible occurrences of this kind. (1.) A boy, aged 11, was killed (it was true the boy acted against orders), but no one person had charge of the safe working of the hoist. (2.) A boy, aged 9, fell down a hoist, broke both thighs, both arms, and injured his head. In this case there is no man in charge of the hoist; had there been, or had the doors been a sufficient protection, the accident could not have occurred. (3.) A lad, aged 16, assistant to the hoist man, was crushed between the hoist and the doorway and was seriously injured internally. In this case the only inference to be drawn is that no child or young person should be allowed to be employed in working the hoist. The number of hoist accidents has increased alarmingly of late."

Steam Press Accidents.—On page 78 of this same report we read that—"The catalogue of hand mutilations" (in that half-year there were some 600 recorded) "tells its own sad tale; with very few exceptions these mutilations have occurred to boys employed in the same process."

This inspector goes on to give a list of mutilations from this cause alone. In but eight works in one district from May, 1870, to July 1875 (five years—

4 amputations of hand.
4 lacerations of hand.
11 amputations of fingers.
1 crushed hand.
—
20 in all, of which 15 were boys.

In both the instances we have noticed the inspector urges for powers to enforce well-known precautions. All that our Legislature has apparently accomplished is the conferring power on the inspectors to see how people are killed and injured, and that's all.

In the return issued six months later, what do we find? At page 66 we read as follows, in the words of a sub-inspector:—

"I take this opportunity of expressing my regret that no clause has been enacted by the 1874, or any other of the Factory Acts, forbidding children to clean machinery in motion. The Factory Commissioners submit that such a regulation should of course be maintained, overlooking the difference in mill gearing and machinery, and failing to see that the regulation has never been enacted by law. It is very sad to know the number of children who are annually maimed by the thoughtless, nay heartless, way in which they are early driven to clean portions of fast running machinery, which it is quite impossible to fence. It is preposterous to say that these accidents arise from the children's own carelesness, nevertheless in two out of every three cases, that is the excuse offered."

This sub-inspector records 8 cases in his small district which occurred in about five months.

3 little girls aged 10 were injured.
2 „ boys „ 10 „ „
1 „ boy „ 11 „ „
1 „ „ „ 12 „ „
1 „ „ „ 13 „ „
—
8

These injuries included broken arms, amputated and smashed fingers, and injuries to head, of which the details appear in the report.

Cleaning Machinery.

On page 98, another inspector says that accidents from cleaning machinery in motion continue to lead to numerous and painful mutilations, especially in the case of children and young persons, and he regrets that the prohibition recommended by the Royal Commission has never been enacted.

"In order to give some idea of how the Factory Acts deal with over-work, let me give an instance. In the last month of 1876, eight nail manufacturers were fined sums amounting to about £25 for cruelty and oppressively working children contrary to those Acts. Some young children laboured as long as ten and eleven hours a day making nails, and did not attend school. In pronouncing judgment, the stipendiary magistrate said he "wept for the poor things, who were shamefully used, and had neither time for growth or education.' Most people will agree with him, and applaud the verdict, but if these children had only been mutilated for life, or killed by a bursting boiler, these masters would not only have been unassailable, but could have repeated the operation with impunity."

Of the many causes of accidents in factories quoted from the most recent returns, the extracts given are but a sample of repeated reports of a like character, and as regards mechanical improvements, these comprehensive and admirable reports contain engraving after engraving of machinery guards and preventatives, supplemented by recommendations which, in some cases, if acted on, would abolish, and in all instances vastly mitigate, this continuous mangling of human beings.

To anyone who may desire a task calculated to shake his belief in English humanity, I can suggest no more likely occupation than to study these sickening details, whilst he endeavours to realise to himself the misery, agony, and suffering which they record.

Table of Deaths and Injuries in some Industrial Occupations in England during 1873, 1874, 1875, *and* 1876.

	1873.		1874.		1875.		1876.		Total.	
	Killed	Injured.	Killed.	Injured.	Killed.	Injured.	Killed.	Injured.	Killed.	Injured.
By Boilers	53	84	68	146	67	96	88	103	276	429
In Mines	1,069	*15,000	1,056	*15,000	1,244	*15,000	*1000	*15,000	4,369	60,000
On Railways	773	1,171	788	2,815	765	3,628	673	2,600	2,999	10,214
At Factories:—										
Adults—Male	221	2,767	253	2,574	216	2,575	194	2,440	1265	26,236
,, Female	9	683	17	692	11	605	1	626		
Young Persons—Male	66	2,014	69	1,945	67	1,697	45	1,691		
,, ,, Female	12	918	13	929	8	712	4	731		
Children—Male	13	481	10	531	12	455	14	377		
,, Female	..	218	5	215	3	201	2	159		
	2,216	23,336	2,279	24,847	2,393	24,969	2,021	23,727	8,909	96,879

Total casualties, 105,788.

* Estimates.

Thus we have a total for the four years of 105,788 men, women, and children killed or injured whilst engaged in peaceful pursuits in this country, a total which, even if it occurred in a decimating war, would create a profound impression throughout the kingdom.

Here I would leave the totals, but that I more than suspect we have by no means reached a true appreciation of the vast extent of suffering in this country. Have we here the whole truth, and nothing but the truth? It will be remembered that I read, from the memorial presented by the Steam Users' Association, an extract which showed how ready people were to cover up and obliterate all traces and effects of a catastrophe. Concerning mining injuries, some may have considered me rash in placing them at 15,000. The accounts of one Miners' Permanent Relief Society for the year 1876 show that, taking 24,000 men as the number of members, there were 4,000 members disabled, besides those there were killed, in that year; this shows one member in every six. If we apply this rate of disablement to the whole number of miners in England, we have the terrible total of 85,000. It is not probable that such a state of things is universal; but, after making every allowance, and supposing that some of the members' disablements occurred in previous years, I hold that I shall be very largely within the mark if I put the total of killed and injured in mines in this country at 30,000 a year.

How about railways. The report of an insurance society for 1876 shows that out of a working staff of 10,000 men on one railway during last year, 1,600 have been either killed or injured—one in every six. If (as we will assume to be the case) this railway has returned its full list to the Board of Trade at 1,600, then the other lines have contributed on an average of less than twenty accidents each. This cannot surely be the case; the published returns must be at fault. Let us make here an inferential estimate of 7,000 railway servants per annum, and we shall be then well within the mark.

We are distinctly told concerning factory accidents that, "Accidents in workshops are not given, nor are those even in factories, save such as are described." We are also told that "Many other accidents have occurred, and that there has therefore been a very great amount of suffering, of which no notice has been taken." We will put these at 13,000. We may therefore reasonably conclude that the true total very far exceeds even our inferential estimates, which give us for the next ten years as follows:—

Inferential Estimate for Ten Years, 1877 to 1886.

Mines	300,000
Railways	70,000
Workshops, factories, &c.	130,000
	500,000

We are apt to consider ourselves so much better than other nations. Inquiry will disabuse our minds on this score. It is humiliating to find that whereas in Prussia not quite two men per thousand, and in Belgium about two and-a-half men per thousand, are annually killed, the average total of

England much exceeds those countries; whilst in Staffordshire our mining deaths far exceed per thousand those of Prussia and Belgium when added together, and in the report for factories we are startled with this announcement:—

> "In their endeavours to prevent accidents by machinery, the French are far before us, not only in preventing suffering, but of keeping the limbs, which are the main dependence of the workers, uninjured."

Do not our Pharisaic feelings of national pre-eminence receive a shock?

It will not be amiss if we endeavour even aproximately to ascertain what the loss of life and injuries cost this country.

The late Lord Mayor, when writing to the *Times* on the occasion of soliciting subscriptions for the sufferers by the explosion on board her Majesty's turret ship *Thunderer*, expresses his opinion that the employers of the sufferers (*i.e.*, the country) should compensate; but failing this, urges that £12,000 will provide only fair compensation for the widows, orphans, and dependents. In this instance rather more than half the killed were married, leaving widows, and on an average two children each. To the widow, £350 each was to be allotted; to the children and dependents, about £33 each.

Adjusting this fair compensation to our victims, with 4,700 widows to provide for, we must assign them £1,645,000. To about one-half injured (and making a liberal allowance for fault of the sufferers, and we leave out of consideration all the orphans and all the dependents) £33 each, distributes just £1,900,000, a total for the four years of, say, three and a-half millions, or about £880,000 a year. In order to do ample justice to employers of these sufferers, we will credit them with a contribution annually of £130,000, and having admitted that £500,000 of the balance is never paid, I would ask from whence comes the necessary quarter of a million, which certainly has to be provided by somebody—by the way of cost of funerals, support to the widow and orphan, and aid and subsistence to the crippled. At least £150,000 is subscribed by the fellow labourers and neighbours of those injured, and through insurance societies. The balance is provided by the ratepayers in poor relief, through workhouse infirmaries, and by hospitals and orphanages. Does any one doubt it? I believe it will be found that surgical cases in hospitals average over a month's attendance.

Find out the cause of the bulk of the surgical cases in hospital, and then who provides the funds. Visit orphanages, ascertain the position of those little ones whose parent was killed by an accident, and we shall find that a very large number indeed come under the heading—preventible causes.

We all know the look of the election card on which "Your vote and interest is earnestly solicited for Robert Smith, the son of John Smith, who has been killed by the explosion of a boiler, The boy, with the widow and six other children, is left totally unprovided for." Some of us may have taken up such cases, worked night and day, and after the expenditure of time, money, and energy, sufficient to have supported the whole family for a year, have succeeded in providing for this one orphan.

Many other channels by which the moral duties and responsibilities of a careless or heartless employer have been thrust upon or charitably taken up by one or other of the community will readily occur to you, and not least, the case in which a clergyman by virtue of his commission throws himself heart and soul into the good work of alleviating such distress. But this is by no means all the cost. Were we able to ascertain what the State loses in the needless sacrifice of some 50,000 taxpayers every ten years, we should be startled. What again does the country's wealth lose? for we must never forget that these workers are not idlers, or drunkards, nor old or worn out, but toilers cut off or cut down at the period of their best contribution to the nation's wealth. Thus we see yet another exemplification of that grand fact, that as with the human body, so with the body politic, it rarely happens that one member suffers that others do not suffer with it.

Here we part from our statistics to consider the subject of compensation for injuries.

In commercial transactions, pecuniary responsibility is the best known security for moral rectitude, and this same responsibility in the matter of compensation for injuries, exemplified as it is in the instance of railway and other passengers, is found to be most effectual.

In 1861, the railways of this country carried not quite 174,000,000 passengers; they paid compensation for injuries amounting £135,000, or about 20s. for 1,300 carried. In 1871 (ten years later) they carried 375,000,000 passengers, paid £312,000 in compensation, 20s. between every 1,200 carried. The actual number of passengers killed was not a third of the number in 1861, showing, notwithstanding increased amount of compensation, but 7 per cent. worse than that year.

In 1870, a select committee of the House of Commons was appointed, and from that date to the present hour, the improvement in proportion to the number of passengers carried has again been most noticeable.

Take 1874—it is the worst year for fatal accidents to passengers we can find. The railways carried 478,000,000, and paid in compensation for injuries £356,000, which gives 20s. for every 1,345 passengers carried, an improvement of over 12 per cent. of safety to passengers in three years. The past year, 1876, we all recall as a terrible year for accidents, but even that year will show that in proportion to the number of passengers carried there will be found an improvement of something like 20 per cent. on 1871.

Other causes have doubtless contributed to this result, but that the alternative of liberal compensation to the passenger has a very large share in it few will deny, especially when we consider that in 1861 the train miles run were 105 millions, and are now over 200 millions a year, *i.e.*, double the risk.

We may fairly conclude that the application of this same principle elsewhere will be equally advantageous.

This safe working of traffic has been brought about mainly by two things—the adoption of improved conditions of work, and adoption of mechanical and other improvements.

With respect to the several occupations we have considered, human frailty, carelessness, and heedlessness largely enter, as of course they do into all conditions of work; but one of the excuses frequently advanced by employers is that improvements make the workers careless, and that these so-called improvements thus become a source of danger in themselves. This, as we are told by one Government inspector, is a mistaken notion, that "these arguments by the results of more extended experience have received further confutation;" and we might ask any employer who has really, thoroughly, and not half-heartedly adopted improvements, both in conditions of work in care for his employés, and as regards mechanical improvements, whether he has not found them on the whole a paying investment. Of one thing we may be quite sure, and that is, that his factories or workshops will be filled with the best men of his trade.

We have seen that the miner's average of life is very low. Is it possible for the majority of these men ever to attain to either the physical or the mental strength of average manhood? Can they ever put forth a man's energies, or take a man's developed brain to their work? If some person concerned in mining operations could test the ventilation of different mines, check the output, examine the statistics of crime and poverty in the immediate neighbourhood, and obtain reliable results of profit to the mine-owner, the advantage to well-ventilated mines would be found far in excess of any estimate we might form. The loss to employers by bad conditions of work, and neglect of improved appliances, means quite as much to them as it does to workers. Take a prominent instance. Some thirty years since, two of the largest railways in England had the telegraph successfully at work. They failed to appreciate its advantages, and rejected it. What large railway could now carry on its business for twenty-four hours without its aid? And can we estimate how much those companies were out of pocket by refusing its assistance?

The law of compensation to workmen for injuries, as it at present stands, appears to be this:—"A master is responsible to his servants for any accident that may occur through his fault, in a work of which he personally superintends and directs the operations, but if the accident occurs through the fault of a fellow-servant, he is not responsible."

Lawyers differ very much in the interpretation of the law? But this question of "common employment" bids fair to be a battle ground on which justice will have a hard fight. Where lawyers fail in interpretation of law, we shall hardly succeed; but a layman is quite as competent to understand justice, which, far too often, is a totally different thing.

You will concede that in the City of London there is nothing so well fenced in and protected as capital or property. Come with me into Lombard-street, enter a gigantic banking establishment; here are clerks by the score, some of whom deposit their capital or savings at interest. Let us suppose that one day, by the action of one of these clerks, these deposits are lost. What would the character of that banker be as an honourable man, if, when applied to for those deposits, he fell back on "common employment," and repudiated his liability. He could justly refuse the repayment of a farthing to the defaulting clerk, but so well is capital protected, he might seek in vain to shirk responsibility at law.

Now what is lost by our employés? By loss of life, that which, were the employer to give his own life for, he could never repay. By mutilation, a portion of that which constitutes his whole capital, his health and strength and power to work, which in full faith he had deposited at interest in the charge of his employer. Unless like security is given to the capital of the toiler, that already is to the capital of the millionaire, our so-called justice will continue what it now is, a farce and mockery.

As will be judged from the tenour of this address, the responsibility of the masters to servants for the adoption of improved conditions, of work and life preservation appliances, is not disputed, but it would be unjust to denounce even the most faulty with equal vehemence. We may reserve our burning indignation for those who "heartlessly" bring about the mutilation of children, and for the despicable employers who, having made good rules, never have them enforced, and fall back upon those rules only when the systematic breach of them brings about a catastrophe. But we must not forget that some employers have risen from the ranks of the workers, that they have never known better conditions of labour, that as they learn the law they find the death of a fellow creature, provided you accomplish it legally, can be effected with far greater impunity than if you attempted to pick his pocket. Except in those most noble natures which, out of poverty, can rise above mere money-grubbing, is it a wonder that in many such cases moral responsibility is un-realised?

Again, large and expensive improvements may be required for the security of life and limb. Instance the improved ventilation in mines. Can we not suppose that many a mine-owner, even without the stimulus of compensation, would gladly incur the requisite outlay, did he see his way to do it? Yet, in fierce competition, it may be with the very next pit, he would find that it would be impossible to sell his produce at a profit against his neighbours, were he alone to go to such expense.

There are others, who we can hardly term masters—directors of commercial undertakings—whose position is peculiar. Placed as trustees of an estate, to procure the best dividends they can for their employers, they justly hold to the principle that their employers are the first consideration; but, are they not morally responsible for the lives and limbs of their workers? Is it not possible for them to put upon their employers, the shareholders, a more direct responsibility, first, by pointing out that the dividends are earned with the life-blood of their servants, and then, after showing the expense of improvements, ask those shareholders to decide?

The enactment of compensation for injuries could not fail to remind the heartless employer of his duty and bring about the observance of dummy rules. It would acquaint the ignorant employer of the value of life and give to human employers courage to incur needful outlay, sure in the knowledge that from self-interest alone (that most potent of levers), their rivals must quickly follow their good example.

Still, even in these Government reports, there are gleams of sunshine to be found. We read of the almost patriarchal care of some masters; the improvements they effect, the inventions they devise, and how gladly they take the slightest suggestion of improvement and turn it to account. Such pictures of fatherly care do these reports give us—side by side with, and sometimes in the very same paragraph as the extracts given to-night—that they stand out in grand relief, and bid us hope for brighter things.

After making every reasonable deduction for carelessness and heedlessness on the part of the sufferers, our search has supplied us with unmistakeable evidence of wrong done to our fellows, which is a standing disgrace to our country's boasted humanity. Government report after report has not only supplied us with evidence that a very large number of deaths and injuries are preventible, but they also show how they may be prevented. We have acknowledged that even negligent employers can hardly be called upon piecemeal to provide advantages unenforced on other sections of the community; and now, satisfied that the remedy lies with Parliament, we ask ourselves will this remedy be enacted unless, as on the sailors' behalf, this country makes itself heard?

DISCUSSION.

Mr. Liggins said the subject was a very important one, but he did not agree in all the conclusions drawn; and thought there might be in some cases a diminution of the figures. The explosion on board the *Thunderer* was the most serious one last year, and deducting that from the general boiler explosions of the year—which it was said generally arise from the rottenness of the boilers—the number of deaths from this cause would be greatly diminished. Mr. Brockelbank did not say a word about the carelesssness of stokers, but his experience was that the greater number of boiler explosions arose from this cause, and it often happened that no deaths ensued because the men were at dinner at the time. Mr. Brockelbank seemed to think that it would be desirable to have more Government inspectors, but the *Thunderer* was under Government inspection; the best talent in the world had been employed in the construction of her boilers, and then in the inspection of them, and the ship was filled with engineers of intelligence and skill when the boiler exploded and caused such a sad loss of life. Government inspectors were as fallible as other people. Inspectors of railway locomotives were very acute, but occasionally one exploded; and he believed as long as men were mortal machinery would be from some cause defective. It would be most unjust to enforce compensation from employers for all accidents. Lord Campbell's Act gave a remedy to those who were injured by the carelessness of those who employed them, not only on railways, but elsewhere. A few years ago he was on a special jury at Westminster, in a case where the widow of an engine-driver brought an action against a railway company for compensation for her husband's death, but his fellow-servants all came forward and proved that if he had not himself mistaken the signals and gone into a siding when he ought to have kept on the main line, he would not have been hurt; but he made this mistake, smashed his engine, and killed himself. It was very well for the company to give the poor woman a present by way of sympathy, but a jury could not with any justice give her compensation. Nine out of ten explosions in coal mines arose because the men would not use the Davy lamp. It did not give as good a light as was convenient, and therefore the unfortunate miners, with the recklessness engendered by constant use, took off the wire-guard, and an explosion occurred. It ought not to go forth that these figures were serious; but even as they were, they only showed the death of $\frac{1}{3}$ of a person in every 100 per annum. Since the world was created accidents had occurred. Would it be right to make the owners of a ship like the *Northfleet*, well found in every respect, pay compensation because another vessel carelessly ran into her? With regard to railway accidents, he did not remember figures very well, but he was quite sure he had seen very different figures exhibited in that room, he believed by Mr. Bramwell, when lecturing on the railways of England. He was really astonished at the small per-centage of accidents which happened on railways from preventible causes, for nearly all arose from carelessness. Only the other day he saw a man jump out of a Metropolitan train when in motion, and he was knocked down under the train, though he fortunately escaped with very slight injury. He did not believe Government inspection would be of the slightest use in the case of steam boilers. The safety of railway travelling consisted in this, that the engineer was the first man to be killed; and it was each man's caution in the use of his own boiler which they must depend upon. With regard to the children, he believed many of them were not employed in the factory at all. He remembered a case in the West Indies, where a little boy of four or five came to play with his father, who was employed in a sugar mill; his little shirt got caught in the rollers, and he was killed. It did not follow in every case that compensation should be given. Government inspection of ships had proved most vexatious and injurious to ship-owners; and he would say, on behalf of owners of machinery, that their humanity should not be enforced by Act of Parliament nor by Government inspectors, but each one should be allowed to use his own discretion, and take his chance of being prosecuted for manslaughter if any accident occurred.

Mr. Macdonald, M.P., thought the last speaker had not understood the object of the paper, which was, not to enforce further Government inspection, but the necessity of compensation for injuries; and he was perfectly satisfied there was a strong necessity for an alteration of the law. There were a thousand-and-one stories told respecting the recklessness, negligence, and folly of the class from which he sprang, and with which to the end of his life he trusted he should be associated—the mining population; and he was not going to say that they were the wisest; but, considering the adverse circumstances in which they were placed, it was not to be wondered at if they were reckless. Mr. Liggins said that nine-tenths of the accidents arose from taking off the tops of the lamps.

Mr. Liggins said he did not say that; there were accidents from other causes, but they often heard of accidents from that cause.

Mr. Macdonald said that in 1830 a law was passed that the gases in mines should be diluted and rendered harmless; that was repeated in another Act in 1855; again in 1860; and again in 1872, which declared that the gases should be diluted and rendered harmless to such an extent that the working places and roads should be in a fit state for working and travelling. That law was not passed without full inquiry, and the knowledge that every mine in England could be rendered as safe as that room from explosions of fire-damp. There had been inquiries in 1837, 1854, and 1866, which led to the results he had stated. If those conditions laid down in the Act of Parliament were carried out, the most reckless and ignorant miner could not injure either himself or his fellows by tampering with his lamp. Every explosion—he said it advisedly—which destroyed a human life, was a crime in this country, and a blot on our civilisation. The point of the paper was compensation. If Government inspection would not do, and if laws would not do, the time had certainly come when they should extend the law, and place every owner of a mine or of a factory in the same position towards his workpeople as he was towards the general public. And he ventured to say that the moment that was done the number of accidents would diminish as if by magic. What was the law now? If the owner by his own act caused the injury or death he was personally responsible, but the moment he was rich enough to hire a deputy, that moment his responsibility was at an end. If he could only say that he had appointed a competent person, he handed over the injured and bereaved to the workhouse or to the charitable institutions to maintain. If a gentleman sent out his carriage with his servant, and he did an act which injured any one, the principle of the law was that the employer was responsible. His contention was, that the same principle ought to be carried out between employers and their servants. What right had they to carry on their works for their own benefit, and then hand over the poor maimed sufferers to be maintained by others. As the individual owner was responsible for his own acts, so ought every person under him doing work which he ought to do as owner, to make him responsible. It had been said to him that this would be very hard on employers, who might be away in India or Switzerland, to be made responsible for the neglect of their managers; but they were not obliged to go to Switzerland, or the Pyramids, or China, or Japan; and if they left to others the duties which they ought to perform, they ought to be made responsible for them. For many years he had been contending against the judge-made law which really ignored Lord Campbell's Act. They had now a Select Committee appointed, which would meet on Friday, and he hoped that with the support of the public opinion some good would be done.

Mr. H. Heath regretted the speech which had been made by Mr. Liggins, though it was a very plausible one from one point of view. He spoke of $\frac{1}{3}$ of a person in 100 being injured, and he presumed he meant those engaged in mines and factories, not the general public.

Mr. Liggins said he had taken the total population; they were all engaged in some occupation or other.

Mr. Heath said that was a most unfair way of putting it, when they were discussing the number of accidents amongst those in particular branches of industry. They were not considering the general mass of the public, and he considered the figures put forward as the total for four years were quite appalling. It was very easy to say that you often read of accidents arising from people's own fault, but on the other hand you often read of injuries to life or limb which might have been averted if there had been proper measures taken on the part of the employers. They must all feel that something must be done to reduce this great evil which was patent to every one, and he should like to ask if any steps has been taken by philanthropists, and clergymen especially, in the manufacturing districts, to press this subject on public attention.

Mr. Thomas Halliday (Miners' National Union) said there could not be a more sacred thing than human life, since it could not be replaced, and its preservation should never be lightly treated of. He, like Mr. Macdonald, belonged to the mining class, and in that class he found that in 1875 there was one death by accident for every 430 persons employed. They had been doing what they could for a long time to reduce the number of deaths, and something had been done already. There had been legislation with regard to shipping, many vessels had been detained and examined, and he had no doubt that thousands of lives had been saved. As to the number of injuries from accident, it was beyond any one's power to calculate them, because only the serious cases were reported at all. He had been brought up in a mine for 19 years, and he could testify that many accidents occurred for want of timber being provided, not because the men neglected to use it; and men would often leave a pit, but for the sheer necessity of earning their daily bread. There was no doubt that some employers were very careless, and only the other day even a jury had declared against them. He had known cases where mines were known to be fiery, but the men did not dare to complain for fear of being discharged; and he had a case in his own mind where a man who had complained of lack of timbers was sent about his business, lest it should get to the ears of the inspector. Whatever ingenuity and money could do to preserve life and limb was a great national benefit. In his own neighbourhood, near Bolton, where an accident had occurred, the rates had been saved to a great extent by a public subscription, but though it was very pleasing to see the public assisting those who required it, the men would thank them a thousand times more if they would insist on everything being done to prevent such calamities. Working men had as much desire to live as anyone else. Good employers need not fear inquiry, but only the parsimonious ones. Boilers often exploded from false economy. It was said—we will try and make it last another week, and in that very week perhaps it would blow up. He trusted, therefore, that something would be done to prevent this great loss of life and personal injury.

Mr. W. J. Prim said he had had a great deal to do with boilers, and he only knew of two cases of explosion in sixteen years which could not be clearly traced to a want of proper inspection. He was not an advocate of Government inspection. and did not know that it was always desirable, but proper inspection would have saved all those lives. It might be said that Lord Campbell's Act assisted workmen to get compensation, but how many workmen could afford to take a case into Court? Besides, if a workman thought a boiler was dangerous he could go; but what about his next-door neighbour? Not long ago, a case came before him where a boiler was deemed unsafe, and the person living next door complained about it, and went to the municipal authorities, thinking they could stop it, but he was told they had no power to stop the working unless it was a nuisance. He said he could not prove it was a nuisance until it blew up, and then perhaps he would not be able to give evidence. It was often said that the engine-driver or stoker was to blame for not attending to the boiler, but he had never known a case where it could be clearly shown that the accident arose from shortness of water, though he had examined some 200 cases of explosion. It was almost always from the boiler being allowed to get in such a dilapidated state that it exploded from sheer weakness.

Dr. Hake asked if Mr. Brockelbank could give the total number of persons employed, amongst whom the 105,000 accidents had occurred, because that would give the per-centage in a much clearer manner. If the figures were applied to the general public, they must take into account all the accidents which occurred which were not recorded.

Mr. Liggins said he must admit that.

Mr. Brockelbank, in reply, said he was not dealing with the general public at all; but he took certain occupations in which there were a large number of persons killed and injured. There were about half-a-million miners, and about 285,000 engaged in factories. The question of mines had been sufficiently dealt with, and therefore he would not refer to it further. With regard to the children, he must remind Mr. Liggins that the Act of Parliament said distinctly that the only accidents to be reported were those to persons employed, and the cases were limited to machinery, explosions from the escape of gas or steam, or from metal, and the accidents must be of such a nature as to prevent the injured person returning to work within 48 hours. He had also referred to the report of the inspector, which said that an immense number were never reported. With regard to the action of the clergy he was sorry to say that he had looked carefully to find out some action on the part of the bishops and clergy, but in vain. Being a churchman himself, he felt very much ashamed that with 26 bishops and archbishops in the House of Lords, when the question was recently brought forward by the noble Lord in the chair, not a single bishop or archbishop rose to speak upon it.

Mr. Liggins said Mr. Macdonald had referred to five Acts of Parliament for purifying mines, and it seemed to him that if those Acts were enforced no further legislation would be required. He was as anxious as anyone to prevent loss of life, but he did not think Government inspection was the right mode of doing it, or the other alternative of enforcing compensation.

Mr. Brockelbank said he had quoted reports of an inspector of mines, for 1875, who said that the atmosphere in some places was such that a candle would not burn freely in it; that the spittle and mucus became darkened in a short time, that such an atmosphere was a slow poison; and that the margin between it and sudden danger was but small. He could only recommend any one who felt any doubt on the matter to read these reports for himself. He believed the only remedy was to make the owners pecuniarily responsible, and then he believed the evil would be cured in a couple of years.

Mr. Macdonald thought the cause of mines being in their present condition, was that as a nation we had not yet learned to put the proper value on human life. If employers were compelled to pay in every case where the management was at fault, there would soon be an entire change.

The Chairman, in proposing a vote of thanks to Mr. Brockelbank, said the paper was a very interesting and important one. Some people might differ from some of the statements contained in it, but both sides had been very ably represented in the discussion, and it was a question which, if it were fully ventilated, he had no doubt would receive the consideration it deserved. He had taken a deep interest in it himself, and had brought it forward in the House of Lords in the hope that that would tend to keep it before the public; and, with the same view, he proposed that a Committee of that House should be appointed to inquire into it. Finding, however, that a Committee of the House of Commons was about to sit, of which he understood Mr. Macdonald was a member, he did not press the motion, feeling sure that it would there receive every attention.

Mr. Liggins asked leave to second the motion, saying he quite agreed with the objects of Mr. Brockelbank.

The motion was carried unanimously, and the proceedings terminated.

CORRESPONDENCE.

CHINA CLAY.

I have read with much interest Mr. W. Thomson's able paper on "The Sizing of Cotton Goods" published in the *Journal* for March 16, but I think it is a great pity he wandered from that subject to describe the mode of preparing china clay (pp. 364, 365), since he has fallen into a series of very gross errors by doing so.

A full account of the operations as carried on in Devon and Cornwall appears in my paper on "The China Clay, &c., of Devon and Cornwall," published in the *Journal* for May 5, 1876, to which I would strongly recommend persons interested to refer, and I hope the apparent egotism of this reference may be excused, since that is the only complete paper on the subject which has been published, and also because the writer is a manufacturer on a large scale.

I am entirely at a loss to even guess how Mr. Thomson obtained his information, but it is so completely wrong that your readers will do well to cross it out of their copies altogether.

I add below some specimens of Mr. Thomson's misstatements, with the real facts of the case in parallel columns:—

Mr. Thomson, pp. 364-5.	*Facts.*
China clay is manufactured from disintegrated beds of felspar in Devon and Cornwall.	There are no such felspathic beds; the natural china clay rock is decomposed granite.
The rock, when dug out from a considerable depth, is very hard.	The rock is always soft enough to be dug out with a spade, and is softer in depth than near the surface in most cases. Mr. Thompson here confounds china clay with china stone, two very different substances.
The place of manufacture is always by the side of a stream.	Only a small minority of the works are so situated, and consequently the circumstance is quite immaterial.
A series of vats are prepared, &c.	No such vats are used.
The rock is allowed to weather; and by the action of the rain, frost, and air, it gradually crumbles, &c.	There is never any weathering process. The clay is, in fact, washed out of the clay rock directly it is broken down, or at most within a few hours; and the sooner the better.
The weathered substance is passed through a mill, &c.	No grinding process is ever adopted in the preparation of china clay.
The powder is thrown into the first vat, and stirred up with water, &c.	No such process is ever adopted.

The following is a brief outline of the mode of preparing china clay for the market. The decomposed granite is dug out to the depth of two or three feet, in narrow channels, called "strĉks," lying side by side on the sloping side of the clay-pit, and left to lie where it falls. A stream of water is then made to run over it, so as to wash out the fine clay and mica from the sand, coarse mica, and stones. This stream of water is in very many cases raised from a shaft, or from the pit itself, by pumping.

The stream containing the fine mica and clay in suspension is then made to flow along certain long, narrow, and shallow channels, called "drags" and "micas," till the mica has settled, when the clay passes into a large pit and settles down, while the clear water flows away and is done with, except in cases where it is pumped up again for washing purposes. When the large pit is full, the clay is, without further washing, transferred to a tank to become partially dried, and thence to the kiln, where it is thoroughly dried by artificial heat and is ready for the market. In cases where there is no means of artificial drying, *i.e.*, in old-fashioned works, the thick clay is at once transferred from the original settling pit to shallow depressions in the ground, called "pans," and left to dry by the action of the air, after which it is cut into blocks, scraped, and piled up ready for sale.

J. H. Collins.

Truro, March 26th, 1877.

MR. DANVERS' PAPER ON INDIAN RAILWAYS.

Mr. Maitland has rendered great service by his remarks on the paper of Mr. Juland Danvers. A large subject like that dealt with by Mr. Danvers could hardly be discussed in one evening, and, for that matter, its main topics were scarcely touched. The question of Indian railways evidently cannot be restricted to

Indians. It is one which concerns the interests of the Empire and of the world at large, and one which requires an experience that India, kept behind in railway provision, cannot yet furnish.

With regard to the superficial extent of the accommodation provided, it may be as well to consider what are the relations of India, according to the "Statesman's Year-book."

	Population per square mile.	One mile of railway to square miles of area.	One mile of railway to population.
India	210	146	32,000
Russia in Europe ..	..	174	..
Sweden	21	112	2,350
Chili	15	160	2,400

These are the countries about on a level for railway accommodation, with regard to accommodation for square miles of area; but the disproportion of population is enormous. India has only one mile of railway for 30,000 people.

As compared with population per square mile, the figures may be put thus:—

	Population per square mile.	One mile of railway to square miles of area.	One mile of railway to population.
India	210	146	32,000
Italy..............	237	27	6,400
Germany	193	13	2,500
Netherlands........	179	11	3,000
Austria and Hungary	158	22	3,500
France	150	16	2,400

It is clear that India has not one-tenth of the normal accommodation in railways, and if it be said that Germany and France are rich countries, Russia and Sweden are not.

India being so unprovided with railway accommodation it is imperative the deficiency should be made up.

To provide for it from the casual surpluses of a casual general revenue must be regarded as an exploded policy.

To provide for it by provincial budgets is already a recognised substitute.

Measures must, however, be taken to make up for lost time, not awaiting the slow development of provincial finance.

The injustice of subjecting provinces producing a surplus to dependency for public works on the vicissitudes of Indian finance, and the experiment of Indian financiers, is already attracting attention.

Bengal has an area of 157,000 square miles, a population of 60,500,000, and an average population of about 400 per square mile.

The revenue is upwards of	£15,000,000
The expenditure in ordinary years ..	5,800,000
" famine..........	10,000,000

The North-West Provinces and Oude present similar examples.

In the case of Bengal, after allowing for a share of general expenditure, there would be a large surplus, available for paying interest and sinking fund on a railway and public works loan.

The reproduction caused by such a proper expenditure would again create a new income applicable to general Indian expenditure. At the present time the milch cows of India are under-fed. Not only are they sucked for growing calves like Assam, but for the lean kine on the frontiers.

Then so far as Imperial interests are concerned, the history of the Darjeeling Railway, for twenty years past, is a scandal to the political administration of India. It has been made as a forced concession to public opinion, and it is allowed to halt within sight of its destination.

Hyde Clarke.

OBITUARY.

Benjamin Shaw.—Mr. Benjamin Shaw died on Sunday last, the 9th inst., after a very short and sudden illness. He graduated at Trinity College, Cambridge, in 1842, coming out a senior optime in mathematics and sixth first-classman in the classical tripos. He was called to the Bar at Lincoln's-inn in 1868, after having for a long time confined himself to chamber practice. He had considerable practice recently in the Ecclesiastical Courts, being chiefly retained by the Church Association. Mr. Shaw became a member of the Society in 1861, and in 1866 he was elected on the Council. He continued to serve thereon till 1870, when he was obliged to retire, from the pressure of other engagements. He acted as chairman of the Food Committee, and it was principally through a liberal gift from him of £50, that the special course of lectures on "Industrial Hygiene" was given last session. He also founded the prize of £20 every fifth year, in connection with the same subject, which is shortly to be awarded for the first time.

NOTICES.

PROCEEDINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday evenings, at 8 o'clock. The following arrangements have been made:—

April 18.—Lecture by E. J. Reed, Esq., M.P., C.B., F.R.S., "The Modifications which Ships of War have undergone during the last Twenty Years."

April 25.—"Deaf not Dumb," by B. St. John Ackers, Esq.

May 2.—Lecture by J. Baillie Hamilton, Esq., "New Musical Instruments."

May 9. — "The Artesian System of the Thames Basin," by Joseph Lucas, Esq., F.G.S.

May 16.—

May 23. — "The Measurement and Settlement of Musical Pitch," by A. J. Ellis, Esq., F.R.S., F.S.A.

African Section.

Tuesday evenings, at 8 o'clock. The following arrangements have been made:—

April 24.—"The Trade and Resources of Morocco," by Dr. Arthur Leared.

Indian Section.

Friday evenings, at 8 o'clock. The following arrangements have been made:—

April 20.—"The Existing and Possible Commercial Communications between Persia and India," by Major-General Sir Frederick John Goldsmid, C.B., K.C.S.I. Major-Gen. F. Cotton, C.S.I., will preside.

May 4.—"Thaumato-dendra, or the Wonders of Trees," with illustrations from life, by Wm. Tayler, Esq.

Chemical Section.

Thursday evenings, at 8 o'clock. The following arrangements have been made:—

April 19.—"Spontaneous Combustion in Factories and Ships," by C. W. Vincent, Esq., F.C.S., F.R.S.E.

April 26.—"Phosphor-Bronze and its Applications," by Alexander Dick, Esq.

May 10.—"A New Process for the Production of Carbonate and Caustic Soda, without the Formation of any Noxious Waste and the Recovery of the Sulphur," by George E. Davis, Esq.

Cantor Lectures.

[Members are specially requested to take notice that the hour for this course of lectures is **FOUR** p.m., not **EIGHT** p.m.]

Monday afternoons, at four o'clock. Third Course on "The Connection of Greek and Roman Art with the Teaching of the Classics," by Sidney Colvin, Esq., M.A., Slade Professor of Fine Art at the University of Cambridge.

Lecture I.—April 16.

Introductory.—Definition of a classical education—the training of the mind by a systematic study of the genius of ancient Greece and Rome. Two kinds of remains left by ancient Greece and Rome, viz., remains of literature and remains of art. In England, classical literature and language studied to the neglect of classical art and archæology. Not so in Germany. Place and value of the study of art and archæology, (1) as illustrating the study of literature (2) for its own sake, as an independent training. Examples.

Lecture II.—April 23.

Range of the Study.—Architecture—not to be specially considered in the present course. The imitative arts. Subjects of imitative art in ancient Greece and Rome co-extensive with the whole field, (1) of imagination, (2) of life. Subjects of imagination—deities, personifications, heroes. Subjects of reality—history, portraits, ceremonies, sports and pastimes, family life, death.

Lecture III.—April 30.

Materials of the Study.—Division according to the art employed, as sculpture, painting, and their subordinate arts. Division according to the nature of the work produced, as statues in wood, gold and ivory, bronze, marble, terra cotta, free and decorative statues, reliefs, wall-paintings, vases and vase-paintings, coins, gems, gold ornaments, bronze armour and implements, glass, &c. Historical sketch of the accumulation and distribution of the materials. Excavations and museums.

Lecture IV.—May 7.

Methods and Development of the Study.—Archæology at the Renaissance. Archæology in the seventeenth century. Modern archæology—the eighteenth century. English travellers and German critics: Stuart and Revett. The Society of Dilettanti: Heyne, Winckelmann, Lessing. The mystical school: Creuzer. The comparative and historical school: K. O. Müller. Subsequent progress in the interpretation of monuments. Examples of method.

Lecture V.—May 14.

Future of the Study.—Importance of its systematic recognition in England. Unlimited results possible from future excavations. The French and German schools at Rome and Athens—an example to be imitated. National museums; provincial and university museums. Facilities offered by casts and reproductions.

Each member can admit one friend to these lectures. No special tickets are now required for the purpose; the tickets issued to members at the commencement of the session are available for the Cantor Lectures, as well as for the Ordinary and Sectional Meetings.

MEETINGS FOR THE ENSUING WEEK.

Mon.... **SOCIETY OF ARTS**, John-street, Adelphi, W.C., 4 p.m. (Cantor Lectures) Prof. Sidney Colvin, "The Connection of Greek and Roman Art with the Teaching of the Classics." (Lecture I.) (Introductory.)

Institute of Surveyors, 12, Great George-street, S.W., 8 p.m. Mr. J. Shaw, "The Rivers Pollution Prevention Act, 1876."

Medical, 11, Chandos-street, W., 8.30 p.m.

Asiatic, 22, Albemarle-street, W., 3 p.m.

Victoria Institute, 10, Adelphi-terrace, W.C., 8 p.m. Rev. H. G. Tomkins, "The Life of Abraham, Illustrated by Recent Researches."

Tues. . Charity Organisation Society (at the House of the Society of Arts), 4 p.m. Sir Charles Trevelyan, "Metropolitan Medical Relief."

Royal Institution, Albemarle-street, W., 3 p.m. Prof. J. H. Gladstone, "The Chemistry of the Heavenly Bodies." (Lecture II.)

Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. 1. Discussion on "The River Thames." 2. Prof. Edward Hull, "A Deep Boring for Coal at Scarle, in Lincolnshire."

Statistical, Somerset House-terrace, Strand, W.C., $7\frac{3}{4}$ p.m. Mr. Frederick Martin, "Births, Marriages, and Deaths, and the Comparative Growth of Population in the Principal States of Europe."

Pathological, 53, Berners street, Oxford-street, W., $8\frac{1}{2}$ p.m.

Zoological, 11, Hanover-square, W., $8\frac{1}{2}$ p.m. 1. Mr. W. A. Forbes, "The *Bursa Fabricii* in Birds." 2. M. L. Taczanowski, "Liste des oiseaux recueillis en 1876, au nord du Perou occidental, par Messrs. Jelski et Holzmann." 3. Rev. R. Bogg Watson, "Some Notes on the Medeiran Mollusc, Identified by the Rev. R. T. Lowe as *Achatina folliculus*, Groin." 4. Mr. E. Pierson Ramsay, "List of Birds met with in North-Eastern Queensland, chiefly at Rockingham Bay." (Part III.) 5. Dr. O. Finsch, "Three Supposed New Species of Birds brought home by the Bremen Western Siberian Expedition."

Royal Colonial, 15, Strand, W.C., 8 p.m. Mr. Nevile Lubbock, "The Present Position of the West Indian Colonies."

Wed.... **SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Science Lecture.) Mr. E. J. Reed, "The Modification which Ships of War have Undergone During the Last Twenty Years."

Meteorological, 25, Great George-street, S.W., 7 p.m. 1. Mr. C. N. Pearson, "The Meteorology of Mozufferpore, Tirhoot, for 1876." 2. Prof. J. Luvini, of Turin, "The Diéthéroscope; an Instrument for Measuring Atmospheric Refraction." 3. "Mr. G. Symons, "New Form of Thermometer for Observing Earth Temperature."

Royal Society of Literature, 4, St. Martin's-place, W.C., 8 p.m.

Archæological Association, 32, Sackville-street, W., 8 p.m.

Royal Horticultural, South Kensington, S.W., 1 p.m.

Thur. ...**SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Chemical Section.) Mr. C. W. Vincent, "Spontaneous Combustion in Factories and Ships."

Royal, Burlington House, W., $8\frac{1}{2}$ p.m.

Antiquaries, Burlington House, W., $8\frac{1}{2}$ p.m.

Linnean, Burlington House, W., 8 p.m. 1. Mr. M. C. De Candolle, "The Geographical Distribution of the Meliaciæ." 2. Dr. Francis Day, "Geographical Distribution of Indian Fresh Water Fishes. (Part III.) The Siluridæ."

Chemical, Burlington House, W., 8 p.m. 1. Mr. E. Riley, "The Estimation of Manganese in Spiegeleisen, &c." 2. Mr. M. M. Pattison Muir, "Bismuth Compounde." (Part V.) And "A Method for Detecting Small Quantities of Bismuth."

Society for the Encouragement of the Fine Arts, 9, Conduit-street, W., 8 p.m. Mr. Alfred Gilbert, "The Life and Works of Franz Schubert." (With Illustrations.)

Royal Institution, Albemarle-street, W., 3 p.m. Prof. Tyndall, "Heat." (Lecture II.)

Numismatic, 4, St. Martin's-place, W.C., 7 p.m.

Psychlogical, 11, Chandos-street, W., $8\frac{1}{2}$ p.m.

Fri....... **SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Indian Section.) Major-General Sir Frederick John Goldsmid, "The Existing and Possible Commercial Communications between Persia and India."

Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting 9 p.m. Mr. Frederick Pollock, "Spinoza."

Philological, University College, W.C., 8 p.m. Rev. A. H. Sayce, "Acadian Phonology."

Sat....... Trades Guild of Learning and National Health Society (at the House of the Society of Arts), 8.30 p.m. Prof. W. H. Corfield, "The Laws of Health." Part II. (Lecture XI.)

Royal Institution, Albemarle-street, W., 3 p.m. Rev. Archibald H. Sayce, "Babylonian Literature." (Lecture I.)

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,274. Vol. XXV.

FRIDAY, APRIL 20, 1877.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

HEALTH AND SEWAGE OF TOWNS.

The Annual Conference on Health and Sewage of Towns will be held on Thursday and Friday, 3rd and 4th May next, the Right Hon. JAMES STANSFELD, M.P., late President of the Local Government Board, in the chair. The Conference will meet each day at 11 a.m., and will sit till 1.30, then adjourn till 2; sit again till 5 p.m., and, if necessary, meet again at 8 p.m.

THURSDAY, 11 am.—Opening of the Proceedings by the Chairman. Papers and discussions on—

1st. DRY SYSTEMS.
    Pails, Pans, Boxes, Earth, Middens, Cesspools, Ash, and other Closets; their influence on health, cost of collection, commercial value of products, &c.

2nd. WATER-CARRIED SEWAGE.
    a. New facts about Sewage Farms, with or without precipitation or subsidence, profit and loss thereon.
    b. Effluent Waters.
        Subsidence.
        Precipitation.
        Filtration.
    c. Possibility of producing an effluent harmless to health.

3rd. ESCAPE OF SEWAGE GAS INTO DWELLINGS.

4th. DISCHARGE OF SEWAGE INTO SEA.

5th. ADDITIONAL FACTS TO THOSE STATED IN THE REPORT OF THE LOCAL GOVERNMENT BOARD ON DISPOSAL OF SEWAGE.

FRIDAY, 11 a.m.—Proceedings will be resumed. Papers and Discussions contiued.

The object of the Conference is to discuss existing information in connection with the results of the systems already adopted in various localities; to elicit further information thereon; and to gather and publish, for the benefit of the public generally, the experience gained. The introduction and discussion of untried schemes will, therefore, not be permitted. Special papers, which have been prepared at the request of the Council, will be printed and circulated at the Conference.

An exhibition of sanitary appliances will be held during the Conference. Only such apparatus will be admitted as have a distinct bearing on the subject of the Conference. Intending exhibitors should at once communicate with the Secretary.

A prize of £20 is offered for "The best Sanitary Pan for collecting pure excreta, unmixed with ashes or refuse, having regard especially to cleanly use, the separation of the urine from the fæces, and a ready and cleanly means of removal and transport." These pans will be exhibited at the Conference. The system must have been in use six months previous to the 31st March. The Council reserve the right of withholding the prize, should nothing be submitted which is considered worthy of reward.

Arrangements have been made for those attending the Conference to dine together at Simpson's, 101, Strand, at 6 o'clock each day. Tickets, 6s. 6d. each, without wine, may be obtained at the Society's office, on the morning of each day. To secure places, applications must be made to the Secretary on or before Tuesday, the 1st May.

BLOWPIPE ANALYSIS.

The Society of Arts are prepared to offer Prizes of £5, £3, and £2 respectively, and Certificates, for Proficiency in Qualitative Blowpipe Analysis. The competition is open to any person, but as it is intended principally for those interested in the mining industries of Devon and Cornwall, the examination will be held in the centre of the mining districts. The arrangements will be in the hands of the committee of the Miners' Association, and intending candidates should apply to the Honorary Secretary of the Association, Mr. J. H. Collins, Lemon-street, Truro. The examination will be held at Redruth, from 5 to 9 p.m., on Tuesday, 5th June, 1877, and will be conducted by Dr. Clement Le Neve Foster, H.M. Inspector of Metalliferous Mines. The examination will be entirely practical, and the following will be the conditions:—

1. No Prize or Certificate shall be given unless the candidate has taken a Certificate in the Science and Art Department Examinations in Inorganic Chemistry and Mineralogy.

2. The candidates will have to determine the composition of several minerals and simple artificial products, writing down each experiment, its result and the inferences drawn from it. The examiner will have the right, during the practical examination, of putting questions to the candidates to test their ability.

3. Each candidate will have to bring his own blowpipe, lamp or candle, platinum forceps, reagents, platinum wire, charcoal, spirit lamp, glass

tubes, &c., and any other blowpipe apparatus he likes. Any dry reagents may be used, but the only wet reagents allowed will be nitrate of cobalt and water. The use of gas and blowing machines will not be permitted.

4. If two or more competitors for prizes are equal, their respective merits will be decided by a second examination.

5. Persons who have not passed the Science and Art Department Examinations may present themselves for examination in Blowpipe Analysis, but they will not receive a Certificate until they satisfy Condition No. 1.

CHEMICAL SECTION.

Thursday, April 12th, 1877; Dr. Wright in the chair.

The paper read was—

THE CINCHONA ALKALOIDS; THEIR SOURCES, PRODUCTION, AND USE.

By Dr. B. H. Paul.

At the commencement of the present century, shortly after the time when the attention of chemists had been specially directed to questions respecting the constitution of the substances known as alkalies and earths, a Hanoverian apothecary, named Sertürner, ascertained that opium contains a substance which presents several characters analogous to those of the earths and alkalies of mineral origin. It was found that this substance, combined with acids, forming salts similar in their general chemical characters to the salts of potash or lime, that it changed the red colour of litmus to blue, and was precipitated from solutions of its salts by mineral alkalies. It was also found that the soporific effects of opium were due to the presence of this substance, which, on this account, was termed morphia. Very soon after this discovery, it was found that many vegetable products, which had long been known as possessing powerful physiological activity, contained substances of a similar kind, to which their action was due, and in course of time a great number of these vegeto-alkalies were discovered. Among these may be mentioned strychnia and brucia, the active principles of St. Ignatius' beans and the beans of nux vomica; veratria, conia, and nicotine, the poisonous principles of hellebore, hemlock, and tobacco. Subsequently a large number of these substances have been discovered, and they are classed together under the name of alkaloids. Four of these alkaloids, viz., quinine, cinchonine, quinidine, and cinchonidine, occur in the bark of various species of cinchona trees, and are therefore termed the cinchona alkaloids. It is to the consideration of these substances that I have to ask your attention this evening.

Cinchona bark, the source from which these alkaloids are obtained, has only a mythical history prior to the 17th century, and the febrifuge virtues of the drug are said to have been experienced by a Jesuit missionary at Loxa, and by the Spanish corregidor of that town about the year 1630. A few years afterwards, the wife of the Viceroy of Peru was similarly cured of fever by some powdered bark sent to her by the corregidor of Loxa, and in the year 1639, the bark was tried in Spain, under the name of Polvo de la Condesa. In some way, not well ascertained, this drug also acquired the name of Jesuits' powder, and in 1655 it was thus known in Holland and England. In 1677 it was introduced into the London Pharmacopœia as *Cortex Peruanus*. Nothing, however was known of the tree producing the bark from which the powder was prepared, until the year 1739, when La Condamine and Jussieu, in the course of an exploring expedition in South America, obtained some of the plants, which they purposed sending to the Jardin des Plantes, in Paris. In 1742, the botanical genus of the trees yielding this bark was established by Linnæus, who gave to it the name cinchona in honour of the service rendered by the Countess of Chinchon in introducing this drug into Europe.

The cinchonas are all natives of South America, where they occur exclusively on the western side of the continent, in an area which includes portions of Venezuela, New Granada, Ecuador, Peru, and Bolivia. The trees are always found in mountainous districts, at an altitude of from 5,000 to 8,000 feet above the sea-level. Climatic conditions appear to influence the growth of the cinchonas far more than the composition of the soil, and the temperature most favourable to their development appears to range between 54° and 68° F.

The number of species belonging to the genus cinchona amounts to upwards of thirty, and there are likewise many sub-varieties of these; but the cinchona bark of commerce is the produce of about twelve species, the chief of which are *Cinchona officinalis*, a native of Ecuador and Peru, and *Cinchona calisaya*, discovered by Weddell in 1847. This tree inhabits the declivities of the valleys of Bolivia and South-eastern Peru, at an altitude of from 5,000 to 6,000 feet above the sea-level, and extends northwards into the Peruvian province of Carabaya. The bark obtained from this species was an article of commerce long before its source was made known.

A third species, *Cinchona succirubra*, formerly grew in all the valleys of the Andes, debouching upon the plains of Guayaquil. It is now almost entirely confined to the forests of Guaranda, on the western declivities of Chimborazo, between 2,000 and 5,000 feet above the sea-level.

The different kinds of cinchona bark known in commerce may be classed under the following heads:—

1. Pale bark, also called Crown bark, and Loxa bark, is chiefly the produce of *Cinchona officinalis*, and imported from New Granada and Ecuador. This bark presents the form of quills, of various size and thickness. Prior to the use of quinine it was the ordinary Peruvian bark of English medicine.

2. Yellow bark, or Calisaya bark, is the produce of *Cinchona Calisaya*, and is imported from Southern Peru and Bolivia. There are two kinds—one in the form of quills, the other in flat pieces.

3. Red bark, the produce of *Cinchona succirubra*, was formerly in high repute, but is now less used than the preceding kinds; it is imported from Ecuador.

All these kinds of bark are used in pharmacy; but, in addition to them, there are several other kinds, which are used exclusively for making quinine. These are known as Columbia, Carthagena, and Pitayo bark, the first being imported from New Granada, and the latter two are collected on the south-western districts of Columbia.

Reverting now to the four alkaloids, which are the most important constituents of cinchona bark. Among these, cinchonine was first obtained in an impure state by a Portuguese chemist, named Gomez, in 1811, but its true nature remained unrecognised until 1820, when Houton Labillardière drew attention to the alkaline characters of the substance obtained by Gomez, and communicated his observations to the French chemists, Pelletier and Caventou, who, in the same year, succeeded in isolating cinchonine, and afterwards quinine, and also demonstrated that they were true vegeto-alkaloids. Quinidine was not discovered until 1833, when Henry and Delondre obtained it from the resinous residue obtained in the manufacture of quinine. Cinchonidine was discovered by Winckler in 1847. Since that time some other alkaloids have been found in certain kinds of cinchona bark, but they are not of sufficient importance to require mention here.

The proportion of alkaloids in different kinds of bark is subject to very great variation, not merely as regards the total amount, but also in the relative proportions of the different alkaloids. Quinine and cinchonine are most frequently met with, cinchonidine is restricted to certain kinds of bark but is, nevertheless, very abundant in some kinds, and quinidine is less frequently met with than any of the others.

There is much reason to believe that climatic conditions and other circumstances affecting the growth of the cinchona trees are largely influential in determining the amount and nature of the alkaloids in the mature bark; but, though recent observations have tended to confirm this opinion, we are still far from being able to adopt measures for bringing about such modifications as would be desirable in this respect.

Soon after the discovery of quinine, the sulphate of that alkaloid began to be used in medicine, in cases where some preparation of cinchona bark was required, and gradually this new salt drove out of fashion, to a great extent, the powder, tinctures, and decoctions which had formerly enjoyed a high repute in medical practice. At first, no doubt, the sulphate of quinine of commerce consisted of a mixture of the several alkaloids contained in the particular bark from which it was obtained. But when the different alkaloids had been distinguished from each other, chemical tests for ascertaining the purity of quinine were introduced into the pharmacopœias of most countries, and the other alkaloids came to be disregarded.

But notwithstanding the distinction thus established, the sulphate of quinine of commerce very generally contains a considerable amount of cinchonidine sometimes exceeding ten per cent. Possibly this did not materially affect the medicinal efficacy of the article, but it made a great difference in its intrinsic value, since cinchonidine is worth only one-eighth as much as quinine. When, therefore, quinine is bought by the Government in quantities of several tons for sending to India, the presence of such an amount of cinchonidine would be a very serious matter in a monetary sense. If it was paid for at the same rate of quinine, a premium would be offered for falsification, and if the price paid for such quinine were lower than the pure article could be sold for, conscientious manufacturers would be placed at a disadvantage.

The efficacy of quinine as a medicinal agent soon led to a highly increased consumption of cinchona bark, and in consequence of the demand for it, measures were adopted by the Bolivian Government with the view of enhancing its price. In the year 1850, a national bank of bark was established, with sufficient funds to give regularity to the bark trade, by purchasing it in the interior of the country at a fixed rate, and selling it abroad at the value due to an article of exclusive production in the woods of Bolivia, and of the first necessity and great demand in the trade of the world.

While thus endeavouring to take advantage of the monopoly in the production of cinchona bark which was enjoyed by South America, the Government of that country took little care to preserve the natural forests which were the source of this valuable drug. The bark collectors employed by the contractors cut down the trees in order to remove the bark, and when one district was exhausted they sought for new ones, without sowing seeds or planting for future supplies. This reckless and exhaustive system naturally gave rise to fears that the supply of bark might eventually cease altogether, or that it would be obtainable only at a price which would place it beyond the reach of the great mass of the community. Such a prospect was especially important in regard to those possessions of the British and Dutch Governments where quinine was almost a necessity of life, and where the greater part of it was consumed in the treatment of fever. Early in the year 1852, therefore, the project of cultivating cinchona trees in other countries besides their native regions began to be seriously considered. This idea had been put forward long before, and, in 1835, Dr. Royle, while acting as superintendent of the Botanical Garden at Seharunpore, had suggested that an attempt should be made to introduce cinchona cultivation on the Nilgiri and Khasia hills in India. In 1848, Weddell brought some seeds of *Cinchona Calisaya* from South America to France, and strongly urged the importance of cultivating the plant. Some plants raised from these seeds in the Jardin des Plantes, in Paris, were sent to Algeria in 1850, and others were sent in 1852 to Java by the Dutch Government. A previous attempt had been made to introduce cinchona into Algeria by the Jesuits of Cusco, but the cultivation of the plant was not successful.

An important impulse to the cultivation of cinchonas was given in 1852, by a report addressed by Dr. Royle to the East India Company, in which he pointed out that the Government of India was then spending upwards of £30,000 a year for quinine and bark, supplied for use in that country in the treatment in fever. He urged that the introduction into other countries having suitable climate and localities for the growth of such a valuable tribe of plants, could not fail to be of great advantage, not only for home consumption, but also for commercial export. He referred to previous suggestions that this attempt should be made in India, and showed that, from comparison of the soil and climate of that country with the geographical distribution of cinchonaceous plants, there was every reason to anticipate that the quinine-yielding species might be cultivated on the slopes of the Nilgiris and of the Southern Himalayas.

The credit of first practically endeavouring to carry out this project of cultivating cinchonas is, however, due to the Dutch Government; and under the directions of the colonial minister, Pahud, arrangements were made for Mr. Hasskarl, the director of the Botanical Garden of Buitenzorg in Java, to visit Peru and collect plants for growth in Java. The result of the first attempt was not very successful, and most of the plants raised from the seeds collected by Mr. Hasskarl turned out unproductive of quinine. However, a plant of true calisaya had been sent to Java from Paris, previously to Mr. Hasskarl's expedition, and a very valuable supply of seed was obtained through the agency of Mr. Ledger, so that, after numerous disappointments, resulting from error in selecting seeds and in cultivation, the Java plantations, at the end of 1860, comprised about 7,000 plants of *Cinchona calisaya*, and after discontinuing the growth of various worthless species, these plantations have since been considerably developed, until, at the present time, they are rich in quinine-yielding trees.

The first attempts made by the British Government to carry out the suggestions of Dr. Royle, were directed to procuring plants and seeds through the intervention of the British Consuls in South America. These attempts were unsuccessful, and it was not until Mr. C. R. Markham undertook an expedition for the purpose of collecting plants in South America, that any success was attained. With the aid of Messrs. Pritchett, Spruce, and Cross, three skilled assistants, a considerable number of plants were collected in the Carabaya district by Mr. Markham, in the Huanuco forests by Mr. Pritchett, in the red bark district of Eucador by Mr. Spruce, and in the forests near Loxa and Pitayo by Mr. Cross.

After encountering many obstacles and experiencing various disasters, among which may be mentioned the loss of all Mr. Markham's calisaya plants, the only living cinchona plants which reached India in good condition were those obtained by Mr. Cross, together with six plants of calisaya that had been raised at Kew. The supply of seeds obtained by this expedition was more fortunate; some of these were sown at Kew and others were sent to India.

The site selected for the growth of cinchonas in India was near Ootacamund in the Nilgiri hills, and several plantations have been established in this neighbourhood, which are now yielding valuable supplies of bark. In the Bengal Presidency, cinchona plants were afterwards introduced in the Rungbee valley near Darjeeling, on the southern slope of the Himalayas.

Unfortunately for the success of the enterprise, it soon turned out that the cultivation of *Cinchona calisaya* on the Nilgiris did not progress favourably; the growth of this species was less vigorous than that of the *Cinchona succirubra* and *Cinchona officinalis*, and it was found that the stems scarcely increased half as much as those of the latter species during the same period; as a bark-yielding tree it was, therefore, less valuable. On the contrary, the cultivation of *Cinchona succirubra* on the Nilgiris has been throughout successful, so far as the growth of the trees is concerned. The same result has been observed in the Sikkim plantations in Bengal. The plant of *Cinchona officinalis* thrived so ill that the further planting of this species was discontinued, and at the present time the great majority of the trees are *Cinchona succirubra.*

So marked is the difference between the growth of the various species of cinchonas in the Sikkim plantations that the succirubra trees promise to replace all other kinds, and hence we find in the last report from this district that the main work of the year has consisted in gathering a crop of red bark (211,931 lbs.) the produce of *Cinchona succirubra.* As regards future cultivation likewise, it is stated that the necessary stock of this species has been largely increased, and that 125,000 young plants have been prepared for a new plantation at Sittong. The seedlings of *Cinchona calisaya*, the tree yielding yellow bark, returned in the previous year's report as numbering 116,000, have now been written off as worthless, since experience has shown that calisaya seed, however carefully it may have been collected from the varieties yielding only good bark, produces an uncertain and mongrel offspring. The same statement is made in regard to the hybrid plants referred to in a former report, and the planting of them has been abandoned, since they manifest the same tendency to degenerate that has been observed in calisaya seedlings.

The total expenditure upon the plantations in the Nilgiris, up to the official year, 1873-74, has been as follows:—

	Rupees.
General Charges.	
For direction, offices and propagation	1,61,172
Special Charges.	
Expenditure at Neddiwattum	2,36,259
„ Dodabetta	1,52,318
„ Pykara	81,501
„ Mailkoonda (abandoned)	43,776
Total to 31st March, 1873 ..	6,75,026

Or about £67,500.

At the same date the total number of trees in permanent plantations in the Nilgiris, was as follows:—

	Surface.	Acreage.
Total of plants of all sorts at		
Neddiwattum	474,740	455
Dodabetta	345,980	378
Pykara	104,484	336
Mailkoonda (abandoned)	65,254	75
Total	1,190,458	1,244

The revenue received from the plantations since the commencement to the end of the official year, 1868-69, has been as follows:—

	Rupees.	£
Sale of plants in 1863-64 ..	5,100	510
„ „ 64-65 ..	4,809	480
„ „ 66-67 ..	2,450	245
„ „ 68-69 ..	1,680	168
		£1,403

The total expenditure on the Sikkim plantations up to 1st of April, 1875, has been 646,243 rupees, or about £64,625.

The total revenue to the same date has been 7,958 rupees, or about £800.

In addition to the two chief localities in which cinchona cultivation has been undertaken in India by the Government, it has been tried in some other places; a plantation was began by a private company in Sikkim almost simultaneously with that belonging to the Government. Patches of cinchonas were also planted in several tea gardens in that district; but the cultivation has not been taken up by private enterprise to the same extent as in the Nilgiris.

In this latter district the growth of *Cinchona succirubra* has been tried by the coffee planters of Wynaad. A small plantation was formed in 1869 in a place called Nagooli, above the Koloor Ghât, in South Canara, but it has been practically abandoned. The opening of a small plantation was sanctioned in 1871, by the Madras Government, in the Mahendra mountain in the Ganjam district. And the attempt, on a small scale, has been made under the Forest Department in Coorg.

The Travancore Government opened a plantation in 1862, at Peermede, on the Western Ghâts, about 3,000 feet above the sea. This locality was visited by Mr. Markham, in 1865, and approved as likely to suit cinchonas. The plantation contained in 1869, 3,532 trees, chiefly succirubra; but shortly after 1870, Mr. McIvor reported that they were diseased.

In the Pulney hills, the introduction of cinchonas has received some attention from the Government and from private enterprise. The result is that the trees grow fairly; but the bark is not very rich in alkaloids.

In the Tinnevelly hills, experimental plantations were made at various elevations of from 2,700 to 4,300 feet, and under various conditions of exposure, soil, &c. Very little care was expended upon these plantations, since the district is practically uninhabited, but still the result is said to be rather favourable than otherwise.

The *Cinchona succirubra* also thrives on the Shevaroy range.

The higher parts of British Burmah have been considered to offer a suitable climate for cinchona cultivation, but the result of trials hitherto made has not been promising.

In 1869, a plantation was opened at Nunklow, on the north-west slope of the Khasia hills, which was in two years increased to a total stock of about 27,000 plants, chiefly succirubra. The trees grew well as low as 800 feet and as high as 4,800, but at higher levels they failed, and at lower levels they soon died, especially on the plain of Assam, thus confirming the opinion arrived at in other places that cinchonas will not prosper on level ground.

For several years cinchona cultivation received a very patient trial in the North-West Provinces, under the staff of the Botanical Garden at Seharunpore, but the climate was found unsuitable.

Another extended trial was made by Colonel Nassau Lees and other persons in the Kangra valley. Seeds and seedlings of good species were procured, and great care was bestowed on the experiment, but the majority of the plants succumbed to frost.

In the Bombay Presidency the cultivation was tried at Lingmulla on the Mahableshwar hills, but the climate was subject to such extremes of drought and moisture that the trees did not thrive.

In 1861 the cultivation of cinchona was commenced in Ceylon, and in 1865 Mr. Markham described the site of the plantation at Hakgalla as admirably selected, and so closely resembling the native habitat of the plant, that its healthy growth must have been a certainty from the first. The growth of the succirubra and officinalis at Hakgalla has been excellent, and the ground under the trees is crowded with spontaneous seedlings, a circumstance clearly proving the suitability of the spot to the requirements of the cinchonas. The cultivation has been taken up by many coffee planters in the colony, and seeds as well as plants have been supplied to them with great liberality. The Director of the Royal Botanical Garden mentioned, in his report for 1873, that he had applications during that year for more than one million of plants, and that he actually distributed 800,000. During 1874 he reports that 826,000 additional plants have been distributed, and that counting the plants obtained from private nurseries and estates, very nearly three millions would be made up. From 1872 to 1875 the acreage under cinchona cultivation in Ceylon increased from 500 acres to 3,000 acres. Large extensions are still being carried on, and it was estimated that by the end of last year the number of cinchona trees in Ceylon would amount to near six millions. Owing to the rapid growth of succirubra, and the prospect it gave of a quick return, this tree was at first most in favour, but now that the merits of pale bark are becoming better understood, the officinalis is being largely planted. The cultivation of calisaya has as yet made but little progress in Ceylon. Since 1875 repeated consignments of Ceylon bark have been sent to England and realised good prices.

The cultivation of cinchonas in Jamacia and other West Indian colonies, as well as in Bourbon, Abandon, St. Helena, Mauritius, &c., has been commenced, and the succirubra is the species chiefly grown.

It has already been mentioned that of the four alkaloids occurring in cinchona bark of various kinds, quinine is the one which has hitherto been regarded of the principal importance as being a specific for malarious fever. For the manufacture of this alkoloid, therefore, those kinds of bark command the highest price which contain the largest amount of this alkaloid; such, for instance, as the bark of calisaya, officinalis, &c. Cinchona barks, however, have long had a recognised value for other purposes than as a source of quinine. They have been used in medicine as tonics, and in the preparation of various pharmaceutical products, such as tinctures, decoctions, &c. In many instances the bark used for these purposes contains but little quinine in proportion to other alkaloids. The demand for such preparations is, however, insignificant as compared with the demand for quinine, and though the red bark obtained from the succirubra grown in India may prove suitable for making those preparations, it is unfortunately less adapted for use as a source of quinine, since the alkaloid contained in it consists chiefly of cinchonidine, with only a small proportion of quinine.

Though it would not be fair on this account to regard the attempt to cultivate cinchonas in India, as having resulted in failure, it is, at least, a very serious disappointment that, so far as the provision of a certain source of quinine is concerned, the anticipations originally entertained have not been realised. On account of the small amount of quinine in the greater part of the bark now produced in India, and the large proportion of other alkaloids with which it is associated, this bark is not a suitable material for the quinine manufacture.

Until within a comparatively recent period, little attention has been given to the medicinal efficacy of the other alkaloids which are associated with quinine in cinchona bark. This circumstance is probably to be explained by the fact that these alkaloids were not at first distinguished from quinine. It may also be that the bark formerly used for making quinine did not contain any large proportion of the alkaloids. However that may be, there is now a considerable production of the alkaloids which accompany quinine in certain kinds of bark, and among these cinchonidine is especially important, by reason of the large amount that some kinds of bark contain.

As bearing upon this question as to the febrifuge value of cinchonidine, it is remarkable that there is, according to Mr. J. E. Howard, much reason for believing that the early reputation of cinchona bark was gained by a kind of bark in which cinchonidine is the predominant alkaloid. So far back as 1866 the attention of the Indian Government was directed to the question of the comparative efficacy of the several cinchona alkaloids, and medical commissions were appointed both in Madras and Bombay to investigate the subject. A considerable quantity of the several alkaloids were sent out to India, and each of them were tried in the most malarious districts.

The result arrived at by the Madras commission was to the effect that, in recent cases of uncomplicated paroxysmal fever, there did not seem to be any great superiority of one cinchona alkaloid over another, but that the alkaloids previously little valued in medicine were scarcely, if at all, inferior to quinine.

The numerical results in which the commission founded its conclusions were as follows:—

		Cured.	Failed.
Treated by cinchonine ..	410 ..	400 ..	10
,, cinchonidine	359 ..	346 ..	13
,, quinidine ..	376 ..	365 ..	11

In subsequent trials these alkaloids were compared with quinine, and the total number of cases treated was 2,472. Of these cases 2,445 were cured and 27 were not. The ratio of failure per 1,000 cases were as follows:—

Quinine	7·092
Quinidine	6·024
Cinchonidine	9·925
Cinchonine	23·255

The result confirmed the opinion before expressed, and it was considered by the commission as conclusively establishing the nearly equal febrifuge of quinine, quinidine, and cinchonidine, while at the same time it showed that even cinchonine has some considerable value in this respect.

In the Bengal and Bombay Presidencies similar results were obtained.

As a consequence of the value of cinchonidine as a febrifuge, and of the preponderance of this alkaloid in the red bark, which is the chief produce of the East Indian plantations, attempts have been made to turn this bark to account, by preparing a mixture of the alkaloids in preference to extracting merely the quinine it contains. By this means it is believed that the cinchonidine, as well as the other alkaloids, will be rendered serviceable.

At home, efforts have been made in a similar direction by Messrs. Howard and others by the preparation of cinchonidine sulphate in a pure state; and Mr. W. Cuffen has prepared a mixed alkaloid, analogous to the Indian preparation, to which he gives the name quinetum.

DISCUSSION.

The Rev. W. H. Hechler said that, having been for some time on the West Coast of Africa, where people suffered a great deal from fevers, he should like to ask Dr. Paul whether the cinchona plant could be grown on the Cameroon Mountains? It would be a great point gained if they could have quinine close at hand.

Mr. Mill, having taken a considerable interest for some time past in this subject, felt bound to express his sense of obligation to Dr. Paul for the extremely able manner in which he had treated the subject. The question of the manufacture of quinine was now assuming a very formidable aspect, the price being no less than 16s. an ounce, whereas a short time ago, he believed, it was about 14s. 6d. If this state of things were likely to continue, it was a matter of the most vital importance for every one connected with the medical profession to inquire if it were possible to devise some means by which quinine, cinchonine, and the allied products, could be manufactured from other substances than the natural bark. He should like to ask whether Dr. Paul thought it at all possible to manufacture this product from some of its allied products of the tar group, such as aniline. The tar series formed a basis for the manufacture of an enormous amount of extremely useful substances, and it occurred to him that quinine and the allied products might also be produced from those bases. With regard to the growth of the cinchona plant, a most remarkable fact had been mentioned, to which his attention was drawn some time ago, namely, the curious development of quinine, which took place when the the bark was mossed. That was one of those curious results of cultivation which had not yet been sufficiently explained, and he should esteem it a great favour if Dr. Paul could give any explanation as to the nature of the changes which was induced into the bark by the process of mossing, because, if that process was one which of itself caused an increase in the alkaloids, it would be a matter of serious importance to ascertain whether it could be produced by any definite means—such, for instance, as the exclusion of light.

Mr. Goodwin said he had not the slightest doubt, from having read most of the works which had been published on Africa and its climate, especially the last work of Cameron, that cinchonine bark could be produced in all that region near Lakes Tanganyika and Ngam. He wondered that the London Missionary Society, which had established *entrepôts* in that locality, had not gone to Dr. Hooker and taken out seeds, because there was no doubt the want of quinine had caused the death of many of the most able explorers in that region. One great peculiarity in Africa, which also existed in Neilgherri, Darjeeling, Chimborazo, and parts of South America, where the best bark is produced, was the remarkable moisture of the atmosphere. Even in the summer time there was continual moisture, and in some parts even a damp fog. He had not the slightest doubt, without knowing much as to the Cameroon Mountains, that as from St. Paul de Loando, Benguela, and all that part there was an immediate rise, within 50 miles, from 4,500 to 6,000 feet, which was about the altitude at which such plants grew, that the cinchona could be well-grown and rich in alkaloids. There was no doubt that it would be found necessary to plant them if the establishments of the different missionary societies were to last. As to the price of bark it was at present a very exceptional time, though he did not agree with the last speaker that the ordinary price of sulphate of quinine was 14s. per ounce—he should have thought from 6s. to 8s. nearer the mark. The stoppage of supplies had risen from the sanguinary civil war now going on in New Granada, where the richest barks were produced, and those most useful to the manufacturer, as they possessed more quinine than any other alkaloid. They were known as Pitayo and soft Columbian. Crown barks were little used for the purpose of the quinine manufacture until they were transported to India, where cinchonidine and cinchonine were converted into quinine by the mossing process. No doubt the price of bark must fall eventually, as the large plantations in Ceylon and in India produced bark which could be sold at from 4s. to 5s. per ounce, which would compete seriously with the New Granadan and the Columbian barks. In addition to this, when the war was over, a great accumulation of bark must come down, which would immediately tend to lower the price of quinine. At the same time, they must remember that the annual import from America is never equal to the consumption, the total amount consumed being equal to 36,000 serons per year, whereas the supply was only equal to 21,000, or not much more than nine months' consumption; so that they must still receive a large quantity from India to make up the deficiency.

The Chairman said there was one point brought forward by Dr. Paul which was, perhaps, more a physical phenomena than a purely chemical one, namely, the fact that when quinidine was dissolved in ether and allowed to stand, the dissolved alkaloid separated out in well-defined crystals. This seemed to be a property which was shared by a number of other alkaloids, and, in particular, by several of those derived from opium. If to a solution in a perfectly pure state a fixed alkali, or ammonia, were added so as to precipitate in an amorphous form the vegetable alkaloid, and then that precipitate while still amorphous were agitated with a small quantity of a solvent, not sufficient to dissolve the whole, and if then the solvent were rapidly filtered or drawn off and allowed to stand in a closed vessel, so that no evaporation could take place and no change of temperature, it would frequently happen that a quantity of the substance, perfectly dissolved by a solvent, whilst the alkaloid was in the amorphous condition, gradually separated out in well defined crystals. This phenomenon was apparently strongly marked in quinidine, as exemplified in the sample shown. He noticed that in reference to this alkaloid, Dr. Paul did not accept the name conchinine applied to it by some continental chemists. With reference to the possible synthesis of quinine from cheaper materials, he feared the artificial production of this substance was very far distant. Some years ago a statement appeared in some scientific papers that quinine had been artificially manufactured—he believed from naphthalene—and that the quinine so prepared had been exhibited at some society, but nobody he had ever met had seen a sample, and nothing further had been heard of the process. Inasmuch as in the molecule of quinine there were something like twenty atoms of carbon, and those might be connected together in a large number of ways, before the materials which would be proper for the synthesis of quinine could be tested, it would be necessary to find out the mode in which the various constituent atoms were aggregated together, so as to form subsidiary radicals, and this knowledge was at present to a very great extent wanting. In fact, what was called by chemists the structure of these alkaloids, was a branch of inquiry in which comparatively little had been done. Even in those few alkaloids where some amount of knowledge had been gained in this direction, the results of inquiry were hardly encouraging as regards the artificial production of these bodies, inasmuch as many of them were very readily altered by various agents, such as would in all probability be required in some stage or other of the artificial production, and instead of producing in various cases a well crystallised body, in all probability a non-crystalline substance would be formed. Especially was this likely to be the case with quinine, which by the agency of heat, or acids, or both jointly, was readily converted into a non-crystalline isomer quinicine. As yet, so far as he knew, chemists had not been able to bring about the reciprocal conversion of non-crystalline quinicine into a crystalline quinine. Nevertheless the circumstance that by transplanting one variety into a different soil, one alkaloid disappeared and another took its place, seemed to show reason for supposing that they might, at some future day, be able in the laboratory to cause the transformation of the less valuable material into the more valuable. With reference to the disappearance of the one alkaloid and the re-appearance of a larger quantity of another, the same phenomenon was noticeable, to a certain extent, in certain varieties of opium. In some cases, those varieties rich in the soporific alkaloid morphine, and comparatively poor in the less valuable alkaloid narcotine, and *vice versâ*, underwent this change, and the same remark seemed to apply to a number of the different varieties of cinchona plants.

Dr. Paul, in reply, said he could scarcely answer the first question, except by putting another, which was to ask what were the climatic conditions of the locality referred to. The requirements of the cinchona plant were—a moist atmosphere, a moderately mild temperature, and the absence of any great variation. A range of temperature between 50° and 70° was required, without either frost or excessive heat during the year, and wherever those conditions prevailed, and deep mountain valleys were available, the cinchona cultivation could be carried on as well as in Ceylon, Java, or any other locality where it was successfully pursued. It had been shrewdly remarked, that missionaries, who went about to all parts of the world, might render very good service by making observations of this kind, if they would condescend to imitate to some extent the activity of the Jesuit Fathers in America. Probably, the introduction of the cinchona into Europe was in great measure due to those astute Catholic priests, who were in the early period of the colonisation of America sent out to that country. With regard to the artificial manufacture of quinine, he looked upon it, from a chemical point of view, as a thing which was to be done, if only you knew exactly how to do it; but between the present position and the attainment of that result there might be a great gap, or there might be a very little one, and there appeared no immediate prospect of arriving at it. No doubt aniline and its congeners had been very fertile in yielding a number of substances of a similar character to quinine, but he was disinclined to raise any hopes of an immediate production of quinine from that source. A more promising prospect appeared to lie in the endeavour to bring into general use those hitherto neglected alkaloids, which were naturally produced in abundance by the cinchona plants, which were now being cultivated in Ceylon, India, and Java. The sulphate of cinchonidine had been proved to be very little inferior in efficacy—for certain kinds of maladies—to quinine. This material was some six months ago—and he believed it was at the present time—quoted at about two or three shillings per ounce; whilst sulphate of quinine was now sixteen shillings, and could scarcely be bought even at that price, and there was no knowing what figure it would go to, for at present there was no reason to suppose that the supplies from South America would be renewed. The stoppage might continue for a much longer time, and as the demand was increasing, the prices must naturally go up. With regard to the very remarkable fact that in Crown bark, grown under moss, there was a large augmentation of quinine and displacement of cinchonidine, he regretted to say the knowledge on the point amounted at present to nothing more than the mere result of observation. It was simply a fact that was well established in the Indian plantations, but anything like an explanation of it was yet entirely wanting. The word *conchinine*, as the chairman had remarked, had been suggested by one of the German chemists, an authority on the subject of the cinchona alkaloids, for what was known as *quinidine*. This alkaloid was discovered about the year 1833, and somewhat later various observers who had to deal with the sulphate of quinine of commerce, noticed that it was not altogether homogeneous, that it contained something that was not exactly quinine, although very much like it. This substance came to be commonly called quinidine; somewhat indefinitely, and it probably comprised not only the alkaloid now known by that name, but also that known as cinchonidine. It was not until about ten or twelve years ago that a French chemist, Pasteur, examined this alkaloid, and definitely described it. Since the time when the presence of these other alkaloids in commercial sulphate of quinine was noticed, the admixture had sometimes been separated, and had been commonly known under the name of "quinidine," which name it retained to the present day. The substance thus indicated was probably in most instances sulphate of cinchonidine, for quinidine was really extremely rare. Not one kind of bark in a hundred contained any; and those which did contained very little. In this way the term "quinidine" had been in trade applied to cinchonidine, and some confusion had thus arisen, but at the same time the proposal of Mr. Hesse to designate quinidine by conchinine was one which, in his judgment, had no justification.

The Chairman then proposed a vote of thanks to Dr. Paul, which was carried unanimously.

NINETEENTH ORDINARY MEETING.

Wednesday, April 18th, 1877; Major DONNELLY, R.E., Vice-President of the Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Forbes, James, jun., Chemical Works, Old Ford, E.
Hamilton, Dr. J. Lawrence, 34, Gloucester-terrace, Hyde-park, W.
Jackson, Francis Halhed Ward, 9, Albion-street, Hyde-park, W.
Jackson, Ralph Ward, 26, Cambridge-street, Hyde park-square, W.
Sanderson, Charles Poyntz, care of the Rev. J. W. Sparling, Crewthorne, Berks.

The following candidates were balloted for, and duly elected members of the Society:—

Dodd, John, 6, Thomas-street, Liverpool.
Dunn, Thomas Edward, The Cottage, Rusper, Horsham, Sussex.
Greene, E. B. C., Chatham College, Ramsgate.
Gwinner, Hermann, International Bank of London and Hamburg, Cannon-street, E.C.
Harris, Arthur G. R., 39, Dorset square, N.W.
Souter, John Clement, M.D., 88, Junction-road, N.W.
Stevenson, Thomas, M.D., Guy's Hospital, S.E., and 21, Caversham-road, N.W.
Ward, George, Buckingham-terrace, Headingly, Leeds.

A lecture was delivered on—

THE MODIFICATIONS WHICH SHIPS OF WAR HAVE UNDERGONE DURING THE LAST TWENTY YEARS.

By E. J. Reed, M.P., C.B., F.R.S.

It is nearly twenty years since I had the honour of delivering in this room, and to this Society, an address upon the modifications which the ships of the navy had undergone during the present century, in respect of dimensions, form, means of propulsion, power of attack and defence, and so forth. That paper obtained considerable public notice; it was much commented upon in the *Times* and other newspapers; and it had a very serious effect upon my future career as a naval architect. It was for that reason, and in spite of many reasons of a contrary sense, that I could not refuse to respond to the invitation of the Council of the Society, to give a lecture upon this occasion to the institution, with the object of continuing the subject, and reviewing what has happened since that lecture was delivered. I must say that, in looking back to that time, and in briefly surveying what has passed, it does strike one with astonishment to think of what has happened in so short a period. At that time the use of iron of any kind in the building of war ships did not exist. There were no iron ships in the British Navy, except in the case of a few in which iron had been tried and condemned by certain persons. The first sea-going ironclad had not then been begun. The whole career of ironclad ship building has taken place since that time. The turret system has taken its rise, pursued a troubled course, and obtained an astonishing position in that period. The use of guns has extended on a scale to which I shall presently have occasion to advert more particularly; but which will, roughly speaking, be present in the minds of all. Armour has come into vogue in sea-going ships, and has been carried to an extent with which you are all familiar, and the torpedo system of warfare has also been commenced. Besides all those things, and many others—for, indeed, I could fill the whole time allotted to this lecture by a simple enumeration of the changes which have taken place within that time—since that time other circumstances connected with the construction of our war navy have taken place, among which I will simply mention the founding of the Institution of Naval Architects, which has had an important influence on the subject, chiefly due to the efforts and enlightened views of my friend, whom I am glad to see here present, Mr. Scott Russell. The new school of naval architecture has been founded, run a distinguished course, and been merged in a new system. Altogether, changes have taken place in the construction of war vessels, and in the science of the subject, which are simply appalling to a man who has to speak to you for an hour in explanation of them. I will, however, do my best to do all that is possible under the circumstances; and that will consist of touching lightly on the principal features, as I did on the occasion of my previous lecture.

First, with regard to the dimensions of ships. I may say that, during the period under review, certainly very great change has been made with respect to the dimensions of ships. The largest ship in the navy at that time was the *Victoria* line-of-battle ship of 6,950 tons displacement. The introduction of armour had a very serious effect upon the dimensions of vessels. The first sea-going ironclad which was built, the *Black Prince*, twin ship to the *Warrior*, was of 9,100 tons displacement, being between 40 and 50 per cent. larger than the largest ship which had preceded her. She was followed by one of 10,000 tons; so that, almost as soon as iron armour came into vogue, we advanced from 6,950 to 10,000 tons. Since that period we have not made any corresponding advance in the size of ships. It is a vulgar error to suppose that the use of armour has driven us to build continually larger ships. I can show that by mentioning to you that, although the *Minotaur* of 10,000 tons existed when I entered the Admiralty as Chief Constructor, when I left, the largest ship that I had designed there was as nearly as possible the same size in displacement —which is the true measure of dimensions—as the *Minotaur* itself. So that under my management, the ships did not increase in size. Since I left the Admiralty, although the armour has greatly increased in the *Inflexible*, and the guns also, she is only 500 tons larger than the largest ship made from my design, the *Dreadnought*.

With regard to dimensions, matters are somewhat different. Owing in the first place to armour, in a sea-going vessel, being used in this country with great fineness of form and with great steaming qualities, we passed at once from the dimensions of a an ordinary line-of-battle ship to ships 400 feet long. The *Warrior* was 380 feet long, and the *Minotaur* 400 feet long. At that stage I myself exerted some influence on the question, believing that long ships were not advisable for war purposes, and that it was better to get the speed by excessive power rather than by excessive length, and a great change was made in consequence. My first ironclad ship was 300 feet long, instead of 400 feet, was of the same speed and power as the *Minotaur*, and carried armour of substantially and practically the same thickness. As a matter of fact, the *Bellerophon* had thinner armour than the *Minotaur*, but she had thicker backing. Had she been covered with the same kind of armour as the *Minotaur*, she would have been the same kind of ship. The difference was—and this is a point of considerable importance—in putting equal power into a smaller ship. This has been objected to by many persons, and nothing is easier than to represent that by adopting that system, you drive a smaller weight with the same power as the larger weight; but I have never been able to see what considerable advantage it would be to the *Bellerophon* to lengthen her 50 feet at each end, for the purpose of obtaining fineness, knowing that when you had so done you would have no more speed, and less handiness, than you had before you begun. That opens up a question which is continually challenging the soundness of view of naval architects, and it is one upon which there is no kind of agreement. I am of opinion that, as the weight of hull becomes more and more great, so form becomes more and more of less importance, and that you can better afford to drive a thick hull than a long and heavier ship with the same power, although in the latter case you would obtain a more scientific result. With regard to the length of the ship, therefore, we came down from four hundred to three hundred feet, and we have never gone back, except to the extent of 20 feet, in armour-clad ships. The *Hercules* and *Sultan* are 320 feet long, the *Inflexible* is the same, and the longest ironclad ships ever built in Europe since the time of the *Minotaur* are 320 feet long. So that, as regards the length of these vessels, which is a matter of much importance in war vessels, we have not gone on in any degree increasing; practically they are very little longer than the ships of the previous period. If we come to unarmoured ships, we find a little difference, but not much, because the longest unarmoured ship built for the Royal Navy, except the ironclads I have mentioned, is the *Inconstant*, which is only 330 feet long, and 59 feet beam, and 5½ in breadth, which is very moderate compared with many of the mercantile steamers in the world.

We have lately made very considerable progress with respect to this question of form as involved in length, and I am inclined to think that we are coming to a very remarkable change in the form and proportion of the vessels, particularly for war purposes, and ironclad vessels. On a recent occasion, the Government were about to build a certain number of small vessels for a particular service, and a design was prepared on the dimensions of the usual type, which was submitted to experiment by Mr. Froude. The result of the experiment was, that the same speed could be obtained in a vessel of the same displacement, by greatly increasing the breadth with the very same power; that you might, by greatly increasing the breadth, obtain a greater speed with a given power, with the same displacement. The result is, a number of vessels have been built for service in the China rivers, only 110 feet long and 34 feet beam, and they have given unexpected results. All that Mr. Froude said regarding them has been fulfilled, and more than fulfilled. That is the case with vessels of no armour at all, and with nothing like the same reasons for shortening the length. Consequently, I feel much encouraged to believe that we are going forward in the direction to which I have always been inclined, and still obtain advantages from doing it. Now, this question has been carried to a very great length in Russia—as I have had an opportunity of explaining before—where there was a peculiar service to be performed, and draught was a matter of great importance. The vessels were to be employed at the mouths of the Dnieper and Sea of Azof, and the Russian Government sanctioned a proposal by Admiral Popoff, for the construction of vessels which were about as short as any we may ever expect to see, for they were as broad as they were long. It has been ascertained by experiment—what one might have anticipated, and what, perhaps, was anticipated—namely, that you would require a larger power to drive either a section of the vessel, or a displacement of the vessel, than if it had had a more ship-shape form. That is not a conclusive condemnation of the vessels with regard to speed, because, if you do not want displacement, there is no advantage in building for that purpose, and it is conceivable that you might build very prolonged bows and sterns, getting the same speed with the same power, but getting no other advantage. I mention this, because I believe that if this point is not understood grave errors may be made. I shall presently have occasion to show, when dealing with the defensive power of vessels, that we are already commencing on a path which I believe to be a much worse one than making ships short, and I hope the subject will receive candid attention. I do not mean myself to say, and never have so said, that even for the immediate objects of Russia, the circular ironclad might not have been improved by increasing the length; but certainly, if there are any conditions under which that form is justifiable, it is the condition in which light draught of water and great defensive and offensive power are of importance. When you have to build ships which are to defend themselves against the attacks of shot and shell, as shot and shell have never yet found the means, in the form in which they now are used, of penetrating much below the water, you will easily see that, during all the time the bottom of the ship was free from danger, there was a great tendency on the part of builders to go down deep into the water, and to get their buoyancy and size in that part of the vessel which was free from exposure to shot and shell. The consequence is, that all the sea-going ships in the world intended for war purposes have been vessels of great draught of water. To imagine a vessel of light draught with armour, say 6 or 7 feet deep upon her sides, it is easy to see that, by increasing her some 5 or 6 feet you do not add to the armour but to the power of carrying. But the torpedo having now come into use makes me look that circumstance in the face. It is that which prohibits us from henceforth carrying our ships down into the water, because, however much you do that, you do nothing to escape from the attack of the torpedo. That fact imposes upon us the necessity of reconsidering the form of our war ships.

The introduction of rams might be supposed at first sight to have involved the necessity of some such change as the torpedo brings in, but that is not in truth the case, because the limit of the ram's operation is well known. Certainly there have been a few vessels built with very abnormal far-reaching ram bows; but, generally speaking, they are very exceptional, and the existing rams of the navies of the world, as far as sea-going ships are concerned, have been moderate in their projection, and we can always tell within a few feet the limit within which they can do injury.

I may mention, in passing, not as a corroboration, but rather as an illustration of that circumstance, that when the *Vanguard* was rammed by the *Iron Duke*, the inner skin, which it was hoped would not be penetrated by the ram, did escape. The *Vanguard* was not lost because the inner skin was penetrated; she was lost because the two large compartments of the ship—the engine room and boiler room—which should have been cut off from connection with one another the moment the ram went into the ship, was never cut off. Being in one, the amount of water which came in above the inner bottom space found full entrance to the boiler-room as well as to the engine-room, into which it directly entered, the result being that the ship could not do other than founder. As matter of fact, the inner bottom of the *Vanguard* was not injured at all, the ram of the *Iron Duke* not penetrating it. Generally speaking, the injurious effect of the ram is limited, and the limit is known.

But in the case of the torpedo, I very much doubt whether the same can be said. I do not myself see, now that we have once taken to using gun-cotton or dynamite, and other explosives of that kind, against the bottom of ships, how we can guarantee anything within thin sheet-iron. For that reason I think that the new conditions introduced by the torpedo are totally different from, and very much more serious than, those introduced when the ram first came into vogue. Another thing which tended to encourage great draught of water in our ships was the fact that the performance of a single screw propeller, which is necessarily large in order to apply sufficient engine power, was found to be more effective than the same quantity of power which would be exerted upon two or more screws in shallow draught vessels. That, at any rate, has always been the experience I myself have had, and I have never seen anything to the contrary. One fact is often adverted to as being in contradiction of that view, but which is not so. I refer to the exceedingly good performance of the *Devastation*. The answer to that is, although she has twin-screws, she is a deep ship, and both the screws are deeply immersed; and to that fact we must attribute her good performance. Whenever we have twin-screws in light draught ships, the speed has always fallen below that of the one screw with a deep draught. The encouragement to keep up deep draught will always remain, and one of the most serious things which will have to be overcome in bringing about the change of form rendered necessary by the use of torpedoes, will be the undoubted fact that we shall have to encounter, in conjunction with many other disadvantages, the further disadvantage of loss of propulsion with our screws. Some of our ironclads have drawn as much as 27 feet of water, and we are now building ships with great draught, but not so much as that. In my opinion, we have to pass away from that, and to encounter the loss of propulsive effect which we should otherwise receive.

This brings me to mention the means of propulsion which have undergone change in the last 20 years. The use of twin-screws has become general in the Royal Navy, and we have many sea-going vessels and rigged vessels also built with twin-screws. The *Alexandra*, which has recently left our shores for the Mediterranean, to take up the post of flagship, has twin-screws. In Russia, as it would be impracticable to put large screws below the light-draught circular iron-clads, Admiral Popoff has multiplied his screws, and the *Novgorod*, stationed in the Black Sea, is furnished with six screws. As some may be curious to know how they are arranged, I may state that they are placed at the stern, three on each side, and the least deficient of all, contrary to what might be the expectation of many, are the outer screws; in fact, the others do nothing like the service which they do, although the others are situated in a very advantageous position, namely, immediately in the wake of the ship, the side of which is almost vertical. There is a great oblique current of water which interferes with their action. We tried in the *Water Witch* the system of hydraulic propulsion, by the desire of Admiral Elliott; and, like many experiments which are pressed upon public departments, it was found not in all respects satisfactory. It was satisfactory so far that it gave a very fair result, but it was much inferior to the result obtained under somewhat similar conditions with screw propellers, and Mr. Ruthven, who advised Admiral Elliott, raised a question about the indicated horse-power of the vessel, and contended that it was improperly measured. Some side issues of that nature having been raised, and the disadvantages having been experienced, the subject was not pursued. I am inclined to think, looking to the conditions into which we aro gradually coming, and looking to the exposure of all screws hitherto fitted, that in this case again, notwithstanding some loss of propulsive effect, it is quite conceivable that we shall find the means of doing our propelling power within the ships, and within the protection given by armour and other arrangements.

There is one other feature of propulsion which I ought to mention, as it is peculiarly interesting. In the case of sailing ships, that is to say, powerful steam war ships, which are invariably fitted with sails, there is the great difficulty of the embarrassment which the screws produce in handling the ship. Some of the circumstances attending the handling of screws in large ships under canvas are not understood. There are many phenomena connected with the performance of these vessels which we do not understand, and the vessels in consequence incur a deal of odium. Those who are responsible for these ships have borne with much equanimity all that has been said about them, knowing that whenever the sails are required for the purpose for which they were intended, namely, to act as auxiliaries, they will be found efficient for the purpose. The turret ship *Monarch*, which a short time ago was sent from America to fetch the body of Mr. Peabody, is a large ironclad with a great many novelties in engine-power, and as she could hardly depend on her fuel for the passage, canvas was used, and found of immense advantage. In point of fact, however, she did perform the voyage to America and back without the slightest difficulty with regard to fuel. I am not certain whether she took in coal at America, but, if she did, it was a very small quantity, and she could have performed the voyage with the coal she ordinarily carried, not, of course, expending it the whole time, but using the sails as an auxiliary. In the *Favourite*, the screw-propeller became disabled, through the melting of the metal bearings, which became one with the metal of the shaft itself, and the screw could not be turned, and the result was that this vessel, which could not ordinarily be termed a good sailer, hoisted her canvas, and came home like any other ship. I remmber an incident in connection with the *Favourite*, which it may be interesting to mention. She was lying in port, in the West Indies, on one occasion, with a wooden corvette which had a good reputation for sailing, and a new and enterprising captain had been appointed to the *Favourite*. At the dinner-table of the Admiral, the *Favourite* was much decried as to its sailing powers, and the captain took so much notice of this that he got the Admiral's permission to challenge the corvette, in order to show the sailing power of the vessels. He obtained permission, and, curious to relate, although his ship carried armour, and had not sufficient canvas to make up for the difference, she beat the corvette. Therefore, all that is said about the non-efficiency of our sailing vessels must be taken *cum grano salis*, and is subject to a great many contradictions in actual experience. There is no doubt the combination of two systems of propulsion, that of wind and steam, is generally attended by great disadvantages to the former, and it is desirable to improve as much as possible upon it. Some persons think that although the experiments of Mr. Froude have not greatly corroborated the view, it is the fact of the screw being fixed that makes so great a drag upon the sailing power. In the *Alexandra* a device has been adopted for getting rid of this objection. The device, which is a rather bold one, is this:—A pair of small engines have been fitted quite abaft the others; and when the ship is going to perform any serious service with canvas, the screw-propeller is disconnected from the main engines, and the small engines, which require but little steam, and use but a small amount of fuel, are brought into play. Nothing but experiment and trial can show the greater or less value of that arrangement. You will see it is an interesting experiment in propulsion, and may have an important bearing upon the future combination of steam and canvas in our men-of-war.

I am inclined to think myself, that sails are going completely out in ships of the first class for fighting European battles. The *Inflexible* has a small amount of canvas provided, and it was stated recently that that was given by the advice of her designer rather than by that of naval officers, and I have lately seen an announcement in the case of the smaller *Agamemnons*, the *Ajax* and the *Agamemnon*, that canvas is to be altogether abolished. I must say that we have not found any very grave disadvantage of late from the abolition of canvas, because few ships have performed more useful services in the Mediterranean during the time she has been there than the *Devastation*, which has no canvas whatever. She has done several peculiar services. Although heavily armoured, she has been employed, now in carrying mails; now in proceeding from one end of the Mediterranean to the other, to take part in the celebrations, on some festive occasions, in connection with some Royal personage; the other day she went out and picked up a vessel which was in trouble, and it seems that, in spite of having no canvas, she could do anything she was called upon to perform. I remember the late Admiral Superintendent of the Malta Dockyard stating that, when she went into Malta after a long period of service, when most ships required a considerable amount of small refitting, the *Devastation* required absolutely none. I think, then, it is rather an encouragement to see how useful are these great monsters, as they are termed, of ugliness and shapelessness—the sending to sea of which was publicly questioned when they were first produced—because, in the case of the *Devastation*, I remember hearing the First Lord of the Admiralty distinctly state to Parliament that he was reluctant to send her to sea without consorts, and without careful trials; and we all know there was some doubt about sending her to sea at all. It must be gratifying to all of us—however little we may have to do with the navy—to know that such vessels, notwithstanding the doubts with which they entered upon their career, have fully established for themselves a position of equality with other vessels, even for the travelling service of the country.

This question of propulsion ought properly to lead me into another region of change, which has been very marked, and is fully as interesting. I know not how I should be able, with any reasonable regard to proper limits, to dwell upon it, and I am afraid I can only mention some few points. I refer to the propulsive machinery of our men-of-war. Twenty years ago there was no such things, I believe, in the service as arrangements for superheated steam, no surface condensers, and no compound engines. In fact, the man-of-war's engine of the present day differs in all its great characteristics from everything that existed then. The engines then built are not built now. No engine of the kind then in vogue is ever produced for the Royal Navy at present. And it is only fair to remember that circumstances in connection with the greater or less expenditure now arise because all the machinery of the navy is of a more or less modern type, and has been made so from motives of economy. How far an ultimate economy is obtained it would be difficult to say, and how far we shall be compelled in such vessels to return to less delicate machinery, I shall not attempt to speculate. But I am inclined to think that we have been a little too ready, in the Royal Navy, in adopting the contrivances which are found desirable in the mercantile marine. And I think so because the circumstances of ships of war are so very different to those of merchant vessels. In the first place, in every vessel whose sides are meant to resist shot and shell, you have to regard the probability of injury by shot or shell, and that has driven engineers in the navy to the adoption of low-lying engines, considerably below the surface of the water; whereas, in the mercantile marine, some of the most efficient and economical engines—indeed, all of them, one may say—are vertical engines, with cylinders raised high up, because the exposure to shot and shell is not feared in their case. The same with regard to compound engines, which I may explain to those not familiar with this subject, are of this kind. They are engines into which you let steam of a higher pressure than in the old type of engine, and, having allowed it to expand to a certain extent in one cylinder, you let it into another to expand still further, taking power out of it in both cases. That involves, evidently, a great multiplication of parts, and perhaps the best reason for its adoption was, that if you use steam of double pressure—for whereas it used to be about 20 lbs. to the square inch, it is now from 60 to 70 lbs.—and let it at once into so large a cylinder as formerly, you must add enormously to the strength, and therefore to the weights of those moving parts which receive the shock of the steam when admitted. To avoid that, the high pressure steam is admitted into a small cylinder, whose parts are submitted to much less shock than, if it were admitted on to a larger surface, and then, when it has become moderated in pressure, it is passed into a larger cylinder to complete its duty. That system has been carried to a considerable extent in the naval service, and in the mercantile service too. In the French navy it has been adopted generally in the form of three cylinders of the same size, into the centre of one of which you admit the high-pressure steam, and let it pass from that into the side cylinders for further expansion. Now, in a ship recently built for the Italian navy, with engines by Messrs. Penn, a similar system has been adopted, but with this difference, that all the three cylinders and all their working parts have been made of equal strength for this purpose. Thus while ordinarily she works the engines as compound engines, admitting them at high pressure into the one cylinder, and passing it afterwards into the two others, in the event of the ship being placed in circumstances where a very high speed is desirable, you are able to admit the high-pressure steam from the boilers directly into all three at once, and to add largely to the speed of your vessel, of course also adding largely to the consumption of your fuel, because you will be throwing away steam after it has expanded to the extent which alone is possible in one cylinder; whereas in ordinary working, after having undergone that expansion, you pass it into the others, to undergo a much further expansion. That is a most interesting question, and I should be sorry to pronounce any definite opinion upon it, but I am told that it gives considerable satisfaction. Its disadvantages are obvious—that, ordinarily speaking, the two cylinders into which the steam goes with reduced pressure, have to be formed with working parts which are heavy enough to stand the action of the high-pressure steam, and, therefore, you have the disadvantage of driving unnecessarily heavy pistons, piston-rods, and so forth; and you have also to waste the steam seriously when you are pressing hard. How far those disadvantages may be compensated for by the great simplicity and by the great power you have of getting a very high speed for a short period, I will not presume to say. I mention it as an interesting experiment in the steam machinery of war-ships.

The engines of a man-of-war have undergone a great many minor changes which are of more or less interest. For instance, twenty years ago, the steam-engine did nothing but propel the ship. Every part of the steam-engine itself was worked by steam, of course, with the exception of such things as starting and reversing the engines, and so forth. But now, all that is done by steam. A little separate distinct engine is now fitted to start the main engine, stop it, and reverse it; and all through the ship the steam is carried for a variety of minor uses. It hardly comes within the question of propulsion to mention them, but perhaps I may, as part of the changes which ships have undergone, mention that the ship is now steered by steam, the anchor is weighed by steam, instead of by a number of men running round to the sound of a fiddle, as in the old days in a man-of-war, which was one of the most picturesque and pleasing sights connected with a vessel. Then, again, all the pumps, which twenty years ago were worked by hand, are now worked by steam, and in the modern engines, with surface condensers, a centrifugal is employed to force water through the condensers, and is also frequently adapted for pumping out the ship if necessary. Then, in the turret ships, steam is used for the purpose of working them; it is used for hoisting the shot and shell up to the guns, and in some cases for the purpose of ramming them home into the guns; it is used for working ventilating fans for supplying air to the boilers, and for other purposes, and it is also used with a separate engine for raising the ashes from the ash-pit after the coal has been burned. In all these ways, steam has penetrated the ship, and with these modified changes in steam propulsion have come all these additional applications of steam-power.

I have mentioned the working of turrets, and I ought perhaps to have said in passing, that even though at the commencement we worked them by hand, and, of course, even now auxiliary means of working them by hand are provided in the event of accident, anyone who has been in a modern turret, and seen what sort of guns are used there, and what work has to be done, will understand that we were not long in being driven to the application of steam to them.

Now, coming to the attacking powers of ships, not merely 20, but 12 or 13 years ago. A $4\frac{3}{4}$-ton gun, or a 95 cwt., 63-pounder as it was called, was the largest gun in use in the navy. I remember that it was not without some satisfaction to myself that the little *Research*, an ironclad which I had the honour of converting, some 12 or 13 years ago, went into the Mediterranean, and was the first vessel which carried a $6\frac{1}{2}$-ton gun. That was only in 1864 or 1865. We had been from the date of the invention of gunpowder up to this time in getting our guns up to $4\frac{3}{4}$ tons weight; but, since that time, I myself have had to design successively for 12 ton guns, 18-ton, 25-ton, and 30-ton, during the seven years I was at the Admiralty; and, in the seven years, or nearly so, which have elapsed since, the 81-ton gun has been introduced into our navy, or, at least, it will be introduced very shortly; and in the Italian navy guns of 100 tons have been adopted, and are in Italy, ready for the ships, when they are ready for the guns. Therefore, you will see that in the matter of guns we have undergone, in comparatively few years, changes which many ages could produce nothing to equal. At the same time, the attacking power of the ram has been introduced, and many persons may feel justly a little surprised that a question of such importance as the use of the ram, as a means of attack, should have received so comparatively little notice. But there is one point about the ram, and it applies also to the torpedo, which has tended very much to limit the interest that is felt in them. Many persons consider these things from the point of view of naval actions only. Now, certainly, this country has not been wanting in the matter of naval actions. It has won its greatest renown in this way, and Nelson and other great heroes have achieved their distinction in this way; but, in ordinary times, and over long periods, the British Navy has duties to perform, or somebody supposes that it has, which involve no naval fighting whatever, but which involve a great deal of attacking other people's coasts, and, still more, the threatening or menacing of them. Those who know at all intimately the history of this country's relations with other countries, and especially those in the Eastern seas, must be aware that we have not unfrequently found, or had occasion to attack and threaten shores, and indeed it often happens that in Europe we have to do the same thing. Now you will see in a moment that neither a ram nor a torpedo is of the slightest use whatever for this purpose. I should think that a Chinaman would at any period, before he took to studying these matters, and building vessels with large guns and armour plates, have laughed at the idea of our going to attack a Chinese town with a ram or a torpedo; and I believe myself it is because every one has instinctively recognised the fact that the ram has a limited application only, and can merely be used against ships, that it has been taken so little notice of. It has not been without much agitation that has been allowed to take its place in an easy and natural manner in the Royal service. Many have contended that we ought to build ships of considerable size which have no guns, and one of the proposals of the Admiralty of the present year is to build a ship which is to have no guns, but to act as a ram only, and she is to be of 2,000 tons. I wish to say nothing against the vessel, because she is recommended by a gentleman of distinction, and, notwithstanding his great age, of very clear views, the first Admiral in the Royal Navy at the present time, Sir George Sartorius, and I should be sorry to set my judgment against his, even if it were much more adverse to his than it is. But I think you will agree with me that, inasmuch as we are bound in this country to keep a very strict regard to the diversified uses for which our navy is required, we clearly cannot launch out largely into the production of vessels which could do nothing in the way of supporting our fleet in menacing the coasts or fortifications of other countries.

The torpedo, to which I have more than once alluded, presents some entirely new considerations to us. It attacks, as we have seen, the whole bottom of the vessel, and there can be no doubt in my mind that it will impose upon us great changes. I shall have occasion to advert to it again, and I mention it here, because it comes into operation, in so far as the building of ships is concerned, in combination with the ram, as one of those instruments which cannot be used against an enemy on his own shores.

Therefore I think that guns must have a primary place in the British navy, and I can assure this audience that, in bringing large guns into play in ships, we have had to encounter many difficulties, and very many prejudices. Some of the difficulties were of this kind. We did not know, and nobody could very well find out, how far it would do to begin with, to use a gun in any other direction than firing it directly out from the side of a ship, of course with a moderate amount of trailing or divergence from the true broadside direction. I remember in one ship, when a $12\frac{1}{2}$-ton gun was fired straight out, it shifted the portable cabin furniture at the stern of the ship in the Admiral's department, and burst open the doors, tearing off the locks. You can easily see how, with facts like that coming to our knowledge, we were obliged to bring the gun along in the direction of the ship's side very gradually and carefully. That has been done, and greater range has been continually given to the gun, until now it is made to range even in the broadside, from the true broadside fire right along the side of the ship.

The bulwarks have to be made somewhat high, close to the line of fire, and very strong; but we have now many ships in the navy in which the gun ranges directly along the side of the ship for true fore and aft fire. Now, anyone who has studied the history of naval architecture in past generations, and traced the great part which bow guns played, and the modifications in the form of ships which were made for the purpose of enabling you to get a bow-fire, must look with interest on the modern ironclad with a gun firing along 100 ft. of its own side, with the tremendous charges of powder which are now employed. On Saturday last, we saw a little vessel launched for the Japanese Government, one of several which are being made, in which four guns, placed at the four corners of a battery, cover the whole horizon with their fire.

That brings me to the turret system. You are all aware that great agitation and excitement occurred about this system, and I think I may safely say that the chief ground of difficulty which was experienced by those who were supposed to have been unduly adverse to its introduction, was the difficulty of doing what certainly was apparently a matter of great difficulty; because I can imagine no place more unpropitious for placing a gun in a turret than the upper deck of a British man-of-war as she was twenty years ago. You were in the centre of a mass of ropes and fittings, and it seemed perfectly impossible, and was impossible, to place guns there in turrets. It was for that reason that the turret system had to go through a course of gradual development; some of the arguments by which it was sustained were fallacious, and others came into great importance, and proved to be perfectly true, and more significant than was supposed. Some were invalid, as an example of which I may mention the idea which was perpetually propounded by those who advocated the turret system, that you could not fire a large gun on the broadside of a ship. I very well remember official persons, and even those who gave their consent to build the *Bellerophon* to carry 12½-ton guns, smiling at the absurdity of attempting anything so foolish. It did seem a foolish proposal, because in those days guns were worked in ships by a mechanical contrivance which was invented by the first savage who tried to move anything; you put a handspike under the thing you wished to move, and simply prized it along—the old handspike system of training guns, which had been in vogue from the commencement of the use of guns—was the one employed. But what those who advocated the use of larger guns saw was, that by putting them under the control of machinery you could command them, and that has proved perfectly true; and it has been so successfully done that it would have stopped the use of the turret system but for one circumstance, and that was this, that the gun at the broadside requires a much larger port than in a turret; and one of the great improvements which has been made in connection with the turret system has been, that it has enabled you to bring the ports down to a very small size indeed, so that, practically, the people within the turret are not exposed nearly so much as they are at broadside ports; broadside ports also are made to secure a great range of fire. It is from that circumstance that the turret system has come into vogue, because you can see that if we are to carry what we do in the *Hercules* and *Sultan*, 18-ton guns, and if it can be truthfully said of them, as it was said, that the guns were fought and worked more easily than any broadside guns in a small ship that had ever sailed, how the size of the ports came in. I am not certain that turrets will always remain. I think it is quite likely, particularly when we look at what is done now with the carriages on which guns are mounted on the so-called "disappearing" principal, that the gun itself will be made subject to more motion, and the port at which it is placed will be made small; and that we shall be able to multiply the number of guns far beyond what can be done in turrets. In other words, that by adopting "muzzle pivotting" and mechanical carriages, we shall be able to increase the number of our guns.

Now, I must say that in all this we have done a great deal that is experimental, and a great deal upon which much light may be thrown when war ensues; because, after all, there can be no doubt that much of the machinery which is applied to our ships in every part is of a delicate nature, and the rough usage of war may disclose many weaknesses of which at present we know nothing. And when we know, as is the case, that in the mere propelling machinery such difficulties are found as drive some men out of their minds, we may expect that when all these various fittings come to be tried in actual war, great difficulties will be experienced, and many surprises may await us.

With the guns the armour has gone on increasing. I shall say very little about it, beyond the fact that it has gone from 4½ in. in thickness when we began, to 24 in. in our own navy, and to 30 in. in the Italian navy. We hear of the Italian Government now building ships which are to have armour 3 ft. thick, and there is no reason that I am aware of why they should not, or a great deal thicker still. But I would mention—as the use of armour is so obvious—one or two arrangements which have been introduced into some of our ships which are novel, the value of which I should hesitate to speak confidently about. I mean that, in certain of our vessels, there are iron hatchways, a sort of double chambers formed of thin iron; and it is supposed that if, in the event of a shot or shell penetrating, the water should find its way into this, instead of going through into the ship in large volumes, it will be trapped as it were between two walls. No doubt there are circumstances in which that arrangement might prove very useful, but as to its general value I have formed no opinion. There is another arrangement, of perhaps still more importance. In the *Inflexible* the armour is supplemented by something which is intended to be equivalent to armour. It consists of chambers filled with cork. The sides of the vessel between wind and water are formed practically of cork cells, and no doubt, such of these cork cells as remain intact with the cork in them during action, will contribute to the buoyancy and stability of the ship. But it is a subject of such serious moment that I should not feel disposed to enlarge upon it under present circumstances. It clearly, as taking the place of armour, must be subject to very serious consideration, and what its value is likely to be must be ascertained. I may say, in passing, that much encouragement to this arrangement was given by a committee of designers which sat some time ago, of which my eminent friend, Dr. Woolley, was a member, and he would be better able than I am to tell you what opinions were then held. Suffice it to say, that this system has been used in substitution for armour, that the vitality of our ships has in some degree been hung upon it, and it will evidently require grave investigation.

I have trespassed so long on your time, that I hardly dare say a word, as I had intended, upon the materials of which ships are built, and the changes they have undergone. I have already mentioned that iron was not in use for ships of war twenty years ago; in fact, long after that no means existed in our royal dockyards for building ships of iron. Those who visit the dockyards now will see one of the greatest transformations which has taken place; for now no ship is built of wood. I am glad to say, and I think it redounds a great deal to the credit of Mr. Barnaby, the present Chief Constructor of the Navy, that he has succeeded in driving wooden ships out of the navy altogether, for this simple reason, that wooden steam-ships decay so rapidly as to impose a frightful waste and loss on the nation. I hope, myself, they will never come back again; but many people believe they will come back, and will supersede iron ships, whether with or without armour.

There are many who believe, not unnaturally, perhaps, looking at the course which events take, that all this competition of armour and guns, and of iron-cells and cork-chambers, must come to an end, and that we must revert then to the old days, when ships were built of wood and armed with pop-guns.

There are many interesting things to be said in connection with the materials. For instance, some of our ships have been built with wooden bottoms and iron tops, and many French ships have been built in that way, the bottom wholly of wood, and the upper portion wholly of iron; others with iron frames and wooden planking. I attended the launch of a vessel of that kind yesterday, for the Japanese Government, with this further feature, that between the iron and the wooden planks is introduced a thickness of armour to give further strength. Some of these ships built on iron frames are without iron skins when planked with wood, and some with iron skins. The *Inconstant* and the *Volage* are vessels of that kind, and with iron skins on their frames. Then comes in the great difficulty how to sheathe these ships. If you put copper on the bottom, unless you are very careful, the copper goes to work and attacks the iron which you put it there to protect. Here, again, great credit is due to the present constructors of the Admiralty, for they have found out—I do not know how they found it out, but they tried it on a large scale—that zinc is an admirable sheathing for iron ships. The ships keep very clean, the iron is not subject to any risk of injury, and it has this further advantage, that you want no refined workmanship, as you do in the case of copper sheathing, because the more readily the water finds its way from the zinc to the iron, the more efficient the whole arrangement is. I may mention, from my own experience, as a corroboration of the value of this arrangement, that I built two vessels for the Chilian Government, one of which was covered in zinc in this manner, and the other not. The one which was thus covered kept so clean in the water of Valparaiso that the other ship is on the point of arriving in England to be treated in the same manner.

It will be expected that, before concluding this lecture, I shall say something of that future aspect of the subject which, after all, will ever surpass in interest the mere historical records of its progress.

> "Man's heart is ever to the future set
> By secret and inviolable springs."

And certainly the future of this question is one of the gravest interest, especially to this country. I cannot help myself feeling that we have already in some respects shown signs of weakness and want of clear purpose in resisting even the attack of the gun, and that some of the most costly of the modern armour-clads of Europe, which are put forward as being invulnerable to all guns, are in reality destructible by guns which are afloat in every navy of the world. In other words, we have, I fear, shrunk from facing full-front some of the essential elements of the problem, which have from year to year to be solved anew. But however this may be, it is undoubtedly true that hitherto, beyond a moderate increase of subdivision in the lower parts of a ship, no great effort has yet been made in any navy, so far as we know, to solve the problem of resisting torpedoes. But this great problem has to be faced and solved, and it has to receive, in my belief, a solution totally different from any which has yet been publicly attempted. Neither the suspension of chain nets, nor additional bulkhead division in ordinary forms of ships, will be a sufficient—nor anything like a sufficient—defence against this deadly submarine instrument of attack. No doubt it is an instrument to the use of which many chances of warfare at sea are adverse, and it is one which is utterly unavailable as a means of attacking the shore. But, on the other hand, as a means of attacking ships, it is of a most formidable character. The naval Whitehead torpedo delivers a most terrible blow; it moves for the space of some hundreds of yards with a speed double that of the fastest ironclads; its path is so sure and true that at that distance a second torpedo can be made to pass through the hole which a first has made; and, whereas it has been assumed that in ordinary conditions of weather and naval warfare, under steam, a ship could not have more than a few feet of her depth below water attacked, the torpedo has the whole immersed bottom of the ship exposed to its assaults. In the *Sultan*, for example, while the side to a depth of six feet below water, presents to shot and shell an area of less than 2,000 square feet, the surface presented to torpedo attack is about 8,000 square feet. In view of these facts, I have been deeply studying the effects of the torpedo upon the forms of ships, and I have already come to the conclusion that while in existing ships, and especially in existing large ships, which are more or less unwieldly, chain-net protections, and internal subdivisions, and modifications of stowage must be resorted to as far as possible, and while also in action such ships must be kept under steam and under the helm to the utmost practicable extent, as regards the future no more such ships must be built. Small ironclads of great breadth and short length can be made so handy as to find in their own agility—associated with great modifications of form which are necessary even for them—sufficient security against torpedo attack. But in the case of line-of-battle ships, a total change of form is necessary to meet the torpedo; and the days are already numbered of war-ships more or less long and narrow, and with deep bottoms of thin iron containing the steam boilers and powder magazines. How that change is to be brought about in this country, under our system of administration, I do not know. But this I know, that it must be accomplished somehow, and that the proposal of the Government to lay down a ship of the *Agamemnon* class at Chatham must be reconsidered. The design of the *Agamemnon* was made two or three years ago, before the tremendous capabilities of the torpedo had been developed, and to repeat her now would, in my opinion, be to confess our inability to surmount the new difficulties of war-ship design. I should like to speak of many other changes which must take place in the ships of war of the future. Some of them may be foreseen distinctly enough, and only want of time forbids me from forecasting a few of them for your information. But the torpedo question, which has already absorbed so much of our time, has yet another aspect which is of such immense importance to us as a nation, that I cannot pass it over. I am quite aware that the public must be tired of this war-ship question, and of its continual change and progress, and, to tell the truth, I expect to see it fall more or less out of the public mind and of the public interest, from the sheer fatigue of pursuing its troublesome transformations. I am myself not a little tired of it, and yet I must endeavour to do my duty in it still. The serious fact in this torpedo matter is the cheapness and facility with which the new weapon can be turned against us. In former days, during all the ages from the invention of gunpowder down to to-day, increased offensive naval power has only been obtainable by increased size of gun, which has carried with it a thousand other increases of cost and of difficulty. Even of late, when the gun has grown to such gigantic proportions, although we at first sight shrink from its consequences, we soon steady ourselves with the recollection that such guns cost enormous sums of money themselves, that they can only be worked by means of steam and hydraulic appliances more costly still, that they can only be carried with speed at sea in steam-ships of a yet far more costly character, that when the whole mighty engine—ship, gun, and all other appliances—is at length produced, they can only be made available by exercised practice, for the acquirement of skill by means of still further outlays for fuel, for powder, and for shot and shell, and in short, that the bringing of guns against our big guns at sea, in suitable ships, is a game of lavish expenditure and extravagance which but very few indeed of the Powers even of Europe can afford to engage in upon a scale commensurate with our own. But the torpedo is a weapon of offence differing altogether from a gun in all these respects, for although each torpedo itself costs from four to five hundred pounds, it can be discharged from almost any ship or boat whatever, and the fittings for discharging it are of an inexpensive nature. Here, then, we have every Power furnished with means of attacking our large war-ships so cheap and so simple, that few Powers are too petty or too impecunious to provide them on an emergency; while the larger Powers could, with the financial means at their disposal, completely compass and surround our few largest and finest ships with these agents of destruction. In my opinion, this state of things imposes altogether new and solemn obligations upon our naval administrators, and the objects to which it points are clearly two-fold:—First, the construction of our large ships on principles which make them as little destructible by torpedoes as by guns, which I believe to be quite possible; and secondly, the building of all our other war-ships of small and handy types, and with the necessary improvements. With these objects neglected, we shall be placed in a position of serious disadvantage and danger; with these wisely and scientifically attended to, Britannia may in the coming days, as in the past, continue to rule the waves.

MISCELLANEOUS.

TECHNICAL EDUCATION.

The following letter, on the subject of the proposed City Technical University, has been addressed to Sir Sidney Waterlow, by Major Donnelly, R.E.:—

London, 14th March, 1877.

Dear Sir Sidney Waterlow,—In reply to your request, I am happy to place at your service such suggestions, with regard to the proposed "City Guilds Industrial University," as my experience in connection with the Science and Art Department enables me to offer. And I shall be glad at any time to give every assistance in my power to the promoters of an undertaking which I feel confident will, if supported by the City Guilds generally, be of great advantage, not only to the City of London, but to the whole country.

Perhaps I should commence by criticising the title of the proposed university. This kind of encouragement, however, you will obtain from many; and I do not know that I can suggest a better name. For the omission of the word "Industrial" would leave the object of the university obscure, and make it difficult to maintain the special character which it is wished to give it. The idea, or distinctive feature of the university I take to be this—that it shall be a seat of learning, to afford to those engaged in trade or in manufactures that which the old universities of this country—founded and developed under a different set of conditions—were intended to provide for the learned professions.

Under anything like a broad view of the subject it would be difficult to say what branch of learning should be omitted in an Industrial University. But if we confine ourselves to what is practicable with the probable means immediately at command, and if we look to commence by supplying that of which there is the greatest want, we shall, I think, have no hesitation—considering the relative facilities for obtaining instruction in the different branches of knowledge—in deciding that science, as now understood, and particularly applied science, has the first call on our attention.

If this position be correct—and I would carefully guard against its being considered that it was not of the utmost importance that provision should ultimately be made for the teaching of modern languages, history, geography, political economy, and commercial law—the Industrial University might be commenced by establishing professorships with the necessary laboratories, tutorial staff, &c., in the following branches of science and art:—

Mathematics (pure and applied and practical geometry).
Chemistry.
Physics (heat, light, magnetism, and electricity).
Mechanics (practical mechanics, machinery, and machine drawing).
Engineering and building construction; and in applied art (modelling, designing, enamelling, repoussé work, wood carving, &c).

As the teaching would be specially directed to the industrial applications of science, it is needless to say that considerable subdivision would be required in the subjects named. How this should be done, how many teachers would be required, and with what appliances, it would be useless to consider until the means at your command are known with some definiteness.

This subdivision should, however, be always borne in mind. It is of great importance that the professors should be not only teachers, but investigators, constantly endeavouring to enlarge the field of accurate knowledge and scientific procedure in our industries. To appreciate how much may be effected in this way we have only to consider the millions saved to France by Pasteur's researches on the disease of the silkworm, or the knowledge obtained by his inquiry on fermentation.

The benefit that the country may derive from such investigators is likely to be quite as large as from mere teaching. But this necessitates a considerable division of the scientific staff; though the time of the professors may be much economised by making it no part of their duty to commence their courses with the elements of general science. It is quite unnecessary that they should do so. This teaching may be obtained at other places, with which the Industrial University would be only needlessly interfering if it gave elementary instruction. It should, on the contrary, be its object to supplement and specialise the knowledge obtainable in ordinary science classes, from which the students should be drawn; and they should be expected to have acquired sufficient general knowledge of science before entering the classes and laboratories of the university to be able to follow its courses with advantage.

A leading feature of the university should be evening courses—not merely popular lectures—for the use of those whose circumstances in life have rendered it necessary that they should commence the practical work of life early. By circumstances in life I do not refer solely to poverty. There are many occupations that it is advisable, if not necessary, to enter upon early. For instance, it is of the utmost importance for a mechanical engineer to be a good practical workman. To do this he must join the workshop when young. And the lad who enters when he is thirteen has an advantage which might not be expected. Mr. Phythian, the master of the Oldham School of Science and Art, established by the Messrs. Platt, informs me that to the lads who come into the workshop at this age, the evening intellectual work is no effort, it is a relaxation and recreation. To the apprentices who enter at eighteen it is almost an impossibility. They are so exhausted by their day's labour that they cannot pay attention.

It is agreed on all hands that if the teaching of science is to be of any use, it must be essentially practical —that is to say, the teaching of the laboratory. And no pains should be spared to make the laboratories perfect and readily available. By them the university may supply a great want.

It is, perhaps, necessary to guard against the idea that the university is to teach any trade or business. There could be no greater mistake than for it to attempt to do so. The purely technical knowledge of a trade must be learnt by practising it. The teaching of a public institution can with advantage only extend as far as the special application of various branches of abstract science to the different arts. It is no doubt difficult to define how far the teaching of applied science may go without trenching on the workshop. But in practice the limits are readily found. This difficulty will be still less felt in an institution drawing its pupils from among those actually engaged in trade, who will know what they can acquire in the university, and what they can better learn directly in business. The programme of examinations in technology by the Society of Arts will give many suggestions on this subject.

I have no doubt that the Society of Arts would be willing to transfer the whole or a part of their system of examinations in technology to such a body as the City Guilds, who, with far larger funds at their disposal, may give it a development which the Society of Arts can never obtain for it. By employing local agencies, and taking advantage of the machinery of the Science and Art Department, these examinations are held throughout the country. And by availing itself of this and similar organisations the central university might be brought *en rapport* with every part of England, Scotland, and Ireland.

And here let me briefly recall some observations I addressed to you in 1873, when, during your mayoralty, you did me the honour to ask my opinion on this subject of aiding technical instruction.

I there pointed out that, through the action of the Government stimulating local effort, the country was being rapidly covered by a network of science and art schools and classes, where the working classes—whose interests and advancement the City Guilds are, I understand, especially anxious to promote by the industrial university—had opportunities of obtaining that elementary instruction in science and in art which must be the basis of any sound technical education. There are now 1,750 separate schools or classes in the country in connection with and receiving aid through the Science and Art Department.

It is, therefore, unnecessary to consider the question of the creation of any organisation for giving instruction in elementary general science or art. What are wanted are a stimulus to increase the number of students, the development of systematic courses of instruction onwards and upwards from the elementary school, and means to enable poor, but clever and industrious, youths to pursue such courses. The award of small scholarships or bursaries in competition, which would support the holders while carrying forward their studies in a higher school —the retention of the bursary being contingent on a definite course of instruction being pursued satisfactorily —is therefore, I believe, the most effective means the Guilds can adopt to aid technical instruction.

Much good may no doubt be done, as I see has been suggested, by direct aid or payments towards instruction in local schools. But this aid might well be confined to classes for technology or applied science, which receives no Government grants, and should be principally payments on results supplementing local action.

I cannot, however, help thinking that in no way can the City Guilds employ such funds as they may have, after providing for the immediate wants of the university, with greater advantage than by offering bursaries of, say, £50 a year, with gratuitous instruction at the university, to be competed for by students in all parts of the country. Or they might contribute a moiety of such bursaries, the other half being furnished by the localities. The royal exhibitions and local exhibitions to the Royal School of Mines in London, and the Royal College of Science in Dublin, of this nature and amount, have already done great service. If your funds enabled you to extend your assistance still lower, by supplementing local contributions in founding small scholarships of

£10 or £15 a year, to be held in local schools, as is done in the elementary school, and science and art scholarships by the Science and Art Department, the Industrial University would spread its roots still more widely.

By a system of maintenance, allowances, and free instruction, awarded, of course, solely on merits, the university would draw up to it the very cream of the students in local schools, and it is difficult to over-estimate the stimulus that might thus be given to scientific industrial training throughout the country. A hostel in connection with the university in which to lodge such students would probably be very useful. In that case the amount of the bursary might be much decreased.

I have dwelt at considerable length on the bursaries and scholarships, or maintenance allowances, because these must be looked to as one of the principal feeders of the university. It is very necessary to bear clearly in mind in what directions the university must look for its pupils. Broadly speaking, these will, I believe, be:—

1. The holders of bursaries and scholarships.
2. Young men whose means enable them to carry on their education beyond the school age, and who can attend an institution in London more conveniently than elsewhere.
3. A limited number of students of the same class, who are attracted by the goodness of the instruction and its appropriateness to their future prospects. I say a limited number, because, however good the instruction, it will take years to divert the class of students from the channels which time has consecrated.
4. Evening students—men who are engaged during the day.

It would be useless to expect many students from classes 2 and 3 at first.

Degrees and examinations are so inseparably connected with the idea of a university, that many will be the schemes for both forced on the consideration of the promoters of this undertaking. Some examinations the university must no doubt hold, as, for instance, those in technology, above referred to, and for the scholarships. But let not the examinations and diplomas be a first consideration. There are plenty of examinations. It is not another examining body that is wanted, but a place where students can learn and work. Let the university commence by enabling them to do this. Let it grow as the old universities grew, and were resorted to, because they were places where knowledge was to be gained not obtainable elsewhere. Diplomas, if they are worth anything, will come in time. But if really able and distinguished men are employed as the professors, the certificates given by them to the students who have worked in their laboratories will probably carry as much weight as any mere examination diploma,

The real point seems to me to make a beginning. Get a good site—by a good site I mean a site in an accessible position, sufficiently large to allow of expansion as the university grows—build chemical and physical laboratories, and lecture-rooms, and some mathematical class-rooms, on a portion of the site. If these are well managed, and are in a prominent position, such as that suggested on the Embankment, where they cannot but be seen—it is difficult to make anything known in London—surely there must be many rich men in the City besides the City Companies, who will seize the opportunity, by adding to the endowment or the buildings, of perpetuating their memories as munificent patrons of what will eventually be a credit to the country.

I have felt that it would be useless to enter into details until it is known what funds are available. What I have suggested would cost comparatively little. But I am convinced that it would be far better to commence by doing two or three things well—by building two good laboratories, if you have not the funds for more, say a chemical laboratory where applied chemistry in all its branches may be thoroughly followed out, and a laboratory with workshop for applied physics and mechanics, and to trust to future development in other directions—than to fritter away your means in an attempt to teach a little of everything by way of providing a complete curriculum.

But, as I said before, make a beginning. If you ask a hundred of the ablest men in the kingdom to give you schemes for aiding technical instruction, you will obtain a hundred different ones—all doubtless very good, but all proceeding on different lines. You must then refer them to some committee, the result being a colourless, objectless proposal, with all the good points of the hundred carefully eliminated. And you will certainly lose much valuable time.

The City Guilds should themselves first decide broadly what they intend to do, what portion of the scheme they desire to commence upon, and what money they will devote to it. They should then ask a committee of experts to advise them how to proceed, and how much they may take in hand advantageously with those means.

You must also bear in mind that though much of the advice you will get will be honestly given, it is only natural to expect that any new educational institution may excite the jealousy of existing bodies, however groundless may be the fear that it will compete with them. It always seems to be forgotten that the population of London is as large as that of Scotland; and that if its provision for instruction were tenfold what it is, it would not be proportionately larger than that of the Canton of Zurich.

Any plan you commence upon must be much modified as the institution is expanded and developed. To succeed, the university must be built up by slow degrees, and adapted, with the experience you gain from day to day, to meet the wants and circumstances of the time. That it will be a success, and a great success, if taken heartily in hand by the City of London, there can be no doubt.

Believe me,
Yours very faithfully,
J. F. D. Donnelly.

CORRESPONDENCE.

THE PATENT-OFFICE EXAMINERS.

Your correspondent O. P. Q.'s calculations are excellent, as far as they illustrate the inadequacy of a staff of six examiners to undertake so overwhelming an amount of work. But in his remarks on the series of "classified abridgments" (the only possible key for solving the question of how to conduct the proposed examination) he draws no distinction between the earlier series published from ten to twenty years ago and those now in course of issue. They were first commenced undoubtedly without regard to uniformity, and the original conception of their author was of the vaguest description, some being provided with, and some without, inferior subject-matter indexes. On inquiry, I think O. P. Q. will admit that the works in question, more recently published, are not undeserving of great praise for improvement and rectification of former shortcomings. Would it surprise O. P. Q. to learn that the American examiners use these works, and set a high value upon them? Allow me to introduce another relevant question. Mr. Lloyd Wise's observations, at the Society's meeting of the 6th ult., on a restricted or modified form of examination, which he termed "a medium course," and which he claimed would be neither harassing nor obstructive, were, in my opinion, the most admirable and clear that have been made on this very involved subject. Nevertheless, in speaking of the magnitude of the examiners' work, as defined in the Bill (section 9) now before Parliament, directing the examiners to decide "whether the invention is a proper subject for a patent within the Statute of Monoplies," he said that under this phrase lurked every possible legal issue, and then he inquired whether such examiners should not be as omniscient in law as in science and art. Now, the embarrassment of the proposal for an examination with a momentous legal difficulty is entirely a misconception, by which the Lord Chancellor himself appears to be deceived, since he proposes to appoint examiners qualified with "legal [?] or scientific knowledge." This strange misconception must be due to a want of consideration as to the meaning of the phrase in the Bill above quoted. In reality, though sounding legally formidable it means simply that the examiners shall decide "whether the invention is a new manufacture within this realm." This will be best understood by explaining what applications for patents are refused under this rule. The cases are few, simple, and easily to be understood by the non-legal mind. Applications for patents cannot be entertained for, first, art and fancy designs; secondly, for shapes of utility not combined with mechanical action. Protection for such "inventions" is obtained by process of "registration." Thirdly, for words, titles, trade names, or trade-marks, to which protection is given by copyright, as in the case of trade-marks by special registration. Application for patents have been refused to "an invention for preventing panics in the City." This decision of the law officers would be based, I presume, on the supposition that "it was not a proper subject for a patent within the Statute of Monopolies." Applications are likewise refused, in the present state of the law, for other reasons than the above, viz., when adjudged to be frivolous or nefarious in object. As instances of the first I would name certain perpetual motion schemes, and similar notions to that of a certain individual with a name suggestive of eastern nationality, who proposed to make a ship's screw propeller work without a steam-engine; sails were to start the vessel, which, when moving, would rotate the propeller, which in its turn was to propel the vessel. What legal knowledge would the above cases necessitate? Z.

COMPENSATION FOR INJURIES TO EMPLOYÉS IN FACTORIES.

Although I am unused to speaking in public, I should have done so last evening at the meeting if there had been time, and certainly employers could have been absent or silent on no more important occasion. The paper read gave 107,588 persons killed or injured in the United Kingdom, and left the audience to infer that the whole of these mishaps were occasioned by the employer. Now, would it have not been fair to divide this list into three parts:—Accidents caused by the laxity of employers; accidents caused by the laxity of employés; accidents, cause unknown. The evident feeling of the meeting, or, at any rate, of the speakers (one excepted), was in favour of the employers paying compensation, and one speaker even went so far as to say that an employer should be always on the spot, and never take a holiday. Of course it follows that the employer should be present night and day, and in every part of the factory, or else it follows that the factory is to be of the size of a small room, that can be superintended in every part by one man, to the exclusion of our Brasseys and others. This is the *reductio ad absurdum* of such an argument. The same gentleman said that miners were uneducated, that they could not be expected to do better than they did do, and his argument followed that employers should pay for the want of that education, which I should think was a national sin, and not the fault of the employer.

I could refute, one after the other, many statements made there, especially as to the cause of boiler explosions. Many boilers are allowed, by careless or stingy employers, to become in bad order, and they should suffer for it; but, as an employer, I must protest against the idea that all explosions occur in that manner. The carelessness of men is enormous; they will smoke near naphtha vapours, they will let the water run low in boilers; and that an employer should be at the elbow of every man is what none but the majority of people, who (as a speaker remarked) are not employers, would agree to.

I can say for myself what I would do in case such a law was passed in its entirety—although, thank God, I never had a serious accident happen in any factory with which I had connection. I would, at the first opportunity, and at all costs, join and become one of the majority. E. Wood.

Lime-street, London,
April 12, 1877.

SAFETY FROM FIRE.

The accounts received of the terrible loss of life by fire in the recent destruction of the St. Louis "Southern Hotel," should be very suggestive to the proprietors of the hotels and large dwelling-houses and warehouses constructed and in course of construction in London, provided with lifts and ventilating shafts, which cannot fail to act as chimneys conveying sheets of flame from the floor on which a fire breaks out, and risking the entire destruction of all means of descent from the upper floors.

It is a fortunate thing that there exist means of rendering these shafts perfectly safe at the expenditure of a very small outlay. The ingenious and simple method patented some time ago by Mr. Brannon, for constructing sheets of concrete with a certain amount of vegetable fibre, and on a net-work or skeleton of iron wire, is readily adapted to existing buildings, and should be the lining skin of every shaft, whether for lifting or ventilation, in this class of buildings, and every door of communication from these shafts into the house should be of the same material. The staircase, being also of stone or concrete, and away from these shafts, no difficulty in escaping could arise, even if the ceilings were not fireproof.

I am happy to learn that, after long delay, there is a prospect of the manufacture of this admirable application of a well-known material being available for architects and builders. The patents have been purchased by a company, and I believe that this company will soon be in a position to offer doors, casings, staircases, and chests, all absolutely fireproof, at a cost not more than half that of the elaborate, but ineffectual contrivances hitherto adopted. The lining of rooms and parts of buildings is one of the most important of the works they undertake.

It is to be hoped that concrete partitions, walls, and doors will be insisted on before long in all lodging-houses built under the recent Act.

D. T. Ansted, F.R.S.

4, Westminster-chambers, S.W.

NOTICES.

PROCEEDINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday evenings, at 8 o'clock. The following arrangements have been made:—

April 25.—"Deaf not Dumb," by B. St. John Ackers, Esq. Major-Gen. F. Cotton, K.S.I., will preside.

May 2.—"Continuous Breaks for Railways," by Capt. Tyler.

MAY 9. — "The Artesian System of the Thames Basin," by JOSEPH LUCAS, Esq., F.G.S.

MAY 16.—"The Practical Use of the Food Collection of the Science and Art Department," by W. STEPHEN MITCHELL, Esq., M.A.

MAY 23. — "The Measurement and Settlement of Musical Pitch," by A. J. ELLIS, Esq., F.R.S., F.S.A.

AFRICAN SECTION.

Tuesday evenings, at 8 o'clock. The following arrangements have been made:—

APRIL 24.—"The Trade and Resources of Morocco," by Dr. ARTHUR LEARED.

INDIAN SECTION.

Friday evenings, at 8 o'clock. The following arrangements have been made:—

APRIL 20.—"The Existing and Possible Commercial Communications between Persia and India," by Major-General Sir FREDERICK JOHN GOLDSMID, C.B., K.C.S.I. Major-Gen. F. COITON, C.S.I., will preside.

MAY 4.—"Thaumato-dendra, or the Wonders of Trees," with illustrations from life, by WM. TAYLER, Esq.

CHEMICAL SECTION.

Thursday evenings, at 8 o'clock. The following arrangements have been made:—

APRIL 26.—"Phosphor-Bronze and its Applications," by ALEXANDER DICK, Esq.

MAY 10.—"A New Process for the Production of Carbonate and Caustic Soda, without the Formation of any Noxious Waste and the Recovery of the Sulphur," by GEORGE E. DAVIS, Esq.

CANTOR LECTURES.

[Members are specially requested to take notice that the hour for this course of lectures is **FOUR** p.m., not eight p.m.]

Monday afternoons, at four o'clock. Third Course on "The Connection of Greek and Roman Art with the Teaching of the Classics," by SIDNEY COLVIN, Esq., M.A., Slade Professor of Fine Art at the University of Cambridge.

LECTURE II.—APRIL 23.

Range of the Study.—Architecture—not to be specially considered in the present course. The imitative arts. Subjects of imitative art in ancient Greece and Rome co-extensive with the whole field, (1) of imagination, (2) of life. Subjects of imagination—deities, personifications, heroes. Subjects of reality—history, portraits, ceremonies, sports and pastimes, family life, death.

LECTURE III.—APRIL 30.

Materials of the Study.—Division according to the art employed, as sculpture, painting, and their subordinate arts. Division according to the nature of the work produced, as statues in wood, gold and ivory, bronze, marble, terra cotta, free and decorative statues, reliefs, wall-paintings, vases and vase-paintings, coins, gems, gold ornaments, bronze armour and implements, glass, &c. Historical sketch of the accumulation and distribution of the materials. Excavations and museums.

LECTURE IV.—MAY 7.

Methods and Development of the Study.—Archæology at the Renaissance. Archæology in the seventeenth century. Modern archæology—the eighteenth century. English travellers and German critics: Stuart and Revett. The Society of Dilettanti: Heyne, Winckelmann, Lessing. The mystical school: Creuzer. The comparative and historical school: K. O. Müller. Subsequent progress in the interpretation of monuments. Examples of method.

LECTURE V.—MAY 14.

Future of the Study.—Importance of its systematic recognition in England. Unlimited results possible from future excavations. The French and German schools at Rome and Athens—an example to be imitated. National museums; provincial and university museums. Facilities offered by casts and reproductions.

Each member can admit one friend to these lectures. No special tickets are now required for the purpose; the tickets issued to members at the commencement of the session are available for the Cantor Lectures, as well as for the Ordinary and Sectional Meetings.

MEETINGS FOR THE ENSUING WEEK.

MON.... **SOCIETY OF ARTS**, John-street, Adelphi, W.C., 4 p.m. (Cantor Lectures) Prof. Sidney Colvin, "The Connection of Greek and Roman Art with the Teaching of the Classics." (Lecture II.)
Royal Geographical, University of London, Burlington-gardens, W., 8½ p.m. Dr. William B Carpenter, "The Temperature of the Deep-sea Bottom, and the Conditions on which it Depends."
British Architects, 9, Conduit-street, W., 8 p.m. Sir Gilbert Scott, "St. Alban's Abbey."
Medical, 11, Chandos-street, W., 8.30 p.m.
Antiquaries, Burlington House, W., 2 p.m. Annual Meeting.

TUES.... **SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (African Section.) Dr. Arthur Leared, "The Trade and Resources of Morocco."
Royal Institution, Albemarle-street, W., 3 p.m. Prof. J. H. Gladstone, "The Chemistry of the Heavenly Bodies." (Lecture III.)
Medical and Chirurgical, 53, Berners-street, Oxford-street, W., 8½ p.m.
Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. 1. Prof. Edward Hull, "A Deep Boring for Coal at Scarle, Lincolnshire." 2. Mr. Robinson Souttar, "Street Tramways."
Anthropological Institute, 4, St. Martin's-place, W.C., 8 p.m. 1. Dr. John Rae, "The Migrations of the Esquimaux." 2. Mr. Robert B. Holt, "Earthworks in Ohio." 3. Prof. George Busk, "Note on Skulls from Ohio." 4. Col. A. Lane Fox and Mr. W. L. Distant, "Exhibition of Photographs from Andaman and the Malaccas." 5. Mr. R B Martin, "Exhibition of Objects from a Supposed Kitchen Midden at Smyrna."

WED.... **SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. Mr. B. St. John Ackers, "Deaf not Dumb."
Geological, Burlington House, W., 8 p.m.
Royal Society of Literature, 4, St. Martin's-place, W.C., 4½ p.m. Annual Meeting
London Institution, Finsbury-circus, E.C., 12 a.m. Annual Meeting.

THUR.... **SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Chemical Section) Mr. Alexander Dick, "Phosphor-Bronze and its Applications."
Royal, Burlington House, W., 8½ p.m.
Royal Institution, Albemarle-street, W., 3 p.m. Prof. Tyndall, "Heat." (Lecture III.)
Inventors' Institute, 4, St. Martin's-place, W.C., 8 p.m.
Royal Society Club, Willis's Rooms, St. James's, S.W., 6 p.m.
Civil and Mechanical Engineers, 7, Westminster-chambers, S.W., 7 p.m. Mr. F. Heath, "Water Works."

FRI....... Royal United Service Institution, Whitehall-yard, 3 p.m. Captain H. C. Marsh, "Our Relations with the Tribes of the North-west Frontier of India."
Royal Institution, Albemarle-street, W., 8 p.m., Weekly Meeting. 9 p.m., Dr. John Rae, "Arctic Life."
Quekett Microscopical Club, University College, W.C., 8 p.m.
Clinical, 53, Berners-street, W., 8½ p.m.

SAT....... Trades Guild of Learning and National Health Society (at the HOUSE OF THE SOCIETY OF ARTS), 8.30 p.m. Prof. W. H Corfield, "The Laws of Health." Part II. (Lecture XII.)
Physical Science Schools, South Kensington, S.W., 3 p.m.
Royal Botanic, Inner Circle, Regent's-park, N.W., 3¾ p.m.
Royal Institution, Albemarle-street, W., 3 p.m. Rev. Archibald H. Sayce, "Babylonian Literature." (Lecture II.)

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,275. Vol. XXV.

FRIDAY, APRIL 27, 1877.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

HEALTH AND SEWAGE OF TOWNS.

The Annual Conference on Health and Sewage of Towns will be held on Thursday and Friday, 3rd and 4th May next, the Right Hon. James Stansfeld, M.P., late President of the Local Government Board, in the chair. The Conference will meet each day at 11 a.m., and will sit till 1.30, then adjourn till 2; sit again till 5 p.m., and, if necessary, meet again at 8 p.m.

Thursday, 11 am.—Opening of the Proceedings by the Chairman. Papers and discussions on—

1st. Dry Systems.
    Pails, Pans, Boxes, Earth, Middens, Cesspools, Ash, and other Closets; their influence on health, cost of collection, commercial value of products, &c.

2nd. Water-carried Sewage.
    a. New facts about Sewage Farms, with or without precipitation or subsidence, profit and loss thereon.
    b. Effluent Waters.
        Subsidence.
        Precipitation.
        Filtration.
    c. Possibility of producing an effluent harmless to health.

3rd. Escape of Sewage Gas into Dwellings.

4th. Discharge of Sewage into Sea.

5th. Additional Facts to those stated in the Report of the Local Government Board on Disposal of Sewage.

Friday, 11 a.m.—Proceedings will be resumed. Papers and Discussions contiued.

The object of the Conference is to discuss existing information in connection with the results of the systems already adopted in various localities; to elicit further information thereon; and to gather and publish, for the benefit of the public generally, the experience gained. The introduction and discussion of untried schemes will, therefore, not be permitted. Special papers, which have been prepared at the request of the Council, will be printed and circulated at the Conference.

An exhibition of sanitary appliances will be held during the Conference. Only such apparatus will be admitted as have a distinct bearing on the subject of the Conference. Intending exhibitors should at once communicate with the Secretary.

A prize of £20 is offered for "The best Sanitary Pan for collecting pure excreta, unmixed with ashes or refuse, having regard especially to cleanly use, the separation of the urine from the fæces, and a ready and cleanly means of removal and transport." These pans will be exhibited at the Conference. The system must have been in use six months previous to the 31st March. The Council reserve the right of withholding the prize, should nothing be submitted which is considered worthy of reward.

Arrangements have been made for those attending the Conference to dine together at Simpson's, 101, Strand, at 6 o'clock each day. Tickets, 6s. 6d. each, without wine, may be obtained at the Society's office, on the morning of each day. To secure places, applications must be made to the Secretary on or before Tuesday, the 1st May.

NATIONAL TRAINING SCHOOL FOR MUSIC.

A competition for three Scholarships was held by the Birmingham Local Committee, on the 10th inst. Nine Candidates were examined, and the Scholarships were awarded to Misses E. M. Farnol, E. S. Atkins, and A. M. Porter. The Examiners were Dr. Heap and Mr. Stimpson.

First Annual Examination.—The following is the Class List, Easter, 1877, arranged in alphabetical order:—

First Class.

Balfour, Henry L.
Bradwen, Gertrude S. J.
Cliffe, Fred.
Cox, Bessie
d'Albert, Eugène F. C.
Glen, Annie Eliza
Heale, Hélène
Hodge, William
King, Frederic
Marriott, Annie A.
Marshall, Charles
Pidcock, Eva P.
Riley, Lucy
Thomas, Adelaide L.
Thomas, Mary
Walker, Emily

Second Class.

Alcock, Walter G.
Bénard, Eugénie E. L.
Beney, Theresa H.
Bourne, Mabel C. H.
Boyle, Frank
Brickwell, Emily P.
Chappel, Sarah A.
Cole, Florence H.
Cosford, Eliza
Cravino, Josephine
Davis, Charlotte R.
East, Louisa C.
Gibson, Evelyn B.
Goss, Lucy
Hickling, Amy
Hudson, Sophia E.
Jefford, Robert
Jones, Marianne M.
Maile, Grace
Mundella, Emma W.
Parfitt, Edward W.
Roche, Nina
Sharpe, Herbert F.
Shirley, Ellen
Sidley, Clarence
Simpson, Leonora
Sturmfels, Eugènie E.
Turner, Elizabeth A.
Twist, Monimia
Warman, Florence M.
Watson, Rebecca
Weller, Emily

Third Class.

Dove, Frederick S.
Fowles, Ernest G. A.
Hughes, Norah
Hughes, Matilda E.
Lauder, James
Macleod, Helen
Roberts, Ada B.
Storey, Ann N.
Strange, May B.
Sweeting, Edward

Examined but not Classified.

[These scholars have been too recently admitted to the school to be Classified.]

Barker, Ada M.
Bennett, James C.
Cooper, Amy E.
Creese, Florence C.
Emerson, Dora H.
Ferguson, Christiana
Forrester, James C.
Hall, Isabella
Mull, Percy
Norris, Florence N.
Ward, Annie
White, May L.

Ægrotant.

Fussell, Sarah J.
Harding, Gertrude
Lemmon, Alice M.
Thacker, Ada
Thompson, Emily A.
Wardroper, Marion L.
Webbe, Minnie E.
Westmacott, Marion S.
Woods, Francis C.

FOOD COMMITTEE.

A meeting of this Committee was held on Tuesday last, the 24th inst. Present—Lord Alfred Churchill (in the chair); Hyde Clarke, Henry Pitman, C. S. Read, M.P., and J. A. Youl, C.M.G.

CHEMICAL SECTION.

A meeting of this Section was held on April 19th, when a paper was read by Mr. C. W. Vincent, upon "Spontaneous Combustion in Factories and Ships." The report of the paper and discussion is necessarily postponed, owing to Mr. Vincent's MS. not having been received in time for press. The usual practice has been departed from in the present instance with great reluctance.

INDIAN SECTION.

Friday, April 20th, 1877, Major-General F. C. Cotton, R.E., C.S.I. (Member of Council), in the chair.

The paper read was—

THE EXISTING AND POSSIBLE COMMERCIAL COMMUNICATIONS BETWEEN PERSIA AND INDIA.

By Major-General Sir Frederic John Goldsmid, C.B., K.C.S.I.

It had been my wish and intention, on accepting the invitation to address the Society of Arts on the subject of Indo-Persian commercial intercommunications, to have said something on the old routes of commerce between India and the erst undeveloped and undefined West. But opportunity has failed me to make the researches requisite to an exhaustive exposition of the theme chosen, and I have been quite unable to find the necessary leisure to give even such an outline of this most interesting question as would in any way satisfy hearers who are acquainted with its treatment by writers of now confirmed reputation. Any preliminary remarks to this effect, therefore, will be of a cursory nature; and I shall dwell rather upon the practical exigencies of the hour than on lessons of the past; and seek to engage your interest neither in retracing a state of commercial splendour which has long disappeared, nor in building theoretical palaces which may never have realisation to the extent of a single brick.

The ancient glories of Tadmor, Nineveh, and Babylon, belong as little to Persia of the present day, as the satrapies of Cyrus can be said to represent the territorial possessions of Nasru-d-din Shah. Otherwise, we might look for the routes of existing Persian commerce among those great lines of traffic which passed westward through Syria to the Mediterranean. In Mr. Priaulx's elaborate review of Indian foreign relations, from Claudius to Justinian, we read that the overland route was wholly in the hand of the enlightened Sassanian kings, that "the Persian Gulf also was theirs, and when, towards the close of Justinian's reign, Khosroes Nushirwan overran Arabia, and gave a king to the Homerites, they may be said to have held the Red Sea and the keys of all the roads from India to the West." But the ports of the Persian Gulf and Arabian Ocean, through which Indo-Persian commerce now finds an inlet or outlet, are few and disconnected from the classical period, and the inland routes through Afghanistan and Baluchistan are little suited to an age when steamers and railways have become familiar to the Oriental eye and ear.

My attention has been drawn to a small volume, published in London somewhat less than twenty years ago. It is called "The Commerce of India," and consists of the essay which won the Le Bas Prize in the University of Cambridge, in 1852. Full of information and critical analysis as Mr. Irving's summary must be found by the reader, and suggestive and provocative of speculation as are his comments and observations, we miss in his pages certain local details which would have been useful, could they have been added. It might have been well had he adverted to Dean Vincent's careful researches into Mekran geography, and the track of Nearchus, and the separate divisions of Greeks returning homeward. Such a retrospect might have led him into a connection of the upper routes in Baluchistan, and those nearer the sea, with the more celebrated lines further to the West.[*] But the evidence supplied at the present day to these is naturally imperfect.

There is again another and still more recent work which cannot be disregarded. Dr. Yeats has put forward two small but well-filled volumes, of which one is a narrative of the growth and vicissitudes of commerce for more than 3,000 years before 1789, and the other a manual of recent and existing commerce from the latter year till 1872. But here also we miss any mention of routes which are known to have been used, and one perhaps to this day used, in traversing Mekran from east to west, and *vice versâ*. Allusion is made to the possibility or probability of such a line of transit, in a surmise that "the routes through Central Persia by Kerman, Yezd, and Shiraz were minor channels for trade." But that is all; and in the map illustrative of the volumes (which has been kindly lent for inspection this evening) no line, either ancient or modern, is to be found south of the old road which, leading from Delhi to the Black Sea, skirts northern Baluchistan, between Kandahar and the border of the Sistan Lake.

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[*] It is worthy of remark that Damascus and Baghdad were formerly in an old high road from Tangiers to the borders of China. For it is found in Lelewel ("Géographie du Moyen Age;" Brussels, 1852), at page 32:—"Une autre route continentale à travers toute l'habitable, était moins connue aux Mahomédans. Elle passait de Tanger, par Egypte, ensuite par Damask, Koufa, Bagdad, Bussora, elle pénètre dans Ahvaz, et par le Fars, Kerman, Sind, Hind, elle poussa jusqu'en Chine." I think that Mekran might safely be interpolated after Kerman, but it should be with reference to the route through Bampur, Kej, and Baila.

The nature of the traffic between India and Persia presents another subject of interesting inquiry. It is, moreover, so relevant to the general topic of the evening, that I make no apology for a retrospect which, however brief and desultory, may facilitate useful comparisons with the status exhibited in the trade returns of to-day.

Let us first glance at our earlier commercial relations, as between Great Britain and Persia. In 1627, when Sir Dodmore Cotton went as ambassador to Shah Abbas, the king offered to receive annually English broad cloth in exchange for ten thousand bales of silk. But the silks disposed of to Europeans were not always of the best description; and, on the decline of the Dutch-Persian trade in the 17th century, a contemporary writer reports the article supplied to Hollanders to have been so inferior that it could not be utilised as cordage for horses. In about 1680, the Dutch Ambassador, Van Leenen, after much trouble and the distribution of many costly presents, was enabled to put matters on a better footing, or rather to extract a promise of improvement. However, the deterioration of coinage was even a more serious evil than the heavy charge on silk, and, in the words of Monsieur Sanson, a missionary sent by Louis XIV. of France, to Persia, in 1683, the money had at that period become so bad, that nobody cared "to carry their goods so far to receive their price in copper." More than sixty years ago, Sir John Malcolm writes that the commerce in Persia "is nearly the same as it was in the most ancient times." The silks of Gilan,* and wool of Karmania were, in his day, exported as theretofore; and the cotton and gall-nuts of Western and asafœtida of Eastern Persia were still in considerable request. A passing and preliminary word on more recent dates will give us a better notion of the main articles of Persian commerce. In Watson's history of the Shah's dominions, published about ten years ago, the author notices the great trade which had sprung up between Persia and various nations of Europe within the previous thirty years. "Cotton," he says, "silkworms, silk, wool, and other raw produce, are exported to England, France, and Russia, and in return Persia receives manufactured goods and articles of luxury from Europe." But this statement hardly applies to the direct traffic with Great Britain; for, almost at the very period when Mr. Watson was writing his history, the imports and exports were quite insignificant as regards British ports. Of exports we are authoritatively told that there were none in 1863 and 1864; while their value was £517 in 1865, and only £1 in 1866! In 1867, the figure rose to £960; in 1868, it was only £20, and there were no exports again in 1869; but in 1870 we have the comparatively large amount of £15,556, and in 1871, as much as £40,873. The imports of British produce into Persia direct, were of the value of £530 in 1864; of £16,243 in 1865; of £25,906 in 1866; of £14,069 in 1867; of £17,498 in 1868; of £16,985 in 1869; of £15,556 in 1870; and £8,848 in 1871. Of the last-named items nearly three-fourths consisted of cotton.* For the year 1874, the estimated value of articles imported from England to Bushire alone is £55,500, and of exports from the same place to England, £46,640; but while the first item is derived from various sources, the second is found under the single head of opium, which in this instance is disposed of perhaps to equal advantage in London for transmission to the Continent of Europe and America, as in China, where its flavour is not in comparative repute.† It should, however, be explained that variety does not imply a real distribution of elements constituting bulk. More than three-quarters of the above sum of £55,540, officially registered for the year's imports, is for cotton piece goods alone. If we throw in the thread, there would not remain £10,000, exclusive of cotton. Looking at the same year's account of the Anglo-Persian traffic recorded for Bandar Abbas, we find the imports about £5,200, of which nearly £4,600 are for cotton piece goods and thread; and exports about £1,777, made up of wheat, £515; gum, £232, and cotton, £1,030—three items only. Now turn we to Persia and British India, as represented by the above-named gulf ports of Bushire and Bandar Abbas on the one side, and the three harbours of Karachi, Calcutta, and Bombay on the other.

The Persian proper is no sailor—a fact acknowledged by European writers of the sixteenth century. Purchas, speaking of the great and mysterious Tartar prince, of whose entity he is not quite confident, says, "he has no strength at sea;" adding "and herein participate other great and mighty princes, *Prester John* (so called) of Æthiopia, in Africa, and the *Sophi*, and great *Mogor*, in Asia, ranked justly amongst the greatest emperors of the world, who having some part of their dominions adjoining to the sea, make little or no use thereof." The "Moors," with whom d'Albuquerque came into conflict at Ormuz, on sea as well as on shore, were clearly Arabs, as are indeed to the present day the strictly maritime community of the coast from Bandar Abbas to Basrah. But the mercantile spirit is not wanting in the people of Iran, and the profession of a merchant, so far from being derogatory, is esteemed highly honourable by Muslims, both of Persia and India. Chardin, some two centuries ago, laid much stress upon this feature in the Shia'h character. He relates that the Shah himself sells, and causes to be sold to neighbouring countries, "silk brocades and stuffs, carpets, and precious stones." And much the same state of things is observable in our own time. If the reigning monarch does not actually trade in the true commercial sense, it cannot be said that his own way of adding to the royal income illustrates a more dignified and becoming procedure. And we have abundant evidence that the Sunni follower of the Prophet holds an equally high opinion of the commercial calling with the Shiah.

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* For a clear description of the preparation of Gilan silk from the worm, and for a most instructive account of Northern Persia, bordering on the Caspian, one hundred years ago, see M. Gmelin's travels, in 2nd vol., *Histoire des Decouvertes faites par divers savans voyageurs. Lausanne*, 1784.

* Statesman's Year Book, 1873. Macmillan and Co.

† Annual report on Administration of Persian Gulf Political Residency, 1874-5. From non-official sources I learn that Persia exports about 2,000 chests of opium annually, of which about 800 come to Europe, and the remainder go to China,

There is an instructive little volume, abridged by Mr. Bayle St. John, from a French translation of the travels of Shaikh Muhammad, Arab merchant, of Tunis,* one chapter of which commences with a paragraph which, in this respect, is conclusive :—

> "The Sovereign Disposer of all things has placed commercial men neither among the great nor among the poor, but among the middle classes. By their means the productions of various countries are spread abroad, and relations are established between nations. The most virtuous of men . . . . Muhammad himself, honoured this profession, and went on trading journeys into Syria. His example has been followed by men of various climates; among these, the people of Soudan, being in possession of many natural productions, and in want of manufactured articles, have naturally taken to trade."

The late governor of Karmán, Muhammad Ismáil Khan, the Wakil-ul-Mulk, gloried in his practice of the mercantile profession, and received me sitting among his bales. He had his duly appointed "gumáshta," or agent, at Bombay, in the same manner that the Indian "Seth" has his at Karmán or Bukhára. We learn from Chardin that at the close of the seventeenth century, Persia sent to India much tobacco, fruits (especially dates), wines, quince-marmalade, distilled waters (probably rosewater, as now), horses, porcelain, feathers, and leather. Of these, we miss from current returns the wines, and we find porcelain and leather among the imports, while tobacco is despatched to Aden and the Red Sea.

But the silk traffic was by no means brisk. According to Sanson, whom I quote because of his rarity, there were, under Shah Sulaiman, manufactures at Ispahan, Kashan, Tabriz, and Mashhad. These, he tells us, were very fine and rich, but "made only for the use of the kingdom; for the great Mogul, to hinder the utterance of 'em in his empire, has forbid his subjects to wear 'em. And the Turks seldom wear any gold or silver, as also few others of the neighbours of Persia. So that these commodities, being not in use elsewhere, must of necessity be confined to that kingdom." Recent returns show that in 1874 the value of raw silk exported from Bushire and Bandar Abbas to British India was more than £15,000, in an aggregate of £215,000. But it will be interesting to note the component parts of the balance or respectable sum of £200,000, and learn what Persia has substantially to provide for India at the present hour. We will take the year 1874 from present records.

After specie, amounting to £44,204, the first item in importance is "dried fruits," which falls little short of a sum of £41,000; not £250 behind this figure is gum; but under both heads the contribution of Bushire is trifling. The next item is wool, which is valued at £24,450, and of which again Bandar Abbas supplies nearly ten times the amonnt of the Bushire export. Cotton somewhat exceeds £20,000, less than a third coming from Bushire. Silk, of which we have just spoken, occupies the next place; we then have a too moderate figure, somewhat short of £10,000, for horses, of which Bandar Abbas can only be credited for a fourteenth part, a difference readily accounted for by geographical position in respect of the horse-market. For amounts below £10,000 we may mention, in order of importance, dyes (mainly through Bushire); rosewater (only Bushire); dates (mainly Bushire); grain, seeds, and drugs (only Bushire); carpets and rugs (through Bandar Abbas); hides and skins, saltpetre (only Bushire); and £2,860 for etceteras or unspecified articles, a heading not acknowledged by Bandar Abbas.

In return British India, according to the data before us for 1874, supplies to Persia through the two ports of Bushire and Bandar Abbas, goods, inclusive of specie, to the value of £310,653, being an excess of £95,650 pounds odd over the Persian exports to India. We have already noticed the large proportion derivable from cotton in the Anglo-Persian traffic. To the same article must be debited more than two-thirds of the nominally Indo-Persian; as regards the goods landed on Persian soil, it is, £210,040 out of £310,653. The next most important heading is indigo, which reaches a figure little short of £40,000, realised for the greater part at Bushire. There is nothing else valued up to £10,000, though the item of specie is not far from the mark. Below that amount and not less than £1,000, may be classed in order, metals, tea, spices, rice, drugs, and medicine, woollen goods, sugar, arms and ammunitions, clocks and watches.

"A very marked falling off in trade as regards the Persian coast," is officially reported for the year, the results of which we are now examining. At Bushire the decrease in both imports and exports is shown to exceed in the aggregate 18 lacs of rupees, or £180,000. So that if the cause be found exceptional, we must raise our totals before recorded to strike a supposed fair average. But, unfortunately, we hear authoritatively that the decrease would have been greater but for certain legislative enactments; that the Persian market is considered still overstocked; and that "a further depression of trade may be expected." * I have examined the tables which exhibit the various items of increase and decrease in both imports into Persia and exports thence, and the following data seem to merit attention. During 1874, there has been a less supply of cotton goods, to the amount of £30,000, received in Bushire; and less raw cotton, by £10,000, has been shipped from Bushire, than was the case in 1873. There has been a considerable falling off in the imports at the same place of woollen goods, sugar, indigo, and spices; and in the exports therefrom of indigo, soft sugar, raw silk, pearls, ivory, animals (horses), fruits, hides, metals, woollen goods, tobacco, cotton goods, and perfumery. But how far these losses affect the Perso-Indian trade I have not yet ascertained. Judging from the headings themselves which I have selected, the decrease probably applies to India in respect to all the imports, and especially to horses, raw silk, fruits, and rosewater, of the exports. One or two of the articles in the latter classification are, I believe, seldom, if at all, required in the Indian market, at least from a Persian port.

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* Chapman and Hall, 1854.

* Annual report of Persian Gulf Political Residency, 1874-75. Just at this time (1877) I learn there is a fair trade in wheat; but such imports are precarious, owing to the arbitrary acts of a vacillating and despotic Government.

As to the decline, generally, of late years, in the trade between India and the Gulf, it is attributed in non-official quarters, first, to the diminution of the Persian population by famine and disease; and secondly, to the facilities afforded by the Suez Canal to direct traffic with Europe, instead of through Bombay, from which port European manufactured goods have been commonly shipped. Of the return produce from Persia, the cotton is manipulated in Bombay, and very probably reappears amid the Indian bales destined for this country; but here means of communication readily divert it to a market where it has a character of its own. So, also, perhaps, is the case of other articles exported from Persian *bandars*. It is worthy of note that indigo from Calcutta, as sugar from Batavia, is paid by opium shipments to China. And now, with many apologies for what I trust will be found an apparent rather than a real digression, I come to the question of land and sea communication, as they actually are, and as they might be, for commercial purposes.

"Land and sea" I have said, but it will be necessary to reverse the order—for any proposal of an entire overland route for merchants and traders, from Karachi to the interior of Persia, would, I know, be received with mistrust or disapproval. I, myself, have something to put forward on the subject, but shall not venture to do so until at the conclusion of the present paper, when a parting suggestion or two, however wild, may be admissible in the way of epilogue. Existing communications, then, are maintained by the mail steamers of the British India Company, leaving Bombay weekly, for Karachi, on the arrival of the still miscalled "overland" mail, to touch on every second trip at Bushire, Lingah and Bandar Abbas. These steamers are a great boon to Government and to individual passengers, and should be no less esteemed by the mercantile community, native as well as European; but they can hardly be considered a marked success for the enterprising originators in the matter of traffic development on the Persian coast. Between Karachi and the Gulf we are told that the trade has always been trifling, and shows no improvement; and even the increase of the Gulf trade with Europe, by the Isthmus of Suez, must be at the expense of the trade with India and that *viâ* the northern routes. A well-known firm, two years ago, established houses of business in Persia, but their results, however good in some sense, render it probable that the same amount of capital and energy expended elsewhere would have realised a more brilliant and at the same time material success. Besides the British mail-boats, other merchant steamers and occasional sailing-vessels touch at the Persian ports, and an average of 2,280 tons is recorded for native crafts visiting Bushire from India in 1874, and 10,000 tons for Bandar Abbas. I cannot say that the officially-accepted and published statements—that an average of a hundred native crafts, each averaging a hundred tons—have produced the ten thousand tons, has impressed me with confidence in its accuracy.

The port of Bandar Abbas represents the trade with Eastern Persia, while that of Bushire may be taken as indicative of the central lines of communication with the capital. Yet there will be many and frequent exceptions to such a rule. Opium, for instance, according to the Assistant-Resident in the Persian Gulf, is taken to both ports for shipment; but, while the whole of the produce of Ispahan and Fars goes to its natural outlet, Bushire, that of Khorasan, Yezd, and Kermân, in the East, is sent partly to Bushire and partly to Bandar Abbas. Nothing can well be worse for goods-caravans than the roads to the sea in both instances. Between Shiraz and Bushire, as between Kermân and Bandar Abbas, the natural physical difficulties are immense. In the first, are passes of between 6,000 and 7,000 feet in height, traversed over miles of rocky and perplexing road; and in the second, the caravan is dependent on the season for using the direct route, or making a long *détour*, by the Deh Bakri Pass, of 6,400 feet; either course, however, presenting obstacles of no common magnitude. There is a cross road from Bandar Abbas to Shiraz, estimated at 300 to 330 miles in length. I should be glad to learn that the tract through which this passes had been thoroughly explored, because we do not know as much as we ought to know about it, and the difficulties in Lár and neighbouring parts may have been exaggerated. It had been thought of by Colonel Stewart for the line of telegraph in 1862, but native reports caused him to abandon the notion. We must always bear in mind that, as regards the question now under consideration, Bandar Abbas is by sea 425 miles nearer to Bombay than Bushire, and the land distance from the former port to Shiraz is only 130 miles more than from the latter; in short, while it is 1,330 miles from Bombay to Shiraz *viâ* Bandar Abbas, it is 1,625 *viâ* Bushire.*

But there is a new means proposed for communicating from India with the interior of Persia, which I think deserving of every attention; and, as it is at this moment the most feasible plan which offers for the advancement of Indo-Persian traffic, I am about to place it very prominently before you. If, indeed, in itself, it present no actual novelty to most of the members of this Society, it will, at least, have the attraction of being accompanied by a careful report, which my friend Major Champain, of the Royal Engineers, has permitted me to use on this occasion, and from which I shall presently read some interesting and pertinent extracts. I need hardly say that this gentleman is a most competent judge of the questions treated, and, as his report bears date Bushire, the 31st March, 1876, it is not an old one, and was, moreover, not written, as are many Asiatic items of intelligence, in London.

On the 13th of October, 1875, Messrs. Gray, Dawes, and Co., of Austin Friars, addressed the Secretary of State for Foreign Affairs on the present position of British and Indian trade with Persia, in the double capacity of merchants having establishments on Persian soil, and of representatives of the company owning the mail steamers of the Persian Gulf. An active local experience of ten years, however, enabled them to put forward with confidence any scheme for improving the traffic which might commend itself to them.

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* See "Telegraph and Travel" (Macmillan and Co., 1874), p. 190, for these data, and note showing how they are obtained.

I have no data wherewith to estimate correctly the Indian traffic with Persia through Bagdad, or Turkish territory. Now, the following statement may be interesting. It shows the value of imports and exports between Calcutta, Bombay, and Karachi, on the one hand, and the whole Persian Gulf, Arabian side inclusive, on the other:—1873-74—Imports, £846,755; exports, £1,208,414. Average of five years, ending with above year:—Imports, £1,010,971; exports, £1,313,426; or, a total of £2,324,397, inclusive of treasure. This item is recorded in the one year, 1873-74, at some £414,844, so that 2 millions are not exceeded under the head of merchandise.

Believing that there was a better chance for Russo-Persian than Anglo-Persian traffic in the North of Persia, where the natural commercial outlet was the Caspian Sea (conventionally, but not incorrectly, considered a Russian lake), they pressed upon the attention of Government the necessity for adopting protective measures for British trade interests in the south, suggesting the appointment of a consul at Ispahan, and assistance in obtaining from the Shah a concession for running steamers on the Karun river from Muhamrah and Shustar, in connection with steamers from Bombay and London. Lieutenant Selby, of the Indian navy, had, it was shown, reported favourably of the river navigation contemplated, stating that the Karun was "admirably adapted for steam communication from the sea to within six miles of Shustar." And a member of their own firm, Mr. George Mackenzie, after exploring the route from Ispahan to Shustar, thence proceeding to Muhamrah, and thence embarking on the Bombay mail steamer, came to the conclusion that the westerly line from Ispahan to the heart of the Persian Gulf possessed great advantages over the dreary and difficult land routes from Bandar Abbas to Karmán and Bushire to Shiraz.

Major Bateman-Champain, of the Royal Engineers, Director of the large Government Section of the Indo-European Telegraph—a line which has succeeded in establishing its utility and the foresight of its originators in the face of innumerable moral and physical obstacles—has already expressed his views on the feasibility and advantages of this scheme, and my own knowledge of the *locale* enables me to endorse generally the conclusions at which he arrives. I will make no apology for reading copious extracts from the paper he has placed at my disposal:—

"It is hardly necessary to remark that, so far as means of transport and roads are concerned, the present condition of Persia is but little removed from barbarism. Wheeled vehicles are practically unknown. Caravan routes are but tracks worn over steep and stony mountain ridges by the feet of mules and camels for century after century. Bridges are rare, and where most wanted are too often represented by the ruined piers and abutments of some clumsy, massive construction of a bygone age. Caravans are delayed in winter by snowdrifts, in spring by torrents, and in summer by the great heat of the sun, necessitating short night marches, so that there can be, in my opinion, few countries (at any rate of Persia's standing) in the world where any proposal having for its object the opening out of easy means of transport should be more gratefully welcomed.

"The shortest and most generally followed road from Bushire to the interior is particularly difficult. No less than six severe passes have to be surmounted between the sea and Shiraz, a distance of 180 miles, the road at one spot rising to an altitude of some 7,000 feet.

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"It is quite impossible to deny that of late years great changes have occurred in the neighbourhood of Northern Persia, all tending to improve the conditions under which the Russian competes with the British merchant. Many hundred steam vessels now ply on the Volga. A regular service is maintained during the season between the mouth of that river and the Persian ports on the Caspian. A railway now connects Poti with Tiflis, and is being continued to Bakou, while it is merely a question of time when the railway system of the Caucasus will be extended to the Persian frontier on the Arax, less than 100 miles from Tabreez. When Messrs. Gray, Dawes, and Co. assert that Russian manufactures are steadily superseding British productions at Ispahan, and even in the Persian markets south of that centre, they merely describe the inevitable results of existing circumstances, and their evidence is in accordance with the observations of our telegraph officers, who have resided in Persia since 1863, and who recognise the great progress made by Russian trade.

"It is, I imagine, obvious that in the interests of Persia, of Great Britain, and of India, steps should be taken to smooth away, if possible, the obstacles which impede the free movement of trade from the south. If this be admitted, it requires but little examination to convince the inquirer that the Karun river scheme is the one which promises the best results in return for the smallest outlay of energy and money. Bushire has no harbour, it is cut off from the Persian centre of trade by a range of mountains, the passage of which cannot be improved, except by an expenditure so large as to be out of the question. Lingah presents the same conditions, and is further from the field at which we aim. Bandar Abbas has a harbour, but its distance from the commercial centres of Persia, and other physical conditions, prevent it competing even with Bushire. On the other hand, Mohammerah and the Karun river offer such extraordinary advantages that it is a matter of wonder to me how they can have been so long neglected. I have not myself visited the place, though I would have done so on this occasion had I not been able to procure such ample and satisfactory information on the subject, that nothing less than a prolonged stay in the neighbourhood, and journeys into the interior, would have enabled me to add to the existing acquaintance with the facts of the case.

"When at Kurrachee, before leaving for the Gulf, I telegraphed to ask Mr. Robertson, the Vice-Consul at Bussorah, whether he had ever visited the Karun river, and begged him, if he had, to write me an account of it. He replied that he had been several times up the river, and knowing that I was about to inspect the telegraph station at the mouth of the Shat-el-Arab he was good enough to promise to meet me there and talk the subject over. Accordingly, on the 26th instant, I had the pleasure of seeing Mr. Robertson, as well as Colonel Nixon, Her Majesty's Political Resident at Bagdad, who happened to be at the time in those parts.

"Mr. Robertson lent me a copy of one of the Geographical Magazines of 1844, containing a long report on the course of the Karun from Mohammerah up to Shuster, of which I had previously seen only extracts; it is a most complete and interesting account of Lieut. Selby's expedition of 1842, and a perusal of it is essential to enable one to form a clear notion of the commercial facilities afforded by this route.

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"Lieut. Selby's paper proves conclusively that Mohammerah, as a port, offers unusual advantages. It communicates with the sea, not only by the Shat-el-Arab, which is navigable by ocean steamers of moderate tonnage, but also by the Khor Bamushir which, in former ages, used to be the embouchure of the Karun, and which offers a channel not less than 9 feet deep at low water. The Khor Bamushir is Persian on both sides, while the right bank of the Shat-el-Arab is Turkish territory. The development of trade by the Karun would be of great benefit to Persia, and Mohammerah might rival in importance its neighbour, the Turkish port of Bussorah. The climate of Mohammerah is good throughout the year, and up to the end of March might almost be called cold. The possibility of navigating the Karun and the Diz is no matter of conjecture. What was actually done by Lieut. Selby, with the limited resources at his disposal, 34 years ago, conclusively shows that the establishment of regular steam communication, up to within a few miles of Shuster and Dizful, would be to-day, as far as physical conditions are concerned, a matter of certainty and ease.

"The inland journey from Shuster to Ispahan is, by Mr. Mackenzie's account (and this I can well believe) easier than that from Bushire to Shiraz; and Shuster is as nearly as possible the same distance as Shiraz from Ispahan. The establishment of a regular caravan road between Ispahan and Shuster would probably lead to the discovery of easier routes than those followed by Mr. Mackenzie, to the establishment of caravanserais, and to a general amelioration of the means of travelling. Again, the position of Dizful is such that once in communication with the sea the produce of the rich Kermanshah, Burudjird, and Hamadan districts would inevitably pass by it to the south.

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"It appears to me that the scheme put forward by Messrs. Gray, Dawes, and Co., is, from one point of view, an eminently practicable one, and the best if not the only method of diminishing the physical difficulties in the way of trade with the South of Persia.

The results which might be expected are as follows:—

"1. By means of the Karun river transport of British manufactures would be vastly cheaper than at present at Ispahan and places to the north of that city. Mr. Mackenzie, whose experience of Persia enables him to calculate very closely the cost of caravan transport, observes that, were the Karun opened up to Shuster, his firm could deliver goods at Ispahan at 35 krans per load of 350 lbs., as against 60 krans per load sent from Bushire to Ispahan, *via* Shiraz, and he estimates that under such conditions trade by the Suez Canal would beat that by the north completely out of the field.

"2. As regards Persian exports, their present scarcity arises mainly from the complete extinction of the silk supply, in consequence of the continual silk-worm disdisease, for which no remedial measures are ever likely to be taken by the Persian Govenment. Since the silk crops began to fail, the balance of trade has gradually but rapidly gone against Persia, thereby entailing an exportation of the precious metals to such an extent, as to become a most serious embarrassment to the country, if not an actual danger to the State.

"It should be noted, moreover, that, until recently, the main trade route of the north of Persia lay from the shores of the Black Sea through Turkey, a line open, of course, to British as well as Russian merchandise. The rapidly increasing railway system of the Caucasus, however, will soon absolutely close this route for all practical purposes, and leave the trade solely in the hands of Russia, who, by means of differential tariffs, will be in a position to exclude British merchandise altogether, a position which she will not fail to take advantage of.

"From a purely Persian point of view, therefore, it is most advisable that immediate steps be taken to counteract the tendency of the present system towards placing the country, in a commercial sense, at the mercy of her formidable neighbour. In my opinion one of the most effective measures would be the establishment of free navigation on the Karun river, as such a course would not only open the country to British enterprise, as a counterpoise to that of Russia, but would emancipate the whole commerce of Persia in the north as well as in the south, from dependence on the forbearance of the Russian Custom-houses.

"While on this part of the question I may observe that cotton from Ispahan of a superior quality would find its way to the coast by Shuster water carriage, enabling the merchant to ship it at a profit to India and England. Business in this staple is now insignificant, owing to the enormous cost of caravan transport. Naphtha is another valuable article which abounds in parts of Fars and Khuzistan, and it might be utilized as fuel for the river steamers. As an illustration, too, of the enormous loss Persia annually sustains from her defective means of carriage, I may mention that, on Capt. Napier's recent trip to Kermanshah he computed that at least 80,000 tons of grain were there stored, of little service to any-one, on account of the impossibity of removal. The price of wheat at Kermanshah was then 7 krans (say francs) for 700 lbs., while at Teheran or Bushire it is never less than 30 or 40 krans, and usually much more. In exchange for the above-mentioned 80,000 tons of grain, no less a sum than £700,000 might have passed into Persian pockets, had it been possible to convey the corn to Mohammerah.

"For a short time back, one small steamer, capable of carrying 30 or 40 tons of cargo, has made occasional runs at irregular intervals of time between Mohammerah and Ahwaz. This vessel is the property of Sheikh Jabar Khan, Governor of the former place. Owing, however, to this functionary's unpopularity among the Chaab Arabs bordering the Karun, traders in Shuster do not feel secure in trusting their merchandise to this little steamer; and, moreover, other causes incidental to native management operate against the success of this limited enterprise. Yet, even under these conditions Messrs. Gray, Paul, and Co., of Bushire, have, during the past few months, conducted some large business transactions on behalf of Shuster merchants, who begin to discern the advantage of direct trade by sea with England over that overland with Russia."

I may add to the information furnished in the above extracts, that a memorandum on behalf of the Shustar and Muhamrah line to Bombay was formally submitted to the Shah by Mr. Mackenzie. No demand of subsidy was made, but a simple request preferred for permission to work a line of steamers on the Karun River, leaving the further development of land transport between Ispahan and Shustar as a necessary but secondary consideration. After much delay and hesitation, a decision was passed to the effect that the required permission could only be granted on payment of navigation and port dues to the Persian Government—a proviso that was not only inconvenient but arbitrary, because no material aid, but a costless moral support, was all that was expected by the British firm in return for their risk and outlay. The matter eventually dropped; although a *quasi*-promise was given that the Karun would be opened to steam navigation at some future occasion, on terms to be settled hereafter. I need not say that promises of this description are very common in Persia; but they are, as a rule, meaningless and fruitless. For example, when Mr. Jonas Hanway, on arrival at Astrabad in 1743, presented himself before the local Governor, his Excellency bade him welcome to the country, adding that "the city of Astrabad was his to do what he pleased with it." The value of such wholesale generosity may be judged, without comment on my part. When Sir Harford Jones was led to understand that his negotiations with the Shah were so far satisfactorily brought to an end that in one interview he had completed "what the King of England himself in person could not have done," at the very next conference he discovered that he had scarcely progressed a step. And when on this second occasion he was led to believe that a treaty would be prepared the next day for his inspection, the appointed time passed without any communication from the local government or diplomatists beyond an inquiry after health, accompanied by the present of a large citron.

Mr. Scott Waring, in 1804, says, "the Persians are pleasing and entertaining companions; but not the least reliance is to be placed on their words or most solemn protestations." M. Tancoigne, the intelligent *attaché* of General Gardanne's Embassy in 1807, states his impression that the stranger whose ingenuousness would lead him to accept the word or put faith in the oaths and asseverations of a Persian, would infallibly become the laughing-stock of the falsest and craftiest people on earth. And so in the case of Mr. Mackenzie's project in 1875. Nothing has resulted from it, but a new illustration of the correct estimate of the Persian character formed by the more experienced of European travellers.

I have now to say a word on land communication between India and Persia. In so doing it is impossible to avoid allusion to railways, though, as before stated, my views will doubtless appear to many visionary and unsound.

Before railways, however, much may be done in improving existing routes, by protective measures in Persia, and open encouragement on the part of the British Indian Government. There should be no difficulty in obtaining the first by diplomatic action at Teheran; and the latter would be best afforded by the nomination of qualified consuls at Yezd, Karmân, and Bandar Abbas.

When passing from Ispahan to the sea-board of Baluchistan in 1865-66, I found at Yezd and Kermân in Eastern Persia about 4,500 Parsis, with 1,500 Jews, in addition to the usual Muslim inhabitants. The Hindus of Shikârpur, though few in number, sufficed to represent a commercial nucleus at either place. On revisiting the same two cities in 1870-71, the Parsis of Yezd were reckoned under 4,000; the Jews at 800; and the 17 Hindus had been reduced to 5; while at Kermân it was stated there were only 180 Parsis and 50 Jews, but as many as 40 Hindus in lieu of 15. I cannot but think that, greatly as such numbers may fluctuate, and strong as may be the inducement to emigration held out by the recent famine, the Parsis and Hindu element in these parts is favourable to the development of Indo-Persian traffic, even by a long and clumsy overland route. What would be the result of constructing a railway from Kermân to Karachi, I can only compare, *mutatis mutandis*, to that of opening a monster hotel in an eligible, but unfrequented site in America. When the new building, according to Mr. Anthony Trollope, "rises up in the wilderness, it is presumed that people will come there with the express object of inhabiting it. The hotel itself will create a population as the railways do. With us the railways run to the towns; but in the States the towns run to the railways. It is the same thing with the hotels." I have already referred to the honour given to the mercantile profession among Mohammedans, and cited the instance of a late governor of Kermân. It may be added that Yezd is not behindhand in supplying individual illustrations of the intelligent and enterprising Muslim merchant. Hajji Muhammad Taki, whose prepossessing appearance and civilised address at once make him remarkable, called upon me with a compatriot, and expressed his desire to have a telegraph line constructed from his own city of Yezd to Dehbid (on the main road between Ispahan, Shiraz, and Bushire), urging that if British officers would undertake the work, the native merchants would gladly pay the cost.

Having myself been over every inch of ground between Karachi and the Caspian, and knowing the distances from station to station, I am fully sensible that the journey by caravan from the former place to Kermân would occupy from six to seven or eight weeks, and that the intervening tracts must, for the most part, be barren of provisions and population. But the winter road from Kermân to its own natural port of Bandar Abbas is more than a third of the distance to Karachi. Many parts of it are barren also, and there is mountainous and hard country to be traversed. To Bushire the distance is, of course, much greater. Add to this the sea voyage—so distasteful to the garden-loving Persian and the Banian wedded to observances—and I do not think we should wholly refuse to acknowledge the fact that land traffic is, at least, possible between Western India and Eastern Persia, through Mekrân. I have elsewhere ventured to assert that if, as to be desired, the lately determined frontier be applicable to the furtherance of national prosperity, peace, and civilisation, it must not be let alone as a mere geographical line, but utilised for commercial purposes and improving the means of international traffic. And there is little doubt in my mind that a coast line of route from Karachi to Gwâdar, made thoroughly easy and practicable by artificial appliances; or a like line from Karachi to Kej, through the valleys, parallel to the Mekrân coast, and continued from either Gwâdar or Kej to Bampur and Karmân; or, indeed, a long coast line to Jask, and thence upward—all meeting at Kermân—might not only be made a safe route for caravans, but one (the last-named) might be found further suggestive of a very possible railway. Such a line would, of course, be a mere instalment of one long line to England. For the rails might almost be laid without preparation from Kermân to Yezd; whence, to Kashan and Tehran, or Ispahan and Shustar, or the Turko-Persian frontier in Kurdistan, there is no obstacle which would not succumb to engineering skill. In getting thus far, we approach to a junction with the Euphrates Valley Railway, which assuredly must, at no very distant date, be a reality. At the present moment it is in abeyance; but neither does the impending war, nor the general aspect of the political horizon, lead us to regard it as defunct.

DISCUSSION.

The Chairman said he knew Persia only by the map, but he was particularly anxious to see one subject taken up, and that was the importance in a poor country of a cheap mode of conveyance. We had got so much into the way of being carried by wonderfully cheap and convenient railways, that we easily lost sight of the fact that a different system was requisite for a poor country. To get an idea of the importance of this subject, he might mention that once in the delta of Trinchinopoly, a little line of canal, scarcely better than a ditch, was opened, which enabled them to carry materials at a very small price, three men at about 6d. or 8d. a day, each were able to take 25 tons 30 miles, and the result was that those barren rocks which were utterly useless before were carried down into the delta and sold. If goods were carried by means too expensive they were not saleable, and the communication might as well be wanting. He was not going to fight the battle of railways *versus* canals, but he would urge that whatever plan was recommended, the figures should be worked out to see what would really be the cost of carriage. It might, in some cases, be a question whether a railway should be made at all, or whether even the commonest road was not better for a country with small produce, and which could not pay the interest on more expensive works. The idea of the country paying the expense by taxation, and then thinking that the cost of transit was cheap, was an utter delusion. The cost of carriage must cover, in one way or other, the interest on the amount of capital sunk in the undertaking. In Persia, circumstances were such that little could be done for many years either in canal or railway traffic; a highly-finished railway was a machine too costly for such a great extent of country, especially considering that the quantity of goods carried for many years to come, would be insufficient to pay for it. With reference to canals, the want of water throughout the great portion of the country negatived the possibility of their being employed. Major Champain's proposal to bring the river Karun into use was unquestionably the thing for Persia. What was wanted was to arrive at the cheapest possible means of bringing the produce to the coast for the advantage of ocean carriage, and the sooner you could do this the more likely you were to bring it into distant markets at a cheap rate. It had been suggested that small tramways, such as were used in mining districts, might, perhaps, be of great use in Persia; but that, he thought, must be for the future. One suggestion was to have a 15-inch road, carrying a load of half-a-ton; but at present the main consideration in his opinion was how to get the produce in the cheapest manner to the coast.

Major Champain said he was decidedly opposed to attempting at present the establishment of railways in a country like Persia, and it was quite true also that canals could not be introduced, because there was absolutely no water in the country. It was 5,000 or 6,000 feet above the level of the sea, intersected by ranges of mountains, and there was not a navigable river in the whole country with the exception of the Karun, in the Arabistan country. He was not the originator of the idea of developing traffic on this river, for Messrs. Gray, Dawes, and Mackenzie knew much more about it than he did, but he thought the scheme was quite feasible. What were called commercial roads in Persia would hardly be understood by any one who had not been there to be roads at all; in fact, the Persian mules could go over anything; he believed that, if necessary, they would go over St. Paul's, and come down on the other side. It was possible that something might be done with railways in some way, for a little while ago he had a message from one of the Shah's officers, saying the Shah was anxious to start a sort of toy railway between Teheran and a place about six miles to the south-east, and he was in hopes that would be done, because the country was very easy, and it might have led to a further extension. He, therefore, put himself in communication with Messrs. Ransome, the well-known engineers, who made a line of that description in China a short time ago, and obtained an estimate from them, which was very moderate, and he was in hopes an order would have been sent home, but he was sorry to say the Shah at present had dropped the subject, and it had come to nothing. As regards the present condition of Persia, it was very bad indeed; there was no money in the country, and the recent famine had had a very disastrous effect. Last time he was there he saw numerous villages, which he remembered prosperous, well inhabited places, now absolutely deserted, and between Bushire, Shiraz, and Ispahan, it was almost impossible to travel, the people having been driven by want and bad government to brigandage; the consequence was, the number of caravans decreased, and it was almost impossible for a single traveller to pursue his journey. With all this, he was sorry to say that Persian Government shut their eyes to the opportunities offered them of developing their trade, and at present the country seemed in a very hopeless state.

Mr. Hyde Clarke remarked, that if nothing else sprang from the present meeting than public attention being called to the Karun route, it would be of great benefit. Although the condition of Persia was such as had been described, yet, while there were resources in the country which had at former times been developed, and had attracted the attention of everyone acquainted with the country, it was certainly still capable of development if only means of transit were afforded. He would not enter into the question of the availability of railways in Persia. Fortunately for us, expensive railways had not been made in Persia, but still, he thought, Persia was just the country in which they must have railway communication of some kind, the moment its commerce was so far developed as to enable one to take measures to that end. Perhaps they had no cause to regret that the experiment referred to by Major Champain, of the short railway from Teheran, had fallen through. Many, probably, in that room, had been in one way or another connected with the project of a railway from Teheran to Abdul Aziz, which luckily had not been carried out by English hands, nor as yet by Russians. But if, under any circumstances, it was carried out, it must strike a very serious blow at English commerce. On the other hand, if the line of the Karun could be opened, it was the safest and most assured means of opening Persia to commerce, and he would beg leave again to call attention to the picture of the country given by Sir Frederic Goldsmid. The circumstances of the country were not so bad with regard to the poverty and sparsity of the population as with regard to the government and the political condition; and if, therefore, they wished to penetrate into the interior, it must be done by some route on which English influence could be brought to bear. He feared that the efforts of Major Champain and others, with regard to the Karun route, had not been so strongly supported by our own Government as could be desired; but if advantage were taken of the opportunities which sometimes offered, he believed we might ultimately get a route which was capable of being protected by our own Government, and which would give access close to Ispahan, and lead to great development of commerce. Not only so, but they would be safe from the evil which had been referred to, of insecurity, because good commerce gave the means of protecting itself. It had been proposed in connexion with this route that the customs of Mohamereh should be applied as a fund for its improvement. When you got to Ispahan there was a good country for opening a railway of some kind to Teheran. This subject had occupied the attention of the Chambers of Commerce in this country, but few had had an idea of its real importance. He trusted, therefore, that this paper might have some practical result; that the members of the India Committee would call the attention of that committee to it, so that it might again be brought before the Chambers of Commerce, and through them under the notice of the Government. It was only by continual agitation you could keep a subject of this kind alive. It was upwards of a generation since the Karun route was known to be a practicable one, yet there were few merchants in London, or probably in England, who knew anything of the nature of the route. There had been a period when the British Government exercised a real influence in Persia, and when it might have secured the opening of this river, and he hoped such opportunities would not be let slip again.

Mr. T. K. Lynch said he went to Persia in the year

1841, and from that time to the present had been either in the country or in constant mercantile communication with it, and it was under the direction of his brother that Lieut. Selby explored the Karun route. He was then a merchant, and did all he could to open that route, for they found they were so plundered by the merchants and people about Shuster, that it was impossible to carry on any business with them except by ready money transactions. You could deal with the Turks, but with the Persians you must either have ready money or they cheated you, and you got no redress. Even our own Government could not get redress sometimes. They, therefore, endeavoured to open up the Karun route, and there was no doubt it was a route which could be protected by any Power having the command of the sea, and it was therefore most essential to England, even at some sacrifice, to open that river. Between the Karun and the river which watered Ispahan, the distance was only 50 or 60 miles, but it was a different watershed; in fact, it was a project of some of the old kings of Ispahan to turn off the Karun from a higher branch into another channel, and bring it to that city, and a tunnel had even been commenced to do so. Of course it would cost a great deal of money, and be an arduous undertaking, but looking at the geographical position, it would be a matter of the most vital importance to England if such a thing could be secured. His firm was the first in England which commenced a direct trade between London and the Persian Gulf, which was in 1841, and ever since that time their vessels had made constant voyages.

The Chairman inquired if there was any native traffic on the Karun.

Mr. Lynch said very little. His firm attempted to establish cheap communication there in connection with the Sheik Jabbah; they went into partnership with him, and tried to develop the trade, because the Persians to the duty of ten krans being imposed on every person would not allow the British flag to go there, but, owing who came down, they were obliged to give it up. They then obtained a concession from the Turkish Government to establish a line of mercantile steamers between Bussorah and Bagdad. The latter place had not been mentioned, but it was really the centre to which he thought they ought to turn attention. Persia was a poor, wretched country, very barren of water, and difficult to traverse, but his firm had established traffic by steamer all the way from London to Bagdad, and they could now take goods the whole distance for about £3 a ton with perfect security. They had a steamer there which ran up in 70 hours, carrying 300 tons of cargo, whilst the Karun would never take steamers of that size, in fact it was very shallow at certain seasons of the year, whereas the Tigris was a very fine river, flowing through great alluvial plains. They could now send goods to Teheran *viâ* Bagdad cheaper than they could get them through Poti; and another point for mercantile men to consider was that at Bagdad you had an immense population—70,000 or 80,000 people—and a large population besides all round it, because the holy cities of Persia were in the immediate vicinity, and about 30,000 or 40,000 pilgrims came annually. A railway between Bagdad and Teheran would be of most vital importance to Persia, but even without a railway the passes on that route were very easy, there being only one of any importance at all, and that a very small one—the Korind pass. Still, there was a better route from Bagdad than Mandelli. But, whilst mentioning these routes, he did not at all disparage the Karun route, which was, no doubt, a splendid one.

Sir Frederic Goldsmid asked if there was any traffic in goods from India into Persia *viâ* Bagdad, and if the Turks would not impose a duty.

Mr. Lynch said there was a considerable commerce that way; they only charged one per cent. for transit, and were very liberal in their assessment. The other day they had a letter from their agent, saying the goods had been sent on without paying anything. All their trade from India went through Bagdad. He might also mention that the whole of Syria and Anatolia used Ispahan tobacco, so that there were constantly mules coming to Bagdad with it, and they were very glad to get any kind of goods to take back again.

Mr. Hale thought railways must be the panacea, and if they could not be introduced at present, wheeled vehicles might, or possibly tramways.

The Chairman said possibly tramways might be a great help to the country.

Mr. Scott Russell, F.R.S., said that, as an engineer, he regretted very much he had not had an opportunity of examining Persia and Baluchistan, with reference to the passage of something like a modern railway through that country; but a year or two ago he had examined the country between Constantinople and Bagdad with a view to railway communication, having as its ultimate end communication with India through Persia. The conclusions he came to were very applicable in some degree to Persia and Baluchistan. As he understood, there was a high plain of 4,000 or 5,000 feet inland, and, though some gentlemen were appalled, as he was, when asked to go and survey a country some 5,000 feet above the level of the sea, when they came to examine it, it would be found that this height made no insuperable difficulty. He had seen far more difficult lines going up small heights and down again in Wales and Scotland, and anybody who had considered the subject would see that to go up 500 feet and down again, and then up another and down again, was quite as difficult as to go up 500 feet and then up another 500 feet straight on. The question of these great heights, therefore, had nothing to do with the matter, but these beautiful level plains had a great deal to do with it. On the other hand, it must not be supposed because they spoke of these as level plains that there was anything like accommodation for wheeled carriages. The roads for mules and camels were not at all analogous to what were called roads in England. His mules very often, when going along what was called a road, had to put their feet nearly up to their knees in successive holes in the rocks, which had been made by mule going after mule for the last 3,000 years, and as each mule put its foot into the hole made by its predecessors, of course the holes went on getting deeper and deeper, and the mules became so clever that, as had been remarked, he believed by a little management they might be got over the top of St. Paul's. There was a prudent way of making railways as well as an imprudent way, and he was ashamed to say that Englishmen, when they went into foreign parts, very often committed the blunder of putting an expensive and extravagant railway where there was no necessity for it, and employing a great quantity of things utterly unsuitable to the country, though they might be very wise and economical in a densely-populated country like England. An American engineer, if he were asked to survey for a railway from Constantinople to Kurrachee, would certainly begin with the view of laying the first track, as he called it, in an extremely economical manner. Whatever charge he might make to the person for the railway, he would certainly lay it down at a cost to himself of not more than from £3,000 to £5,000 a mile. It would not be an English railway, on which you could send heavy trains at sixty miles an hour; but a railway intended for moderate speeds might be constructed upon a sound financial footing, and in a conscientious manner, through such a country, without any extraordinary works, and at a very moderate cost. He did not venture to say that the local traffic, even if it were wisely conducted—and he entirely agreed that any such line should include Bagdad, Ispahan, and all the principal cities between Kurrachee and Constantinople—would ever pay of itself; but, with

India at one end and all Europe at the other, a moderately-constructed, economical railway, worked at a moderate speed, and therefore at a moderate cost, might have a very great influence on the commerce of England, of Europe, and of the East. Instead of imitating the follies of those who had made railways before, they should take warning by their experiments and utilise their experience, not in making railways of an exceptional gauge, because two pieces of iron were no cheaper if they were put near together instead of further apart, and it cost exactly the same to draw the trains along. An exceptional gauge, therefore, was a great folly, but a light rail might be used. A 40lb. rail was considered in most countries to be very feeble, but he could only say he had been engineer to a railway on the Continent in which such rails were employed, the whole line and rolling stock being properly adjusted to one another, where dividends were constantly paid at the rate of about eight per cent. He therefore believed that a properly-constructed, economical railway, with well-managed traffic, might be profitably worked between Europe and India if it were carried right through, but not if it ran in patches, a little bit of rail here and a little bit of rail there, because the local traffic would not be sufficient to be remunerative.

The Chairman brought the proceedings to a close by moving a vote of thanks to Sir Frederic Goldsmid, which was carried unanimously.

AFRICAN SECTION.

Tuesday, April 24th, 1877, Vice-Admiral Erasmus Ommanney, C.B., F.R.S. (Vice-President of the Society), in the chair.

The paper read was—

THE TRADE AND RESOURCES OF MOROCCO.

By Arthur Leared, M.D., F.R.G.S., M.R.I.A.

When honoured by a request that I should contribute a paper on Morocco to the valuable series relating to Africa, that is now being read before this Section, I was only induced to accede, because so few persons have turned attention to that portion of the vast continent. Having travelled in the country, and collected a good deal of information, I hoped to be able to bring forward some details of interest. But Morocco differs in this notable respect from other African countries so ably treated of from this spot, that in its case we have to deal with an ancient kingdom, possessing a long established Government and social system, lapsed into semi-barbarism. Its history is that of a nation in its dotage, in which, with reversed engines, the vessel of the State has been borne down the stream of time, from a condition of grandeur and progress to one of squalor and decay. In a word, Morocco resembles a ruin in which whatever is admirable belongs to the past, and yet affords much to interest in the present. Morocco, moreover, presents the spectacle of a country almost unknown to the outside world, not because of distance, or climate, of forest or of swamps, but solely because of the jealous fanaticism of its people. Compared with other African regions, the country is at our threshold. From Southampton to Tangier the distance is only 1,300 miles. Tangier was indeed more than 20 years our own soil, having come with Bombay into British possession, as the dowry of the Infanta of Portugal who married our Charles the Second, and yet so little is known of this ancient, and, so to speak, long hermetically sealed land, that I feel it necessary to preface what I have to say about its trade and resources with some geographical and general observations about the country and its people.

The sultanate or empire of Morocco lies between 28° and about 36° of north latitude. Towards the south its boundaries are not very exactly defined, but its area has been calculated to be about 220,000 square miles, an area considerably in excess of that of Spain. Like a huge backbone, the great chain of the Atlas mountains extends through the whole extent of this large territory, from north-east to south-west; and upon this, at different angles, numerous lesser ranges are articulated. Many of the valleys and plains embraced by these ranges, watered by the rivers and streams to which they give rise, are surpassingly fertile.

Some of the rivers are of considerable extent, and all flow into the Atlantic. The chief of them placed in order from north to south, are the Lucos, the Sebos, the Oum-er-Rebiah, the Tensift, the Sus, the Noon, and the Draa. Very little is known about the three last, but it does not appear that any of the Moorish rivers are navigable to any considerable extent. Certain rivers, which receive the drainage of the eastern slopes of the great Atlas chain, flow towards the desert, and are absorbed in its sands. Morocco presents to the sea about 800 miles of coast, of which about 550 are exposed to the surf of the restless Atlantic, while 250 lie within the limits of the more tranquil Mediterranean.

The sultanate, as it exists at present, embraces dominion over three separate kingdoms, namely, Fez, Morocco, and Tafilect, united but not consolidated by conquest. The southern provinces which formed the kingdom of Tafilect are to this day very imperfectly known, and in several of them the sovereignty of the Sultan is practically ignored.

The country has three capitals, Morocco, the capital of the South, Fez, of the north, and, not far from the latter, Mequinez, which is the political and religious capital of the empire. There are many other large towns in the interior of the country, but everywhere there is evidence of decadence. High walls, by which the towns are surrounded, here present no barriers to extension. Thus, the large spaces more or less covered with ruins within the walls of the city of Morocco, testify to its far greater populousness in by-gone times than its present number of about 50,000 inhabitants. The chief maritime towns are Tetuan, Tangier, Larache, Salée, Rabat, Azamoor, Casa Blanca, Mazagan, Saffi, and Mogador.

Nothing is more difficult, in the absence of all official aid, than to arrive at even an approximate notion of the number of inhabitants so unequally dispersed over so large an area. Moreover, the population is, to a large extent, nomad, and some districts are at one time populous and at another almost deserted. It is no wonder that the most various estimates have been made; but, taking everything into account, it appears to me that six millions would not overstate the number of inhabitants. There can be no doubt that, since the sixteenth century, the population has materially diminished. Of this, as regards many of the cities, we have, as already said, absolute proof. In some of the sea-ports, however, the number of inhabitants, more especially of the Jews, has considerably increased. It would be out of place to attempt, within present limits, any detailed account of the various races which inhabit Morocco. It would be difficult to find anywhere a more heterogeneous population, or one which presents less the necessary elements of cohesion. The Moors, who inhabit the towns, are the degenerate descendants of that splendid race which, in the eighth century, overran Spain, and so long contributed to the furtherance of art, of science, and of commerce, and to which Europe and the world are to this day so largely indebted. Expelled at length, after ages of occupation, and thrown back upon the country from whence they issued, they present the spectacle of a people which has retrograded under the influence of of various malign causes, to a degree elsewhere unparalleled. Of the same race as the Moors, the Arabs are also of the same stock as those who still wander over the boundless wastes of the Sahara. Arab migrations from the desert into Morocco now and then occur at the present day. Although agriculturists, they preserve, to a large extent, the habit of living in tents. Restless and turbulent, they are a cause of perpetual trouble to the Government, which, on account of its weakness, is often driven to encourage their dissensions, in order to preserve the empire itself from disruption.

The Berbers are believed to be the descendants of the Gætulians, by which this part of Africa was once inhabited, and who are probably synonymous with the Mauri or Moors of the Roman Empire. They present considerable differences, and are known by different appellations in the wide territory over which they are spread. To a large extent they are mountaineers, and some of them —as the Riffs—are noted pirates and robbers, while others have settled into habits of industry. On the whole, they are less nomad and more tractable than the Arabs. As might be expected, from the constant influx of slaves from the Soudan, there is a large negro element in Morocco. But harsh as the process is by which these slaves are originally obtained from their native wilds, those who are familiar with Mohammedan slavery are well aware that it is a very different thing from that form of Christian slavery which was so long the great blot upon so-called European civilisation. Under the ægis of a religious system inferior to our own, yet, in this particular respect, certainly superior, the lot of the slave is seldom in Morocco a hard one, while the avenues which lead to liberty are constantly being thrown open. In fact, the highest offices of State are at times occupied by negroes, and the trusted guards of the Sultan (Bokhari) are recruited from their ranks.

Last, but by no means least important in this motley population, are the Jews. Here some data are afforded for actual computation. The Jews in the empire are said to number one hundred thousand. They are descended from those Israelites who, expelled from various countries of Europe, but chiefly from Spain and Portugal, found an asylum in Morocco. Here, brow-beaten, despised, and insulted, they present the strange anomaly of being possessed of influence and power. The never-failing ability, love of gain, and tenacity of purpose of the Jew, causes him here, as everywhere, to rise superior to misfortunes, and to hold his own against all comers. Here, too, as everywhere else, the Jew is a financier; he farms the taxes, and negotiates the business of the Government with the outside world. Moreover, the chief trade of the country is in his hands, he prospers and becomes rich; but it is his policy, as it is indeed of the Moors themselves, to appear to be poor.

The form of Government in Morocco is an absolute monarchy. It is in no figurative sense that the Sultan is said to be the source of all power and dignity, and, in so far as church government is concerned, the vicegerent of God on earth. One of the worst features of the system is, that there are no fixed rules of succession. The reigning sovereign, sometimes only on his death-bed, indicates that some member of his family, not necessarily one of his own sons, shall be his successor. It is sufficient that the person selected be one of royal blood, as the throne is restricted to a certain family, that of the Sharifs of Fileli, as the inhabitants of Tafileet are called. In this power of choice we see the arbitrary system carried to its extreme bounds, and in general the wishes of the deceased despot are respected. In not a few instances, however, the throne has been contested by some other more popular member of the family. The question is then fought out at the expense of the unhappy towns and tribes which espouse the respective sides, until one or the other yields. The conqueror, once duly proclaimed Sultan, is afterwards seldom molested; but as regards the conquered, *Væ victis* may with truth be said. It is only when the Sultan has been proclaimed by the council of priests and magnates at Fez that his title to the throne is considered established. But, although the authority of the Sultan is, in theory, and to a large extent in practice, absolute, there are certain limits which he is obliged to observe. He is bound to respect the "shraa," or sacred law, derived from the Koran, any signal infringement of which would lead to rebellion on the part of his religious subjects. Neither can the ruler safely set at defiance certain national usages and customs sanctioned by his ancestors. Nor, unfortunately, is the Sultan altogether a free agent in the matter of reforms, either as regards mode of government, or of things affecting the habits or prejudices of his own subjects, or the privileges conceded to foreigners.

For administrative purposes, the empire is divided into provinces, and these are sub-divided into districts, which are respectively governed by kadies and sheiks. But, besides these, each village has its mukaddam, or head man, who is responsible for the good order of the people amongst whom he lives. Governors are generally selected from the most influential persons of their tribe or district, and, except in a few cases, are entirely unpaid by the State. It is their duty to maintain order, and they can punish by fine, imprisonment, and the bastinado. Capital punishment alone is inflicted by direct order of the Sultan. But the duty of the governor, above all, consists in levying and recovering taxes for the Imperial treasury. And it is in connection with this part of his duties that he is induced to exercise his function of inflicting fines in a most arbitrary and unequal fashion. Sheiks and mukaddams are also unpaid officials.

The kadies, or judges of the land, as we should call them, are appointed by the Sultan. But what is to be thought of a system which allots to the judge a pittance barely enough for subsistence? Take, for instance, the present kadi of Tangier, one of the chief ulemas of Fez—a dignitary of the church,—until lately his salary was equal to the magnificent sum of £2 17s. per month, but, at the representation of our minister it has been raised to £4 8s. per month with the allowance of certain fees.

The result of such a state of things as that just described is that the unpaid governors and sheiks squeeze from the people committed to their charge as much as lies within their power. Pillage, extortion, corruption, and injustice are nearly universal. So with the almost unpaid kadies or judges the longest purse invariably prevails—justice is not administered, it is sold. Even the police are either unpaid or receive only a slender allowance, which is supplemented by what they can extract from those who come within their clutches.

To this wretched system of administration the chronic state of disorder which exists is in greater part to be attributed. Harrassed by oppression, and driven to aggression by despair, the people rise in revolt, now in one portion of the empire, now in another. From this cause it often happens that, while the Sultan is engaged in punishing the tribes in one direction, he is compelled to desist until a more convenient time, in order to suppress a more serious rebellion elsewhere. What can be expected from such a system, or what hope is there for a country so governed? Who can wonder that life and property are alike insecure, the people barbarous, and the fertile land almost a desert?*

But supposing the Sultan to be personally disposed to reforms—as there is good reason for believing the present ruler to be,—unfortunately the difficulties which beset him are immense. Every man in power, and every expectant of power, ministers, officers of court, governors, and kadies, is interested in supporting a system by which all are enriched irregularly, and not equally even in similar posts; but often more rapidly, and to greater extent, than could possibly be the case under any other state of things. Hence it happens that the Moorish is probably the most conservative Government upon earth.

It is quite certain that, under an improved method of collecting the taxes, both the Sultan's treasury and the people would be largely benefited. Taxation in Morocco is nominally not oppressive; to English ears it will sound strange, but it is no less true, that the people are forced by the governors to pay, not double merely, but often treble what could be legally demanded. But only a small proportion of the money thus extorted finds its way to the treasury. By far the larger part is retained by the governors, and much of this is paid as bribes to the ministers and court officials, whose favour is necessary for the retention of power. If to this be added the constant expenditure incurred in reducing tribes revolted on account of the pressure of taxation to subjection, the argument that the revenues of the country would be enormously benefited by abolishing the present system of collection is conclusive.

In one rough and ready way a good deal of the money squeezed out of the people—besides that officially paid in—finds its way to the imperial coffers. Besides the lavish use of bribes above mentioned, every governor is expected to appear periodically at court, and to make his visit acceptable to the Sultan by a large present in money. And if these presents are withheld, or if they are more than suspected of being small in proportion to the power of accumulation possessed by the governor, an excuse for his impeachment and the confiscation of his property is seldom wanting or long deferred.

And yet even for this fair but wretched and impoverished land it may be hoped that brighter days are not far distant. The plan of paying the governors of provinces has been repeatedly suggested to the late and to the present Sultan. At length the experiment has been made in some districts in which the difficulties in the way were least formidable, and already, as shown by increased contentment and wealth of the inhabitants, with the happiest results. Let us hope that the thin end of the wedge has been inserted, and that a great measure of reform will soon follow.

Previous to the treaty of 1856, the system of not paying salaries prevailed in the custom-houses. As a matter of course, the customs revenues were largely defrauded. By the wise recommendation of Sir John Drummond Hay, the plan of paying the administrators was introduced, to the great advantage of the treasury. Lately, great irregularities and extensive frauds have been discovered, but these might be expected under a comparatively new system of things, and will, doubtless, be rendered more difficult by improved checks upon the administration.

Agriculture in Morocco is of the most primitive kind, and yet magnificent crops amply prove the fertility of the soil. It is only when within easy reach of some town that land can be said to be of any value. Even in some of the most fertile and best grain-growing provinces, as Abda, Doquella, and Stooka, thousands of acres lie waste and ownerless. The magnificent plain of Morocco, with its deep soil, only cultivated in spots, might grow wheat sufficient to feed a vast population. Except in the mountains, the soil of the whole country is, as a rule, unusally rich. In some places, as in Bled Ahmar, the earth is of a red colour, and in the dry season the dust which it causes, driven by the wind, gives a reddish tinge to everything in the district.

It is remarkable how easily persons, otherwise intelligent, may be led into error from hasty observations. Not long ago, I met with a merchant whose business led him to Morocco in the height of summer. The country was then in a state to which that of winter in this country affords no parallel. He declared that he could not conceive how human beings could live in a place where nothing green was to be seen on the surface of the ground, and hardly a green leaf on a tree. He could not realise, what I assured him was the case, that in spring all these barren wastes were as verdant, or very nearly so, as his own country. Had this gentleman visited Morocco during the season of rain, his recollections of the country would have been wholly different. The effect of rain, or of irrigation, is almost magical. The great requisite of the Moorish farmer is water. Of the uses of manure he is almost ignorant. His agricultural implements could hardly be more primitive. His plough consists of a prostrate log of wood, pointed at one end for the purpose of scratching the earth, while it is directed by a handle inserted in the other end. A short pole projects from the centre of the log, and to this a pair of bullocks—or, it may be, of donkeys—are roughly attached. Sometimes, when the tax-collectors have seized the animals, a woman or two may be seen unequally yoked with a donkey. The hoe is the only substitute for the spade, a thorn-bush serves for a harrow, and miniature sickles complete the equipments of the farmer.

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* I have strictly endeavoured to avoid exaggeration or misstatements in this paper, and, therefore, not to apply to the present what belongs to the past. For much recent information about the state of the country and its resources, I am indebted to Horace White, Esq., H. M. Consul at Tangier, than whom no one possesses more accurate knowledge.

For cultivation, as has been already said, the one indispensable thing is water, and, fortunately, this element is in many places abundant. The mountains, which are so prevalent, supply many perennial streams, and irrigation is practised to some extent. Now and then, the irrigating wheel, so common in Egypt, is seen. But, in many places, wells afford the only water-supply in the dry season. Some of these are of great depth, and water is drawn from them in the most clumsy manner possible. The bucket is a bag of cow-skin. To this a long rope is attached, which is passed over a bar placed across the mouth of the well, and the bucket is drawn up by men walking away with the rope. There can be no doubt that immense improvement could be effected in the system of irrigation from rivers, and in the construction of wells. Mr. Jackson, a former consul at Mogador, who knew Morocco well from long residence, writing in 1820, says, "It is impossible to conceive the abundance of corn produced by this prolific land, none but those who have actually seen the standing corn in the ear, and have seen it reaped, can form any correct idea of its prodigious increase."

A method of storing corn is practised all over Morocco which might with advantage be imitated in India, at the Cape of Good Hope, and other places where the climate is sufficiently dry. An excavation generally, in the form of a cone, is made in the earth. This, which is called a *mitfere*, is of variable size, but sometimes large enough to contain 2,000 quarters of corn. When filled, the *mitfere* is hermetically sealed with a composition made with lime, and it has been found that corn so stored remains perfectly sound for twenty or even thirty years.

The manufactures of Morocco have a rare excellence of a certain kind, but are confined within a limited range. Weaving is carried on by the aid of a loom of very rude and primitive form, silk fabrics being principally made in Fez; and woollen fabrics in Rabat and Morocco. The most beautiful of the woven fabrics are certainly the carpets, in which the colours are derived from madder, pomegranate peel, henna, logwood, cochineal, and indigo, in all cases employed without mordants. Some very good glazed earthenware of a coarse quality is also made at Fez. Much of the metal work is very admirable. There are skilful coppersmiths, goldsmiths, and gunmakers in all the large towns. The graver is used with great taste and power, as may be seen in the elaborate decorations of brass trays, which are produced off-hand without the employment of a pattern or sketch of any kind. The best gun-makers are found at Tetuan. The Morocco leather, which is of world-wide acceptation and fame, is prepared from goat-skin, and is died only of four tints, namely, bright yellow, white, red, and brownish-red. The value of this manufacture is fairly expressed in the quantity of slippers which are annually exported from Morocco. In the year 1867, 329,000 pairs, worth over £47,000. were despatched. In the year 1870 the export was 174,800 pairs, worth nearly £26,000.

The woollen stuffs and carpets exported from Morocco in 1871 were worth £16,000.

Mining industry, which is at present systematically discouraged, might be prosecuted to great advantage in Morocco. The southern provinces are especially rich in minerals. The mountains which separate Sus from Draa abound in iron, and fifty or sixty miles south-west of Terudant, iron of a very superior quality, used for making gun barrels, is found. In the same ridge of the Atlas mountains are several mines of copper, combined with gold, and also rich silver mines. Lead, sulphur, and saltpetre are found to the east of Terudant. Antimony and lead are also found in Sus. This does not exhaust the list of mines of which the Atlas is so productive. Possibly, in the districts near the seats of power, mining might be carried on by European capital and skill, by special permission of the Sultan. But in Sus and the southern districts the attempt would be utterly hopeless until life and property become secure.

In the investigation of the material resources of the great African continent, so assiduously carried out by this Section, one of its marked features has been brought prominently forward. I refer to the singular want of good harbours presented throughout such an enormous coast-line. Moreover, the West Coast of Africa is at times rendered inaccessible, and very commonly difficult of access, by a dangerous surf. The Moorish Atlantic coast participates to the full in both disadvantages. There is no safe anchorage for vessels at any of the open ports. The southern port of Agadir possesses a fairly good harbour, but has been long closed against trade, because it is so far from the seats of power, and the neighbouring tribes are too unruly to be trusted. It is no unfrequent thing for vessels which have been lying-to for many days in the offing, while waiting for an opportunity to load, to be compelled, through stress of weather, to leave the ports altogether. Morocco, as might be expected, has a bad reputation amongst shipowners.

Notwithstanding these great drawbacks, the trade of the country has largely and steadily increased since 1856, when the British treaty was signed. The abolition of certain almost incredible monopolies, reduction of duties, and improved customs administration, were then effected. Permission was also then obtained to export certain kinds of grain, provided the state of the harvests allowed of it. All this combined to give a new life to trade. Ports that had been previously almost unfrequented at certain seasons, now show a creditable activity.

The main element in this increase of trade is to be found in the removal of the embargo against the exportation of beans, peas, and maize. When Sir John Drummond Hay proposed to the Sultan Ald-er-Rahman, the grandfather of the present ruler, to allow the exportation of these articles, the answer was, "There is not sufficient at any port to load a single vessel." Sir John replied, "I ask, then, but a small favour, and I trust that your Majesty will please the British Government, myself, and the merchants by granting it." The exportation was allowed, and the first year one vessel only was loaded, but during this present year as many as thirty vessels have been congregated at a single port for the purpose of loading.

At the present moment, owing to the great supplies furnished by Morocco, the value of beans in the English market is unusually low.

Now it is quite certain that the influx of wheat—the cereal in such unlimited demand amongst us—from a country so well adapted for its production, would be as large in proportion, were that production not stimulated but even permitted. But a strange infatuation possesses the Moors on this subject. Wheat, the staff of life of the true believer, must not be given to the infidel. Like any piece of written paper, because, perchance, it might contain the name of God, wheat must not be trodden upon, because it is food *par excellence.*

In the open corn market of the city of Morocco wheat is exposed for sale in heaps on the ground, and I received a friendly warning to be most careful not to step on any scattered grains, lest the inadvertency might cost me my life by the dagger of some fanatic bystander. Tradition says that, once in by-gone days permission was granted by the reigning Sultan to send wheat out of the country, and that a dreadful famine was experienced in the following year. The fear of a like consequence acts with full force in preventing the merchants from obtaining a concession so desirable for the interests of Morocco and of the nations of Europe. So deeply rooted, indeed, is the prejudice, that it is said that, on the accession of a new Sultan, to the throne, he is required by the ulemas, or leaders in religion and law, to take an oath that he will not allow the exportation of wheat from his dominions. However, this may be, it is certain that, notwithstanding the immense gain that would result to their treasury from dues levied by the custom-houses, the Sultans have in recent times resisted every pressure that could be brought to bear upon them to sanction the exportation of wheat. The same prohibition extends to barley.

European residents in Morocco are only to be found at the sea-ports. They are most numerous at Tangier, where the different Governments are represented. Mogador comes next, where the English number about forty. At some of the coast towns, such as Azamoor and Agadir, there are no European residents.

Notwithstanding these prohibitions, the concessions which have now been in force for more than twenty years are slowly being followed by good results. Every year more ground is brought under cultivation, for the production of maize and beans, in favoured districts, and in those especially in which the experiment of paying salaries to the governors is being made. In these, too, the evidence of increased wealth in the comforts and appearance of the people is beginning to be shown. But in the less favoured districts the external signs of improvement, if it in any degree exists, are nowhere visible. All evidence of increasing wealth is carefully concealed, and burying money in the earth is a universal practice. In order to extort confessions of the hoarded stores, the bastinado is constantly employed by the tax-collectors. As might be expected from the greater abundance of money, the price of labour and of all commodities have greatly increased within the last few years.

It is at the sea-ports of Mazagan, Casa Blanca, and Saffi, from which grain is almost exclusively exported, that the improvement due to the development of trade is chiefly to be observed. Poor, squalid, and uncared for as these places may appear to the European stranger, their progress has been relatively great. Where, a quarter of a century ago, nothing but small mean, houses and huts existed, many well-built houses and stores, belonging to European and native merchants conducting large businesses, are now to be seen. It was stipulated in the treaty of 1856 that British subjects should be allowed to build houses on sites provided by the Government. But the late Sultan preferred the plan of himself building the houses and stores, for which a rent of 6 per cent. on the money expended in construction was charged. This system has been altered by the present Sultan, in consequence of the increased demand for buildings at the ports, and also of the difficulty in some instances of obtaining the rents. He has, in consequence, recently declined to build at his own cost, and the provisions of the the treaty will in future be carried out. Merchants will be required to pay a ground rent, and to build their own houses, which, after a certain term of years, will become the property of the Government.

It is plain, from what has been already said, that while the Sultan of Morocco is in one sense so complete a despot, that the lives and property of his subjects are at his disposal to a degree we can hardly conceive, he is in other respects a less free agent than many other potentates. In everything which regards intercourse with the infidel and outside world, or which bears upon it the stamp of being derived from that world, he is compelled to revolve within the narrow circle of a jealous and crushing theocracy. For this reason, the Sultan, as an individual, must not be held responsible for the faults of the system to which it may be, he is simply a victim. The present ruler of Morocco, Muley Hassan, is said by those who are best qualified to judge, to be a man of kindly disposition, and of liberal views. He has already shown a disposition to reform abuses, and to introduce European methods, as far as he thinks can be done without risking too much opposition. But he has recognised the principle that if much is to be done the first step is to secure the power to do it. He has therefore set himself the task of establishing a well equipped and disciplined, but not necessarily a large force, by which his throne will be secured against the risings of the wild and fanatic hordes which have proved so disastrous to his predecessors. It is only by this means that reforms can be attempted in Morocco without damage to good order and public security. At the present minute it is in contemplation to send some young men, selected for their intelligence, to be educated in European military colleges. Already a number of men, to be increased to one hundred, are learning drill and military exercises in our garrison at Gibraltar, where they have shown great aptitude and are deservedly popular. These men are intended to be employed in their own country in the formation of a highly disciplined force. It would be difficult to find anywhere better material. Of fine physique, the Moor is brave, obedient, and enduring under privation and fatique. The present force of the Sultan is said to be 7,000 Askar, or troops formed, more or less, on the European model, and, in addition, 6,000 irregulars, horse and foot. He can also assemble 25,000 militia, when raids are to be made into rebellious districts. But, in all these, a want of cohesion combined with mobility, which discipline alone can give, renders them of little real value.

It will at once occur to the English mind that railways would tend to develop Morocco more than anything else. In an engineering sense the country is badly adapted for their formation, but in some places the difficulties would not prove extraordinary, and a line between the city of Morocco and Mogador, a distance of about 130 miles, would probably prove one of the most useful, but the nature of the ground, as I have proved from elevations taken with an aneroid, would make it a very costly undertaking.* The country between Morocco and the sea-port of Mazagan is more favourable, but the first want of the country is ordinary roads suitable for draught. Without such roads as traffic feeders, railways could hardly succeed. It is a very notable fact that at the present time there is not a wheeled vehicle within the dominions of the Sultan, and that there is not a mile of road anywhere better than a mule track.

Nothing would tend more to stimulate trade and to break through the isolation of the country, than a submarine telegraphic system, extending from Gibraltar along the coast to the Canary Islands, with branches to the Moorish coast towns. Such a plan has been in contemplation, and it is understood that no opposition to it would be made, but the project has not been regarded sufficiently hopefully by its promoters to induce them to put it into execution. The prejudices of the people against such an innovation are so great, that it is not likely that land wires would be unmolested. When the submarine line had been in existence some time, the successful formation of branch lines to the interior would undoubtedly follow. And it may be well, perhaps, here to state that the thing which is most essential beyond all else for further improvement in the relations between Morocco and England is, that the British minister should reside at Fez, or near to the seat of government, instead of at Tangier, which is removed from that seat by a virtually impracticable distance. So long as the residence of the British minister remains at Tangier, his influence over the Sultan and his government cannot be constantly effective.

The intercourse between Morocco and the Soudan, and more particularly with Timbuctoo, that capital of a long established community of negro Mohammedans so little seen by European eyes, the name of which is a by-word for the inaccessible and the remote, is very considerable and constantly increasing. The great annual Moorish caravan is formed by contingents which set out from various parts of the empire in the month of September.* These meet at two points, Tizoonin and Tindoof, and, when all are massed together, the astonishing number of ten thousand camels is sometimes reached, The caravans from Algiers and Tripoli are always inferior in number to those of Morocco. This is to be expected on account of the shorter distance and the accessibility of Mogador and other sea-ports, from which European merchandise can be obtained. Not more than about one-fourth of the camels which leave Morocco are loaded with anything except water and provisions. Raw and manufactured silk, chiefly from the cities of Morocco and Fez, form part of the merchandise. But their burdens are mainly made up by European goods from Mogador, consisting of Manchester goods and woollen cloths, Indian fine and coarse salampores, sugar, tea, beads, and cowries. On arriving at Towdeney, a station in the Sahara, a large number of the camels are loaded with salt, a valuable commodity at Timbuctoo.

In traversing the long extent of desert between Morocco and this last rendezvous, no less than five or six different roads are in use. It is not clear why there should be such diversity, probably the supply of water has much to do with it. Some of these routes are, however, more esteemed than others, on account of greater safety from freebooters, and it is also probable that the safety varies in accordance with the movements of the nomad robbers, which are more or less known to the leaders of the caravans. In some instances a journey of seven days is made by the coast through Zhuff, before proceeding into the interior.

The Wadnoon people occasionally make quick journeys to Timbuctoo. From Tindooff they reach Tisit, a large settlement in the Sahara, in twenty-five days, and here they find a market for some of their goods. From thence in ten days they reach Wallatta, another commercial town, and in ten days more arrive at Timbuctoo. This is said to be the best of all the roads for travelling, and to be usually safe from robbers.

It must be borne in mind that, in the computation of distance travelled, the only possible way of arriving at an approximation is by the time occupied by the journey. In the present instance, the journeys refer to those made by the heirie, or fast camel. These animals only carry light loads, but travel with three or four times the speed of the jimmel, or burthen-camel, whose load is about three and a half hundredweights, and pace about two miles an hour. The heirie bears the same relation to the jimmel as the thorough-bred horse to the cart-horse. On account of the violent heat, caused by radiation from the parched soil, it is usual for caravans to travel much at night, when they are often guided by the stars alone. It is no uncommon thing for a caravan to lose a large proportion of its men and animals through not finding water at the places at which it was expected. Instances have occurred of the destruction of an entire caravan from this cause. Recently, tea has come into use with the caravan people, and, it is said, with remarkably good results. It is taken several times in the day, and the fatalities have been greatly reduced since its introduction. Formerly it was the practice to take large draughts of water twice, or even only once, in the day. The average value of a camel's load of goods would be from £25 to £30, and the number of camels so loaded would be about 2,000. This would give a total value of about £50,000 for the entire merchandise of the September caravan when leaving Morocco. On reaching Timbuctoo, not only all the goods, and the salt taken up on the road, but the greater portion of the camels, are exchanged for the more portable commodities of the Soudan.

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* See my work, "Morocco and the Moors." Sampson Low, and Co., 1876. (Appendix).

* I am indebted to Signor Reuben Elmaleh, of Mogador, for some recent information about the Timbuctoo caravans.

The merchandise brought back to Morocco by the caravan, now so much reduced in number of animals, consists of ostrich feathers, ivory, gold in dust or fashioned unalloyed into various ornaments, gums, Senegal, and Amrad, and Soudan cloths, called killats, used as counterpanes, and also a considerable number of young male and female slaves. Ostrich feathers form a valuable article of transport; the value of a single camel's load of these would be not less than £1,000. The feathers are of good quality, although not, as has been stated, the finest.* The total value of this export from Mogador averages £20,000 sterling. The ivory trade has been, for a long time, only sufficient for the consumption of Morocco itself. The time ordinarily consumed in the journey to and from Timbuctoo, until the arrival of the caravan again in Morocco, is six or seven months. The various parties which composed the caravan then separate and repair to their respective districts. Almost all the gums, feathers, and gold go to Mogador, from whence they are sent to London. The gains of a caravan of the dimensions described are known to range between £170,000 and £200,000 sterling.

In addition to the great autumnal caravan, from six to ten smaller ones pass between Morocco and Timbuctoo in the course of the year.

Timbuctoo was conquered by the Moorish arms early in the seventeenth century. This proves that the region is sufficiently accessible for the approach of an army. But the dissensions consequent on the succession to the Moorish throne, long since enabled the distant vassals to throw off the yoke, and rid themselves of a considerable tribute.

According to Dr. Barth's observations, Timbuctoo lies in latitude 17° 37′ N. and longitude 3° 5′ W. from Greenwich. It is hardly necessary to urge upon an assembly such as that which meets in the theatre of the Society of Arts, the immense advantages that would follow in the track of a well-planned European expedition to this as yet commercially unopened region. There is still much to be learned of great interest concerning the regions between Morocco and Timbuctoo, as well as of the countries adjacent and beyond.

The philanthropist might expect that, when the very heart and core of a territory in which the slave trade has flourished from immemorial time had been tapped, this most inaccessible of all its strongholds would come within the pale of European influence.

The missionary might also entertain hopes that new fields would open to his efforts, so ineffectual amongst pure Mohammedans, in the vast regions of the Soudan, where the creed of the Prophet may be supposed to be weakened or diluted by contact with paganism, as well as amongst absolute pagans. But it is from the extension of trade, the great civiliser, for which all African races are eager, that the best results might be expected. If the profit of a single Morocco caravan occasionally reaches the large sum of £200,000, or, say, at the rate of £20 for each camel employed, what might not be expected if British goods could be conveyed to Timbuctoo by some cheaper and readier means than the camels' backs? To speak of a railroad would, in the present state of affairs, be but an idle speculation. But there can be no reasonable doubt that a road for an improved form of transport could be made, and kept open through a great part of the distance, if not across the Sahara. For although the sand lies so deep in some places as to cause much increase of labour to the animals, and, moreover, shifts with the wind very inconveniently, this is not the case generally. We have it on the authority of Sir Samuel Baker, that the camel, although not so utilised, is a beast of draught of great power. The limitation to camels is because no other animal can so long endure privation from water; but is it certain that water would not be found at sufficient intervals, to do away with this limitation, if sought by sinking wells? No doubt the difficulties of the journey are real enough; but, in estimating them, it must be borne in mind that about improvement or progress the Arab knows little, and cares less. As his fathers did so will he continue to do, if left to himself. A blind fatalism rules his actions, and blights his efforts. We hear of whole caravans perishing for want of water, under the influence of the parching wind, which licks up, as with a fiery tongue, the juices of the animal body. My own limited experience, however, in travelling with Arabs, on this very point of neglect, about taking sufficient water for a journey, teaches me how reckless these men are apt to be. It is more than probable that, if an accident of the kind mentioned was investigated, say, by a Moorish Board of Trade of the future, it would be found that an insufficient supply of water had been taken either through cupidity, from a desire to convey goods in its place, or else from a blind reliance upon some particular well, stream, or water-hole, which when arrived at was found to be dried up.

England has been long the friend of Morocco, and the friendship is fully reciprocated by the people of that country. Of all infidels the Englishman is most respected. There is good reason on the part of our nation for this friendship. Our garrison of Gibraltar depends for its supplies on Morocco, and Lord Nelson forcibly pointed out the necessity of having the Moors on our side in case of a maritime war. But it is a cold and distant friendship on the part of England. No encouraging word from our Government reaches the Sultan and the small Liberal party which must be supposed to share his views. The British public has neither time nor money to expend on a part of Africa so much nearer home than its great central lakes, and on the black population by which they are surrounded. And yet Morocco presents a field for philanthropy perhaps unequalled in the world, comprising, as it does, a nation of intelligent men bound in an iron grip of despotism, frenzied by religious bigotry, and only requiring intercourse with the outside world to cause both to relax. In proof of this compare the condition of (and the tolerance of) Christians by the Moors at Tangier with those accorded by the Moors of the interior and the south.

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* "Ostrich Farming," by Harting.

Our able minister in Morocco, Sir John Drummond Hay, has been thought to be indifferent to British interests, and, as regards Moorish politics, to show a tendency to let everything drift on, instead of endeavouring to lead the way in the path of progress. But I have reason to believe that these impressions are by no means accurate.

As regards the interests of individual British residents, it is necessary to consider that there are two sides to every question, and the British subject in Morocco probably sometimes expects that because justice is not indigeneous to the soil, it should not be always upheld by the representative of his own civilised Government on that soil. But, as regards the influence of our minister on Moorish politics, I think it may be safely said that his apparent apathy has its rise in the long-continued indifference of the British Government to the progress and development of the Moorish nation.

It would be a work well worthy of the high reputation of the Society of Arts, if they could do anything that would bring the influence of public opinion to bear upon this point, in addition to the great service which it will otherwise render in drawing the attention of commercial men to the considerations which it is the object of this communication to urge. The Society of Arts will certainly feel that in this latter direction it has an important function to fulfil, in the face of the notable fact that the leading public journal of England, at the present time, affords not one column of its ample space in the year, to matters that bear upon the conditions and capabilities of Morocco. It is scarcely possible, indeed, to over-estimate the advantage that might be attained, if, by any means, the Sultan of Morocco could be induced to follow the example which has been set him by that wise man of the East, the Sultan of Zanzibar, and pay a visit of friendship to England, that he might see with his own eyes, and learn, from direct observation, what might be done for the dominions under his sway by opening more widely a door of access for the influences of civilisation, and for commercial intercourse. It should also be known that the man who stands only second in personal influence to the Sultan himself in the empire of Morocco is the Sharif of Wazan, a gentleman who, although the acknowledged head of the State religion, has, nevertheless, broken through one of the main trammels of Mohammedan bigotry by marrying an English lady. This lady, happily, exerts the very best influence over her husband, and it is hardly too much to say that he is, at this time, only waiting for an invitation to induce him to visit England.

There is one difficulty which would have to be encountered, but which would obviously be not by any means an insurmountable one, in establishing direct English intercourse with Timbuctoo through the instrumentality of Morocco; namely, the jealousy of other European powers. Spain would, in all probability, occasion some trouble on this account, as it would be almost certain to demand still greater concessions as a set-off against any advantages ceded to England. There is also one point in favour of extended commercial intercourse with the Moors, which cannot be too strongly urged. They have paid the interest of their public debt with scrupulous regularity, and, indeed, have redeemed a considerable portion of the debt itself.

In regard to the actual progress of trade within the last thirty-two years, it may be stated that the average yearly value of imports and exports for the eleven years extending from 1845 to 1855, was, for imports, £315,709, of which £240,910 belonged to goods imported either from Great Britain or from Gibraltar. The average value of the yearly exports for the same time was £400,875, the portion for England and Gibraltar being £203,188. The average yearly value for the eleven years extending from 1861 to 1871, was—Imports, £811,805; imports from Great Britain and Gibraltar, £656,443. Exports, £767,741; exports to Great Britain and Gibraltar, £469,522. The principal exports are ambergris, goat and sheep skins, hides, horse and goat hair, ostrich feathers, wax, wool, fowls and eggs, oxen, beans, canary seed, maize, gums, oil, almonds, dates, and manufactured slippers and woollen stuffs.

In all probability, one of the wisest steps that could be taken at the present time, with a view to opening out extended trade intercourse through the portal offered by Morocco, would be to send an experimental caravan, laden with suitable goods of English manufacture, to Timbuctoo. This caravan should not be expected to actually cover its cost, but should be looked at as an investment made in breaking ground. It need not, on the other hand, be a very costly experiment, but it should be well thought out beforehand, and be well organised and equipped. It should consist of from 200 to 300 men, armed with breech-loading rifles. About 20 of these should be Englishmen, but the remainder might be Moors, engaged under an arrangement that they were not to be paid their wages in full until their return to Morocco. This caravan should be laden with sample articles of English manufacture, a large proportion of which would, in all probability, be readily furnished by the manufacturers and merchants of our principal towns. The arrival and fame of such a caravan would create a sensation throughout the Soudan. After passing the boundary of the frontiers of Morocco, all direct protection from the Sultan would be lost. But the moral influence of his firman, and of his friendship and approval, would be continued even to Timbuctoo. There are, surely, numerous agencies that could be brought into play to work out so promising an inroad upon the barbarism of Central Africa as this. Thus, for instance, it is well known that one of the great companies of the City of London possesses a large fund left in trust for the relief of Barbary slaves. There would assuredly be "slaves" found "to be freed," if an experimental caravan of Christian men of England were put into fair competition with the great annual caravan of the Mohammedan Moors, in the prosecution of such an enterprise.

It is pretty well understood that a shorter route for an English caravan to Timbuctoo might be chosen than the one which now issues from Mogador, and other Moorish towns. The neighbourhood of Cape Juby, which lies some little distance to the south of the frontier of Morocco, for instance, has been recently spoken of as a suitable site for the establishment of a new port. On the other hand, however, the consideration should on no account be lost sight of, that trade invariably flourishes best when it is developed along already established and accustomed routes, and that, for this reason, it would be best to endeavour to turn the well-known centres of departure in Morocco itself to account.

DISCUSSION.

The Chairman asked Dr. Leared if he could say anything about the climate of Morocco.

Dr. Leared said the climate of the north of Africa was, perhaps, one of the most salubrious in the world. Tangier, and all the coast of Morocco, was singularly healthful, a remarkable proof of which might be found in a communication lately made by an eminent professor at Montpellier, who, of course, being an inhabitant of the sunny south, and in the habit of recommending patients to different climates, was a good judge, and, after having passed in review the different climates of Europe, and of Madeira, and the various health resorts expressly chosen for the treatment of consumption, he stated, most positively, his firm conviction that the climate of Mogador was the best which had come under his notice; but everybody knew that, from the time of the Romans, in fact, from time immemorial, the north of Africa had been noted for its healthful climate, and extreme fertility.

Mr. Rochusson said he had hoped that out of the number of Moorish merchants established in London some would have been present that evening, because, after all, Morocco was not the *terra incognita* which had been depicted, and the trade with Morocco and with Timbuctoo had been for centuries carried on by Moorish merchants, especially of the Jewish race, established in London. He feared it would be a mistake for capitalists to endeavour to compete with the trade which was already established, and was carried on at the smallest possible profit. Manchester, Birmingham, and other goods found their way by means of caravans in the most direct manner possible to these parts, and he feared no engineering enterprise which could be devised could be profitable. He, himself, in a humble way, had endeavoured to develop communication with Morocco; and in 1835 he established a line of steamers from London to Mogador, which, however, had since passed into other hands, and they only took the place of a thoroughly organised communication by sailing vessels. The main point of interest, he thought, was the mineral resources, which were not yet thoroughly worked, for between Cape Juby and Mogador there were great deposits of malachite and copper, and, also, what were known as the "Iron Mountains," where there were deposits of iron such as were not dreamt of in England, and only about thirty-five or forty miles from Mogador, the country between being almost flat. The state of the iron trade in Europe at present was not such as to encourage the investment of capital, but the ores on the northern slopes of the Atlas range were turned to account on a great scale by the steelmakers of Barrow, by Krupp in Prussia, and by the great French ironmasters, such as Schneider of Creuzot, and they would certainly find a better supply on the southern range. The ports of Morocco were not so bad as not to be capable of easy improvement. Mogador had fronting its harbour an island of about two miles and a-half in length, which protected it against the Atlantic, and the northern channel between that island and the mainland could easily be blocked up, when it would become one of the finest harbours on the Atlantic coast. What was being done already in the corn trade could hardly be improved upon, as there were about 500 cargoes per annum now coming from Morocco, but, undoubtedly, its copper, iron, silver, and nickel were sources of wealth which had been hitherto entirely overlooked. He, himself, had endeavoured to reach Morocco through the desert of Sahara, and had succeeded, Capt. Peacock and himself having been the only Europeans, he believed, who had accomplished it. They came across the caravan track, and found it so well laid out that it could hardly be improved upon.

The Chairman asked how he would provide for working the iron.

Mr. Rochusson said he proposed to export the ore, not to work the iron there. There was a great deal of copper working in Morocco, the whole of the copper coinage being made of native copper. The iron-stone was also worked in the same way as the so-called Roman or Spanish Catalan furnace, which was, again, similar to the process employed in Bengal.

General Bissett said when he was at Gibraltar he made several excursions into the country, and it was quite true there was a great deal of mineral wealth, for he passed lead mines, containing also a large quantity of silver; and there were other metals which might be worked with great facility, but for the jealousy with which Englishmen and English capital were regarded. From Tangier, along the coast to Tetuan, the fertility of the soil was unbounded, and capable of yielding immense crops if cultivated. He found there evidence that the country had been occupied by Europeans long before the advent of the Moors, for he passed over the ruins of towns planted by the Phœnicians more than a thousand years ago; and in the mountains lying at the back of Ape's Hill he found the vines, which had evidently been once cultivated there, growing wild. Going round by Cape Spartel again, you came to an extraordinary cave, where millstones had been cut out of the solid rock twenty feet below the surface of the sea, and this must have been done in days long before the Moors' arrival. He was quite sure there was no finer climate in the world; and he believed all medical men recommended it.

Mr. Grace, having resided in Mogador for the greatest part of the last twenty years, said he had noticed considerable improvement in the country during that time, but certainly its mineral resources deserved more attention. There were copper mines within 30 miles of Mogador, some of which yielded 40 per cent. of metal, and he had sent home several parcels which had yielded 29 per cent. There were thousands and thousands of tons, but though they had applied several times to the Sultan, and had offered him a million dollars a year, for permission to work, or to form a company to work, the mines on his account, his answer was always the same—that his fathers had never worked the mines, and he would not. Lead ore they had been allowed to export, under the name of antimony, for they dare not call it by its right name, and it yielded 80 per cent. of metal, of very good quality; but, owing to the great expense of transport, it did not pay. He did not suppose there was a more charming climate in the world. Mogador was, perhaps, the most healthy, but it was subject to north-east winds; Mazagan was calmer and more pleasant. A proposition had been made, some time ago, to establish a port near Cape Juby, and it was certainly most likely to be successful as the point of departure for a trade with Timbuctoo, and would draw the whole of the desert trade, and, to a great extent, stop the slave-trade with Morocco and the northern parts of the country. He believed this could be done at very little expense, because the chiefs knew very little of the value of money, and the coast there being rocky, they would probably sell a piece of land for a few thousand dollars. The establishment of a port, with a fortification, a neutral ground, with a sanctuary upon it for communication with the Mohammedans, which was always necessary for safety, he believed it would turn out very successful; and, hereafter, the suggested canal, to communicate with the Niger, might be established.

Dr. Leared asked if it would not be possible to open the port which the Sheik of Wadnoon at present held sealed, where Mr. Butler was kept for some time in captivity.

Mr. Grace said there was no port there at all. The place was supposed to be within the jurisdiction of the Sultan, but he had no power there whatever. It had also only a very poor river, not navigable.

Mr. Rochusson said the river did not really exist; there was only a deep gully of sand, with no water at al'.

Dr. Mann said the question of climate was a very interesting one. Dr. Leared had recently published an excellent work upon Morocco, in which he dealt specially with the climate of Mogador, and there was one interesting point in connection with it which he wished to mention. Mogador was in about 28° north latitude, whilst the capital of Natal was in nearly 30° south, and, therefore, about 120 miles farther from the equator; and had, consequently, a climate which might fairly be compared with it. He himself had studied the climate of Natal very carefully for nine years, and one or two points connected with Mogador were to him very remarkable. In the first place it was singularly even throughout the year; it appeared that when the wind blew from the north-east, even that was an agreeable wind, the greatest warmth of the thermometer with it being about 80°. Now, at Natal they found that amongst the mountains where the capital stood, 2,000 feet above the sea level, the highest temperature produced by the sun without a hot wind was about 86°, and when the hot winds blew it rose to 96° or 97°. This was a singular difference between two places so similarly placed as respects latitude. Another peculiarity of the climate of Mogador was its close proximity to the coast, and to the vast expanse of heated water in the Atlantic; so that whenever the west wind blew it came over that part of the globe where the great natural apparatus for warming by the water of the ocean was in play, and this probably contributed in no small degree to the great equability of climate. The cool wind of Natal was the south-east wind which blew over the Indian Ocean, whilst the north-west wind came over the heated surfaces of the central desert districts. He was very pleased to see Dr. Leared there that evening, as he had been very ill only a few days previously, and he might add that he was on the point of starting again for Morocco to gain further information, which he had no doubt would be very welcome hereafter. There were two important points to be especially noticed in his present communication; one, that of attempting to increase the friendly influence of this country with the authorities of Morocco, which he thought might readily be done; and the other the importance of not overlooking the possibility of a largely-increased trade with Timbuctoo. They had had an interesting statement made in that room of what had been done on the West Coast of Africa, by sending out English manufactures as samples, and he had recently seen, in the warehouse of a friend in the City, a marvellous collection of English prints, most artistically produced and arranged, and was informed that the sending out of this quality of goods had led to a greatly increased demand. If that were the case, there could be no doubt that a great sensation would be produced in the Soudan also if things of that kind were sent out to Timbuctoo, and if the people in that great centre of commerce began to understand the peculiarities and advantages of English commerce. He would only add that, when Dr. Leared was in Morocco some twelve or fourteen years ago, wishing to see the Sultan, he went to the town of Morocco, where he had to wait some time, the Sultan being absent on an expedition in which he met with a reverse, and one result was that an attempt was made to poison Dr. Leared and his attendants. However, undeterred by this experience, he was going there again, and this time Mrs. Leared was also going, as an additional security that he would return in safety.

Mr. Purdy said he had not enjoyed the privilege of visiting Morocco, but he had listened with great pleasure to the paper. Still he thought that few, if any, advantages would result from English capital being contributed to this sphere of operations. He thought the country should be occupied not by Englishmen, but by Spaniards, Frenchmen, or perhaps Italians; we had a large colonial empire, and had little or no occasion to occupy ourselves with this particular corner of Africa. He was much struck with the small amount of commerce shown by the figures quoted, though it was undoubtedly increasing, but the trade was very slow and the progress limited, and there were natural obstacles to its development which it was important to remember. Mr. Rochusson had no doubt done the utmost to promote steam communication with the northern coast of Africa, but seeing how limited had been the results, he did not think the prospect very encouraging for further effort. As to telegraphic communication, he should condemn it as a simple waste of public money. If Dr. Leared was going out again, notwithstanding he had been nearly poisoned on his first visit, it would no doubt be very pleasant to communicate with him quickly, but that was not a very good financial basis on which to establish a telegraph. It appeared to him that there was a good deal to be done amongst the people themselves. Let them use their camels, establish their depots, and trade amongst themselves as freely as possible, and we could supply them with the requisite materials, either to our advantage or the reverse, seeing that these were semi-barbarous tribes, nomadic races, who had to be reached by means sometimes almost foreign to our purposes as traders and financial intermediaries, knowing little or nothing of the habits and character of the people. He much admired the doctor's bravery and determination, and felt very much inclined to set out with him, and go wherever he felt disposed to take him, especially as his skill and experience would be of great value in case of any attempt at poisoning, but as to his authority on matters of commerce and finance he was a complete heretic, as he was a thorough obstructive as to those sentimental notions in commerce which were sometimes put forward and acted upon.

The Rev. W. H. Hachel, having travelled in 1873, from Mogador to Tangier, in company with Lord and Lady Francis Coningham, the latter being the first English lady who had made the journey, desired to bear his testimony to the excellent character of the people. When he was there, Dr. Leared's name was in the mouths of all Europeans, and he had with him a letter of introduction to him, with which he was favoured at Tangier, but which he had not an opportunity of delivering. He could not agree to what had been said about Frenchmen, Spaniards, and Italians going to Morocco. His own impression was, that the Spaniards were hated all along the coast, and that the only merchants in whom any confidence was placed were the English. He should be sorry to see the French there, judging by the small amount of success they had achieved in Algiers, though he believed they had an eye upon Morocco. If any European nation had it, he hoped it would be either the English or Germans, and he should prefer the former. He thought telegraphic communication should be established all down the west coast of Africa, and right along to the Cape. It had been suggested that a line should be made along the Nile, and through the central lake district, and down the east coast, but it appeared to him there were many reasons why the west coast should be preferred, starting from Gibraltar, though probably a submarine cable would have to be employed the greater part of the distance.

Dr. Mann desired to protest against the notion which seemed to prevail in some quarters that the function of the Society was simply to encourage trade with those parts of the world where it was already established. He thought, on the other hand, their duty was to spread feelers out in every direction, and not to attempt to decide beforehand what would succeed or what would not; to go rather on the broad general principle that every part of the world where arts, manufactures, and commerce were possible should be within the scope of their inquiries and action. It was sometimes said that the papers read were too geographical, and sometimes that they were too theoretical; but he considered that the great merit of this Society was that it was widely comprehensive; it took up every subject of interest to man, and considered how it could be turned to practical account. He protested against any narrowness of view, which on the one hand would limit communications to subjects connected with trade, or on the other to directions in which they knew that success would be assured.

The Chairman said that, knowing something of Morocco, he considered this paper one of the most comprehensive and valuable that could be found anywhere dealing with that part of the coast. If, as had been suggested, a railway could be made from Mogador to Morocco, it would have a wonderful effect in breaking down the obstructiveness and jealousy of foreign trade which now prevailed. There were some difficulties no doubt, but Morocco was only 1,500 feet above the sea level, the distance was about 120 miles, and there were great engineering difficulties. He was sorry to hear Mr. Rochusson say that nothing could be done to develop agriculture, because there were vast plains of fertile land not turned to account; and it seemed to him there was great scope in that direction. The ports were no doubt very defective; but he remembered being at Mogador for a month in 1844, in command of a ship of 900 tons, the largest which had ever been there at that time. There was very great protection under the island which had been spoken of, and the port could easily be improved. Steamers, also, did not labour under the same difficulties as sailing vessels, because if bad weather came on they could leave the port and return to it again. The political importance of Morocco must not be overlooked. The Sultan had always been the faithful ally of England; and the holding of Gibraltar had elevated us in the eyes of the Moors over every nation in the world. With regard to the Spaniards, he was afraid their antecedents had not left a very favourable impression on the Moors. They held Ceuta, on the lower Riff coast, but it was merely a penal settlement, and they had not done much there to recommend Christianity. He considered that we were much indebted both to the present Sir John D. Hay, and his father, from the manner in which they had upheld English influence; they had resided a long time in the country, and had always been on good terms with the Sultan. In conclusion, he begged to propose a cordial vote of thanks to Dr. Leared, with best wishes for his intended visit and safe return.

The motion having been passed unanimously,

Dr. Leared, in reply, said it struck him as rather remarkable that all those who had seen Morocco seemed to speak very well of it, but those who had never been there set their backs up against it, and said it was a sealed book, and must remain so. Even the gentleman who had been engaged in extending British trade there, although he said the mines were very valuable, did not like the idea of extending the external trade of the country, and Mr. Purdy, who was largely concerned with our colonies, could not get his mind beyond the golden fleeces of Australia. But, was there no such thing as philanthropy? Was there no feeling for these poor Moors, who were ground down as he had described, and whose country might form a vast granary, which would be of inestimable value to England in the event of a European war? Here was a country friendly to us, and with a Sovereign who entertained the most kindly disposition, and yet there was this extraordinary apathy shown by almost every one, except those who knew something about it.

TWENTIETH ORDINARY MEETING.

Wednesday, April 25th, 1877; Major-General Frederick C. Cotton, R.E., C.S.I., Member of Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Baynes, Malcolm Charles, Forest-lodge, West-hill, Putney.
Fairholme, Captain Charles, R.N., 9, Victoria-chambers, Westminster, S.W.
Frankland, Edward, F.R.S., 14, Lancaster-gate, Hyde-park, W.
Gurney, John, J.P., Sprowston-hall, Norwich.
Hanson, John, Savile-town, Dewsbury.
Ricarde-Seaver, Francis Ignacio, Conservative Club, S.W., and 14, Buckingham-street, Strand, W.C.
Soper, William Lawrence, 8, Oat-lane, Wood-street, E.C.
Tribe, Edward Samuel, 10, Woburn-place, W.C.

And as Honorary Corresponding Member:—

Bacceli, Guido, Via della Farina, No. 50, Rome, Italy.

The following candidates were balloted for, and duly elected members of the Society:—

Ackers, B. St. John, Prinknash-park, Painswick.
Beckingsale, E. W., 2, Thanet-place, Temple-bar, E.C.
Hill, Thomas Rowland, 15, Cedars-road, Clapham-common, S.W.
Lecky, James, 3, Houghton-place, Ampthill-square, N.W.
Nagaoka, M. Y., F.R.G.S., 3, Adelphi-ter., Strand, W.C.
Stone, Thomas, Gas Works, Weymouth.
Ward, Major David, R.E., care of Messrs. Richardson and Co., 13, Pall-mall, S.W.
Webb, Edward, Greenfield, London-road, Worcester.
Whitburn, Thomas, Milford, near Godalming, Surrey.

The paper read was—

DEAF, NOT DUMB.

By B. St. John Ackers.

Why am I standing before you to night? Why am I reading this paper on the "deaf and dumb" before your honourable Society? Not as a schoolmaster wishing to bring before your notice some special method of teaching that he himself invented; not as a medical man wishing to advocate some special treatment of ear diseases; not because, in fact, I have any claim to speak in my own person as a professional practicioner, either scholastic or medical, but solely because that has happened to me which might happen to anyone here present; illness came upon my only child—its life was spared, but its hearing lost.

Great, indeed, were the difficulties we experienced in deciding on the best way of educating our child, meagre, indeed, the help we could obtain in our own country. I am desirous that others should have the benefit of our experience, so that no one need go through the terrible uncertainty and anxiety we had to endure. Our child was three months old when a severe attack of fever took away her hearing. For a year or two we kept hoping on. I even refused to enter the child in the census as "deaf and dumb." I would not "brand" it as long as there was any doubt; such was my foolish pride, such is the foolish pride alas! of very many; and it is mentioned here in order to show that this, amongst other causes, makes the census returns of the "deaf and dumb" below the real number. As soon as our child's loss of hearing was beyond question, we brought her here to London for the best medical, surgical, and educational advice. We hoped, indeed we never doubted, that we should have received the best advice about the education of our child from those of the medical profession whom we consulted. But such was not the case. Sad and disappointed, we turned to those who had devoted their lives to the education of the deaf. Here at least we expected to be assured beyond doubt of the best method on which to instruct her; but again we were doomed to utter disappointment. We found different systems at work, and the advocates of each said very hard and bitter things of one another. Here it will be well to explain the technical terms that will be used in this paper. For want of this it is sometime difficult to understand the meaning of many works on this subject, as different terms are used by various writers and speakers to express the same things, and the same terms to express different things.

"Deaf and Dumb." Those wholly uneducated, or who cannot hear or speak, though educated or partially so.

"Deaf." Those who cannot hear or speak before they have been educated; or who, having been educated, are still without hearing, but can speak.

"German" System. That which is based on articulation and lip-reading.

"French" System. That which is based on a system of signs.

"Signs." All, except

"Natural Signs." Which I define as such as hearing persons use and can understand; *e.g.*, "come," beckoning with the hand; "go," motioning away with the hand; which are really actions, not signs.

You may wonder why we did not test for ourselves the results obtained by the various methods in this country. We would willingly have done so, but the "German" system had not been long enough at work to prove the value of its teaching to pupils in general after leaving school, and we were assured by the "French" system teachers—the "old" system, as it is so often erroneously called by Englishmen, simply because in this country it has been the longer established—that, however good the "German" might appear in school, the speech and and lip-reading there learnt were of no value in after life.

We could not disprove this assertion. Nay, we were inclined to believe it, for, we said to ourselves, as so many do now, "if it be the better method, surely it would have been adopted by such a practical nation as our own long ago." Of this I must speak hereafter.

It will be seen that, to persons considering this subject for the first time, as we were, it was impossible to arrive at a satisfactory conclusion—one that would leave no doubt on their minds—without going into the world to find out the truth. So, without loss of time, in August, 1872, our child being three years old, we left her with my wife's family, and commenced investigation for ourselves. We visited some of the principal schools in each of the following countries, in the order named:—England, United States, Canada, Great Britain, Holland, Belgium, Germany, Saxony, Bohemia, Austria, Bavaria, Switzerland, Savoy and France.

The subject before you naturally divides itself into three heads—Medical, Historical and Educational.

Time will not allow me to-night to enter upon the medical and historical aspects of the case, interesting as they are, even more so probably to the general public, than the educational view of the subject. This paper, however, must be confined to this latter portion of the question, viz., education.

Education.—Chiefly as bearing on the results of the different methods of education on the pupils in after life.

Let it be clearly understood that the term "deaf and dumb," as used in this and all countries where the "French" system is adopted, includes the toto-congenital — those born wholly deaf; the semi-deaf—those with partial hearing; and the semi-mute—those who have spoken before loss of hearing. This term "deaf and dumb," used for such degrees and classes of affliction is very confusing; the different conditions are often misunderstood, and much evil arises therefrom.

There are three systems of teaching the deaf—"German;" "French;" "Combined."

The "German" system teaches by articulation and lip-reading. The "French," by signs, dactylology (*i.e.* the manual alphabet), and pantomime.

Writing and pictures are, of course, common to each system. It is true that in "German" system schools, natural signs are used at first, but they are dropped as soon as the pupils have learned to express their meaning in words; and, on the other hand, in "French" system schools, some few pupils are taught articulation. The "German" system teaches the pupils from the first to think in the order of the language of their country, whereas the "French" system teaches the pupils to think in the order of the language of signs, which is an inverted order, as far as English and all other European languages go, *e.g.*, "cart draw horse." It also ignores particles, and other things necessary to ordinary English.

The "Combined" method is so called because it tries to combine parts of each of the two great opposing systems. The teaching, however, being based on signs, is far nearer the "French" than the "German" system, though some articulation is attempted at first with each pupil,—a system which has brought, and always will bring, articulation into disrepute, for it is useless to think of teaching articulation successfully unless it be, as in the "German" system, the basis of instruction; so that the pupil may always think and express ideas in the order of the language of his country. This is next to impossible for him to do, when taught upon any system which is based on signs. Signs are also much easier than articulation to the deaf. The two have nothing in common. The easier will always supersede the harder in the affection and practice of the pupil.

Now, it would be well, before going any further, to get rid of the idea so common amongst hearing people, that children "deaf and dumb" are quite different from others. For instance, it is often imagined that they must be of weak intellect. This is a great mistake. True, some have not full mental development, which is not to be wondered at, when the causes of congenital and accidental deafness are remembered—often it is a fever that takes away hearing and leaves mind and body in an enfeebled condition. Such, however, is just as often the case with hearing children after suffering like maladies. The brain is uninjured in the vast majority of the deaf, and is exactly the same as that of hearing children.

Another very common fallacy is that the child does not speak—is dumb—on account of some malformation of the vocal organs. Now, this is so rare a case, if indeed it exist at all, that it cannot be classed as one of the causes of dumbness. Indeed, there are but two causes, so far as I know, of absolute dumbness, viz., want of brain power, and deafness. As the latter causes dumbness only on account of want of proper education, the former is the only true cause. The term "deaf and dumb" is really an unnatural and artificial one, expressing not the action of nature under favourable circumstances, but the result of neglect.

It is not uncommon to meet with dumb persons who have their hearing perfect; their dumbness arises from defect of brain. But what I have never met with, is dumbness from deafness, except through disuse of voice. There is no such thing as a child born dumb because deaf. The born deaf are at first exactly the same as hearing children; they cry, sneeze, cough, crow, laugh, aye, and talk too, like hearing children. This may seem very startling; but startling though it be, it is true. The born deaf do talk, in their own baby language, just like hearing children of the same age, only we do not understand them. What mother understands all her hearing baby says at first? But, it will be said, "even if this be so, hearing children can understand all that is said to them, and that is what deaf ones never can." Really! Can hearing children understand all that is said to them? Then why do mothers and nurses say the same thing, over and over again, a hundred times? And when the hearing child can imitate what is said to it, does it therefore know the meaning? Does it know what "papa" or "mamma" mean because it can say the words? Of course not. The objects must be shown with the words spoken, and shown over and over again, too, before the hearing child can connect the object with the spoken word; and so—exactly so—is it with the deaf child; you do not let it go on talking its own language; but just as with the hearing, you educate it to repeat certain sounds after you, and to connect those sounds (spoken words) with certain objects—only with the deaf you cannot teach through the ear and so must through the eye. It is all by imitation, as with the hearing child; it does not "come natural," as unthinking people so often say, either to the hearing or to the deaf.

Now, let us contrast the effect of these systems on the after life of those educated thereon. We will take the "French" system first, as that best known in this country. I have said over and over again, and here repeat, that if the object of the education of the deaf were to fit them to live in large asylums and comfortable institutions, they should by all means be educated on the "French" system. It is the easiest and pleasantest to the pupils, so long as they are together or with their teachers. But we know well that institution life can be but the lot of very few. Almost all have, before long, to leave what has to them become a happy home, where everyone understands and uses the language of signs, and to take their place in the world, and earn their daily bread. Here they scarcely ever meet with anyone able to use the language of signs, and very, very few who know the finger alphabet. But it may be said, "They have writing." Yes, but what does this amount to?

However much knowledge or education may be justly claimed for the deaf-mute instructed upon the "French" system of signs, still such knowledge is to hearing persons in a great measure a sealed book, by reason of the want of a proper communication between the two classes; the deaf-mute, in consequence of the peculiar nature of his instruction, which gives him language in an inverted order, has a difficulty in making himself understood by writing, and in comprehending the writing of ordinary hearing persons. His own knowledge of language is very imperfect, and few of those with whom he daily associates are sufficiently educated to read or write with comfort, and many, we know, cannot do so at all.

Now let us pass to the "Combined" method. This is the system that Gallaudet, the first teacher of the deaf in America, found in this country, and erroneously supposed to be the "German" method. He took this for granted, because articulation was taught. He failed to appreciate, as so many do now, the cardinal difference of these systems. It is this, that under the "Combined" method, a system of signs is the basis of instruction, articulation being only an accomplishment, just as modern languages were taught in our old public schools, with the result we all know; the thing was looked upon by the boys as a "bore," and the knowledge (or rather want of knowledge) of these languages so gained, and the little use they were in after life, have passed into a bye-word.

Those thus taught never feel at home in speaking, find great difficulty in making themselves understood, and so soon cease to continue the attempt. So it is with those taught on the "Combined" method. Articulation is to them a "bore," they find people outside their schools unable to understand them, and so they, too, soon cease to make the attempt.

Thus articulation is brought into discredit, not by its being in any way unsuited to the deaf, but because it has been treated as an accomplishment.

Indeed, the case of those thus educated practically differs but little from those under the "French" system, but that little is not in favour of the "Combined" method. In examining the pupils taught on this system, we find them the least educated, and the reason was not far to seek; for the pupils so taught were taken away from the rest to learn articulation, it may be half-an-hour a day, more or less. What were the constant remarks of the teachers? Why, that "the articulation pupils were behind the others." And no wonder, for whatever takes the pupil away from his companions regularly for ever so short a time, be it articulation, drawing, Latin, or any other thing foreign to the ordinary work of his class, must have the effect of making him show to disadvantage with his class-mates, whose attention and time have not been disturbed. But, it may be argued, "Could not more time be given to articulation?" It would be of no avail, I reply, so long as signs constitute the basis of education, for so long will the pupils think in them rather than in articulation. In that case no good result is to be gained, because articulation will be but a foreign language, in which ease enough to be pleasant or useful will rarely be gained, an annoyance very often—a task, and will ever lead to disappointment.

A "foreign" language! Is it not startling to hear English spoken of thus, in the case of English children? Yet such is English to those taught on the "French" or "Combined" methods. It is a foreign language to them, as we are constantly reminded by the teachers of those systems. Let us see whether such is the case with those taught on the "German" system.

Here, to begin with, there is no inverted order; and, as those taught thereon have no other medium for thought than the English language, there is certainly no reason, theoretically, why their language should not be as pure as that of hearing children. This is scarcely the case at first, yet such a result is reached before leaving school, and is not lost afterwards.

I fancy I hear some one say, "This may be so with the semi-mute and the semi-deaf, but can it be possible with the toto-congenital, who have never heard? Are they able to make speech the means of communication with the world in general?" Wait a minute, and I think, when you have heard a few examples of the very many cases that have come under our notice, and which we tested for ourselves, that you will acknowledge that articulation under the "German" method is no mere accomplishment; but is the practical means by which those so taught communicate, not with their fellow pupils and teachers only, but with their hearing fellow creatures also.

Remembering the three classes called "deaf and dumb" in this country, let us take a few examples, all of which came under our personal notice unless mentioned to the contrary. In these cases names and dates will not be specified, but they are at the service of any person who chooses to ask for them for the purpose of proving the accuracy of the statements contained in this paper.

I will not weary you with cases of the semi-deaf speaking, because it must be evident to all that this class—having hearing, although not sufficient to enable them to be educated with hearing children—have ear enough to understand to a certain extent the modulations of sound. We will pass on, therefore, to the next class, the semi-mute.

The first case we will take is that of one of the daughters of a gentleman who, through his kindness to us, has become a great personal friend of my own. As soon as he heard the object of our journey, and that our child was deaf, he spared neither pains, time, nor personal exertion to help us in this matter.

His child had lost hearing, from fever, between four and five years of age. At that time there were no schools in this country on this admirable "German" system; but the parents, convinced of the advantage of this method, made themselves acquainted with the details of instruction, which were successfully carried out in the person of their own child, as you will acknowledge when I tell you that she was able to go into shops in Germany and get things that her father wanted, he being unable to speak the language; and that she came to stay with us in our house in the country, and was conversed with by our friends, both at garden parties and privately, to the surprise of all who saw her.

Take another case. A lady of great wealth had four children; fever came and struck down three; two died, the other lived, but her hearing was totally lost. She was then four years of age. The poor mother, as might be expected, was overwhelmed with grief, and, for twelve months was herself ill, and unable to attend to the education of her poor little deaf child. It was not until the latter was between five and six years of age, twelve months after losing hearing, that the mother attempted to educate her at all. Her speech was almost gone; indeed, to such an extent was this the case, that she had but one word left, a word natural to a child, "cake." The mother was an energetic, clever woman, no doubt, but she had a large household, and kept much company, living in the most fashionable society of a wealthy neighbourhood; yet she found time to educate her child, notwithstanding that a large younger family (she had eight living children when I saw her), added to her other cares, must have left her little time for such teaching. She made a practice of giving her deaf child two hours every morning, and with this instructiion her daughter became a highly educated and agreeable woman in society. We spent the day at her father's house, and a most accomplished woman we found her. She talked to my wife of pictures, poetry, and all manner of subjects common to ladies, such as needlework, &c. To me she talked of riding (she was a great horsewoman), billiards, and other topics she thought would interest me, explaining the difference between their game of billiards and ours, giving me the names of the different woods the cues were made of, and conversing with me as freely as though she had been a hearing person; indeed, several times during the day, my wife forgot that she was speaking to one deaf, so accurately did this deaf young lady read everything that was said to her when she could see the speaker's face; but occasionally my wife, forgetting this, turned away, and of course received no answer. Yet, had she been sent to a "French" system school, all speech would have been lost. There would have been no attempt made to keep up, or restore, the speech of a child so young; and one more would have been added to the long list of the dumb.

The next and last case of a semi-mute—well known, but which did not come under our own observation—is that of a man who went through part of the civil war in the United States as a private soldier. He spoke so well that for some time the secret of his deafness was undiscovered. One night, however, he was challenged by a sentry, and, taking no notice, was wounded. This led to discovery, and he had to leave the army. His early history is interesting and instructive, and I will give it almost in his own words as told to a friend of mine. He lost hearing through fever at five years of age, but retained his speech. His friends communicated with him by writing. One day sitting on the floor he watched his father and a neighbour talking, and when the neighbour left, he looked up and said, "Did not Mr. —— say so and so!" "Yes," said his father, "How do you know, who told you?" "Father, I saw his lips move, and I guessed that was what he said." "You had better practise watching people's lips," his father said. The "German" system was then unknown in America; but the boy did practise, both with his family, and by studying his own lips before the glass. The only difficulty being that he soon discovered a difference in his own pronunciation of words ending in "tion" as he called it "ti-on," and such like spellings, where the sound and the spelling did not agree. At twelve years of age he was sent to the American Asylum at Hartford, and for a whole year he could make absolutely nothing out of the signs and finger talking used around him. This made him very wretched. He continued to say his lessons aloud to the master, who questioned him on his fingers. One day going to his master for the meaning and pronunciation of some new and difficult word, the master in a fit of impatience at his not pronouncing it rightly wrote the word down, spelling it phonetically; the boy at once gave it correctly, and his delight and joy were intense. Here was the key of knowledge. From that day he always went to others with his new words, with the request "spell it wrong; spell it as it sounds," and he had no more difficulty. He married a deaf and dumb woman, and had several children, all of whom heard. When these children were old enough, they were sent to school. Very soon a complaint came to the father from the teacher, his children were so remarkably impudent and naughty they would write nonsense on their slates instead of their exercises. They had been punished, but continued to bring such sentences as this: "Man horse black on riding was," and, if he did not use his authority to stop this, the children must be expelled. He at once wrote, explaining that they had been in the habit of communicating chiefly with their deaf and dumb mother, who employed signs, and this inverted language was the consequence. If no notice were taken, but the children allowed to mix freely with their schoolfellows, he had no doubt their language would right itself, and so the event proved.

We now come to the last of the three classes of the so-called "deaf and dumb"—the toto-congenital. How these educated on the "German" system were able, after leaving school, to get on in the world by articulation and lip-reading, was, you may remember, the great object of our inquiries. This point is all the more important now, as the advocates of the "French" system allow, in theory, however little they carry it out in practice, the value of teaching articulation to most of the semi-mute and semi-deaf, but still deny the use of attempting it with toto-congenitals except in very rare instances.

Now as to those who have left the "German" system schools. We saw specimens of these, some in workshops, some milliners, some married to hearing persons, some at home with their parents, some master tradesmen, &c., all, I again remark, were toto-congenital—such as would be termed in America, France, and England, "deaf and dumb." The result was encouraging beyond anything we had dared to hope. Had we expected to find old pupils that "one would not have known from hearing persons" we should have been disappointed. There may be such, but we have never been able to trace any, nor did we ever meet with a "German" system teacher who knew of one—that is, a toto-congenital pupil, old or present, that habitually, or for any length of time, could pass as a hearing person. But what we did see were men and women, able to earn their own livelihood in trades and other occupations, communicating with and answering hearing persons sufficiently well by articulation and lip-reading to go through the world comfortably, and, in some instances, very successfully. In no case were we unable to make ourselves understood or failed to understand in return, except when with those educated in a school where some signs were allowed, a large "internat."

Just in proportion as signs were allowed in institutions, so those taught therein appeared to less advantage when we saw them in after life. We asked their fellow-workmen, their employers, their workpeople, their relations, and those with whom they lodged, "How do they communicate with hearing persons?" And were universally answered, often with embarrassing astonishment at such a question, "Why, by speaking, of course!"

Let us take a few individual cases; that of the Dutch gentleman, who kindly allowed himself to be examined and tested in this room, and before the Social Science Congress at Leeds in 1871, is probably known to most here present. Of him Dr. E. M. Gallaudet, the Principal of the National College for Deaf-mutes, at Washington, U.S.A., not too willing a witness, declared that he and the Dutchman before-mentioned had no difficulty in conversing together on various topics by word of mouth, not even the jolting of the cab on their way to the station making any difference in the ease with which they understood each other.

But let us pass on to cases that came under our own notice. One, that of a poor woman living with an aunt, is worthy of special notice, showing as it does that the education given on the "German" system is good, and not lost afterwards.

She had left school some twelve years, and lived in a part of Germany where one of the many dialects prevailing in that country was spoken. Her aunt, a garrulous old woman, chattered at such a rate that my wife, though a good German scholar, was sometimes at fault, as was also the German lady who acted as my interpreter. More than once, when such was the case, my wife asked the deaf niece, whose purer German interpreted the sentence.

Another case was that of a young woman, who was a leading dressmaker in a small German capital. She was rather shy at first. On our mentioning this to the landlord of the hotel where we were staying, he called the hotel porter, who was engaged to the deaf dressmaker, and told him we had not found his sweetheart very communicative. Whereupon the porter begged we would, escorted by himself, give her another trial. So off we started, but met the young woman soon after we left the hotel. The meeting of the two lovers was most amusing. He took her roundly to task for appearing to so little advantage on our first acquaintance, and, after some lively sparring—rattled off between them just as though both, instead of one only, had been hearing persons—we chimed in, and had a long and pleasant talk. She assured us that, in following her occupation, the only means of communication between herself and those who employed her were articulation and lip-reading. Writing was never had recourse to; finger-talking and signs she did not understand. Take another case.

We saw in Vienna a fancy leather merchant, who employed seventy men under him, whose premises the Emperor and Empress of Austria visited before the great Vienna Exhibition, who could not only speak the language of his country fluently, but also a little English, who had visited England and other countries, was a practical horticulturist, and altogether an agreeable, intelligent, wealthy man—wealthy through his own educated talents and industry.

A good instance of the independence which pupils, well educated on this system, feel in after life, was mentioned to me last year. A journeyman cabinet-maker had such a thorough command of language, that he told my friend he intended to seek work in other countries, and should settle in whichever he found gave him best employment, having no doubt of being able soon to talk the new language sufficiently. Not to weary you with more of the many other instances one could give, I will end this part by telling you, that we went into a hatter's shop in Friedberg, who had a toto-congenital deaf workman. That very morning a man had been convicted for theft, principally on the evidence, given *vivâ voce* in open court, by that deaf workman, who stood the test of examination and cross-examination without any other method of communication being used than word of mouth.

After what you have just heard of the power of the "German" system, does it not seem strange that its introduction into this country should have been opposed so strongly? Yet the same prejudice against the value of the system—taking the twofold form, either of utter disbelief in the power of the deaf to speak, because they are called "deaf and dumb;" or, on the other hand, the deep-rooted idea that speech, when thus given, is not better than that of the parrot or the magpie—is wide spread, as the following will show.

A gentleman in America had a child who lost hearing in her fifth year; he took her to the best institutions that he knew of in his own country. These were on the "French" system. He was there told he had better take her back, and bring her again when she was twelve. "What," said he, "must she be seven years without any education? And what is to become of her speech? She has already lost some of her words." "Oh, that will soon be gone, and in a few months she will be as dumb as she is deaf." The parents were greatly hurt at this, and resolved that her speech should never be lost, a resolve which they succeeded in carrying out, by means of studying the "German" system. Finding the great benefit their child received from this method of teaching, the father endeavoured to get a school established on this principle. For this purpose he applied for State aid—which is, I believe, freely afforded for the education of the deaf in every civilised country but our own. His application was refused. Twice his proposition was defeated in Congress; and it was not until he had publicly exhibited the success of the system in the person of his own child, that the measure was passed. The opposition was led by a member of Congress, who himself had a toto-congenital deaf and dumb child.

When I was in America the school was large and flourishing; one of the warmest supporters, and most active members of its committee, being the very Congressman, who had so long and successfully opposed its foundation. He told me himself that he felt he could never do enough to further the "German" system, in order to make amends for having kept its benefits from his native State so long.

Now, we will go to a very different part of the world, and give you an instance of the prejudice which did exist against this system in Switzerland. For this purpose I will quote from the able report of Mr. A. A. Kinsey, made of a school at Riehen. He is the gentleman who has qualified himself by residence and practical instruction, in the best German schools in Germany, to preside over the proposed training college for teachers of this system in England:—

"In a little village called Riehen, about four English miles from Bale, in Switzerland, is to be found a most excellent school for the education of the deaf. I cannot refrain from advising anyone reading or listening to the following story, if at some future time they happen to find themselves at Bale, to drive over to Riehen and visit the 'Deaf and Dumb Institution' there. I promise them that they will be most cordially received, and what is far more to the purpose, greatly astonished at what can be done with children stone deaf from birth.

"This school has been in existence now thirty-six years, and is prosperous, but at the commencement of its career, such could not be said of it; in fact, Mr. Wilhelm D. Arnold, the admirable head of this school, could with but the greatest difficulty and economy make both ends meet. Persons accustomed to support charitable institutions pooh-poohed it, looked upon it as the idea of a visionary, a waste of money, which might with greater advantage be used elsewhere. Foremost among such persons was a rich merchant of Bale, named Merian. This gentleman had occasion very often to visit Mr. Arnold at Riehen on business not connected with the school. On each of these visits at the conclusion of the work in hand, Mr. Arnold would endeavour to interest his wealthy friend in the school, but always without success. He sighed to think how easily this rich man could place them out of all their pecuniary troubles, could he be but once convinced of the genuineness of the education. But how to do it was the question. He had talked, argued, quoted in favour of his school, had invited Mr. Merian to see and hear for himself. But, no; Mr. Merian had no time to waste in such an absurd manner; he was a strict man of business, and the moment his business with Mr. Arnold was at an end, he would step into his carriage and be driven back to Bale. One day Mr. Merian, being, let us suppose, in a very good humour, or Mr. Arnold's entreaties to him to visit the schoolrooms being more than usually strong, he consented just to give five minutes of his valuable time to an examination of the children. Crossing from the dwelling-house to the school he grumbled out 'You know it's all nonsense, Arnold, you know very well, as well as I do, that these children just talk like so many trained parrots; I don't deny they do talk, never did, but I simply repeat they talk like parrots, and it's a downright waste of time teaching them to do so.' 'Well, well,' said Arnold, 'you come and judge for yourself.' Mr. Merian continued, 'I never could understand how a man like you, so thoroughly conscientious and honest in all other respects, should be mixed up with such humbug, such charlatanry as this.' 'Pray don't use hard words,' said Arnold, 'until you have satisfied yourself by proof that they are deserved.' Both gentlemen then entered one of the class-rooms together; all the children present rose, and greeted them with a 'good day.' Mr. Merian broke out at once 'There, I knew it, I told you what it would be, 'good day,' 'good night,' 'pretty poll.'" A boy came up to him with a chair, saying 'will you be pleased to sit down sir?" Mr. Merian sat down, but without thanking the boy for his politeness. What was the use of thanking one who couldn't understand (?) a parrot in fact, but said 'Oh! yes, it's all very clever, Arnold, the boy has been well trained in his lesson, but you can't blind me.' Mr. Arnold said to the class, 'This is Mr. Merian, of Bale.' Several children repeated the name and bowed to him. This gentleman, however, broke out again, 'There, there, I can't stop any longer, it is nothing more than what I expected.' 'Well, one moment, if you must go,' said Mr. Arnold, 'while I ask the children one or two questions.' Turning to the class, he said, 'Did you see Mr. Merian come this morning?' 'Yes, we did,' answered several. 'Did he arrive on foot?' 'No.' 'How, then?' 'He came in his carriage.' Mr. Merian sat up in his chair, and paid somewhat more attention. 'Has Mr. Merian's carriage one or two horses?' 'Two horses.' Mr. Merian said hastily, 'Now, Arnold, you are deceiving me; you are telling them all this in some secret way.' 'Oh, no,' said Mr. Arnold, 'I never make use of signs or the finger alphabet; and if I did, I am truly happy to say my pupils wouldn't understand me: besides, see, my hands are behind my back.' He went on, 'What colour are the horses?' 'One is brown, with a white face, and the other is grey.' Mr. Merian jumped up, saying, 'This is very curious,' looking from Mr. Arnold to the boy who had last spoken, and appearing puzzled, 'This is really very curious; one might easily be deceived into fancying that the child was really thinking.' Mr. Arnold, without answering, went on, 'Why does Mr. Merian ride in his own carriage, instead of walking or going by cart, as we do?' 'Because Mr. Merian is a very rich man, and can afford to ride in his carriage.' 'Why, Arnold, the child is thinking, I declare!' cried out the gentleman. 'Of course he is,' replied Mr. Arnold, quietly; 'they all think and express their ideas as you and I do. True, not in such finished language, because at present their vocabulary, like that of all children, is limited; but I hope, by the time they are confirmed, they will be able to express themselves in as perfect language (if not more so) as do their parents and relatives.' 'Well, put some more questions,' said Mr. Merian. This was done, and after half-an-hour he said, 'Arnold, why didn't you tell me about this before? Why did you leave me under such an erroneous impression?' 'My good friend,' answered Mr. Arnold, 'if I have told you once, I have told you a hundred times.' 'Yes, but you should have explained the matter properly to me, so that I could have understood it. But, there, I will come and see your school again to-morrow. I feel quite interested in the poor little things, since I find they can talk rationally.' He did so, and during the next month, he was to be found for several hours, twice a week, listening to the pupils. The first time he put some questions vocally to one of the children, and received an answer, his delight was boundless. He felt almost that he was the wonderful instructor of the child, that he had placed the little deaf boy before him, far above the reach of his sad affliction, and had given him the power to see that which others hear; that he himself had restored to the poor boy the Divine gift of human speech, temporarily lost, but which for the untiring aid and skill of his teachers, would have been lost indeed for ever.

"From that moment Mr. Merian made a resolution, and his resolution was good. He gave 32,000 florins for the purpose of educating six pupils annually; and lent his most willing assistance and influence to the method of instruction he had so long, through unreasoning prejudice, condemned and despised."

A similar noble instance is recorded in America, where a Mr. Clarke most liberally endowed the institution at Northampton, Mass., named after him, though in that country such support is the less wanted, on account of the State aid which is afforded to institutions for the deaf. Let us hope to find in this far richer country some such munificent benefactors.

Briefly to recapitulate some of the conclusions to which our investigations led us, we find that the "French" system schools, to a limited extent, will always be wanted for those who cannot be educated on the "German" system, viz., the weak in intellect, and the very few whose speech, had they been hearing persons, would have been scarcely intelligible.

All others should be educated on the "German" system. And it should be borne in mind that it is for the poor that education on this system is so especially desirable. Important as it is to all, to the poor the gift of speech is of intense value, enabling them to make themselves understood to the world at large.

So far as to the system. How should it be carried out? At home when possible, which should be the case wherever a mother or elder sister could devote the time and patience necessary, or under a private governess.

Failing home education, small day-schools are to be strongly recommended, being preferable to large ones, and large ones preferable to boarding schools or institutions, the object being to render the deaf akin to hearing persons in their tastes, habits, and inclinations—their friendships and marriages—to enable them to be absorbed into general society, instead of forming them, as the "French" method does, into a body alien and apart from the speaking world.

How is this to be accomplished?

Five years ago, at the end of the able paper read by Sir George (then Dr.) Dasent before your Society, from this place, he said that an association had been formed for the purpose of starting a day-school on the "German" system, and that, with your sympathy, the association felt assured of success. His words have been fully realised. A school, such as he described, was started, which is the now excellent and flourishing one in Fitzroy-square. Excellent, however, as it is, a single school it remains. This should not be so; but others, perhaps smaller ones, should be established throughout the country.

That there is need of immediate action in this matter you will allow, when you know that little more than half our deaf are educated at all—what a bitter practical commentary on our boasted civilisation!—while only about 100 of those under instruction are taught on the "German" system. This leaves from 1,500 to 2,000 to be gathered in, without touching existing schools and institutions.

An association is now being formed, which will, we hope, help to spread the blessings of this system throughout the length and breadth of the land. In order to accomplish this, the first necessity is to have a supply of trained teachers. A training college is therefore about to be started, where relations of the deaf can obtain training, governesses can be taught, and masters and mistresses for schools supplied.

As this honourable Society, five years ago, generously assisted the school then proposed into public notice and recognition, so I feel sure that the good which resulted therefrom will be widely extended, by affording to the training college now proposed a like assistance, to the incalculable benefit of so many utterly neglected, and terribly unfortunate, of our fellow beings.

DISCUSSION.

The Chairman said the main point for discussion seemed to be whether the German system was the best.

The Rev. S. Smith said he desired, as Chaplain to the Royal Association for Aiding the Deaf and Dumb, and minister of St. Saviour's Church, Oxford-street, to say a few words on the other side of the question. They were much indebted to Mr. Ackers for going so deeply into the question, and he was entirely in favour of the deaf being taught to speak as much as possible, but he advocated the combined system. It was said by some that the two systems could not be carried on together, but he could prove the contrary. He had a pupil at the present moment who could both use the finger and sign language, and also speak and read from the lips, though, of course, he was not quite so *au fait* at the latter as those who were confined to that method. He was in favour of he finger and sign language, because of the rapid progress which could be made with it in the first few years of instruction, though he knew it was contended on the other side that the progress was not so rapid afterwards as in those who could speak. The sign language was especially necessary for the adults who had never learned any other, and amongst whom he had laboured for the last twenty-two years in London. A sermon or lecture could never be understood by a large assemblage of deaf persons, especially if the speaker wore a beard or moustache, like Mr. Ackers. Their language must always be somewhat limited, and they could not follow, therefore, the metaphors and rhetoric employed in the pulpit, and he defied any deaf person to follow a sustained discourse of half an hour. But he knew that the deaf and dumb in London had derived immense consolation from the sermons and lectures delivered to them in the finger and sign language. These people would always congregate together; previously to the establishment of the institution he represented, they would meet at public houses, but they all acknowledged that there had been a great improvement in their moral condition since these special services had been started. He lately saw two deaf Germans in Mayence, who conversed orally with strangers, but he noticed that with one another they preferred the finger and sign language. On the whole, therefore, he must protest against the sign language being neglected.

Mr. Cooke mentioned several cases which had come within his knowledge, where deaf persons had been able to communicate by the lips, and in no other way.

Mr. A. N. Skinner, Q.C., remarked that, in proportion as they valued the gift of hearing and of speech, should they compassionate those from whom these blessings had been withheld or withdrawn. He had listened with great interest to Mr. Smith, who endeavoured to support the convenience of signs, but, after all, the argumen seemed to come to this—If you cannot get the bes tools, use the best you can get. Possibly there was a greater facility in this off-hand mode of feeling one's way to the intelligence of others, but these communications must depend on the special training of those who where to make and receive them. He remembered, many years ago, visiting a noble lord who had been afflicted with deafness from childhood in consequence of fever. He could read and write English and French very well; but he found that at the dinner-table her ladyship kept up the conversation with him by means of signs, and thus informed him what his guests were saying. Now, if a man always had a sympathising and capable wife opposite him, this might answer pretty well; but if he had learned to articulate, and read from the lips of others, he would not have been so dependent, and could have conversed with those around the table much more freely. Another important feature about this method was that it contemplated beginning the education of the young at the earliest possible moment, when all the vocal organs were still flexible and capable of adapting themselves to exigencies to which they might be applied. Where this was neglected, and the organs became stiffened and impaired by want of use, no doubt signs were the only means left. Before sitting down he might mention that one of his servants, a labouring man, had a boy, a deaf mute, who had never been taught, and though he was tender and affectionate to his parents, and could communicate with them to some extent, he could not do so to other persons, and owing to this want of social intercourse, and consequent restraint, he was liable to fits of most ungovernable rage. Now, he looked upon life very much as an occasion for enjoyment, and loss of temper, therefore, is one of the heaviest grievances which could befall a man. It was to remove this great evil of isolation from social influences that Mr. Ackers was striving, and he most heartily wished him every success.

Miss Hull said she had been teaching the deaf and dumb for the last 14 years, originally on the combined system, but for the last four years she had given it up. She had no idea previously that it was possible to teach a child born deaf to speak, and therefore had only attempted to keep up the knowledge of spoken language in those who had once possessed it, but as soon as she found it was possible to do so, she commenced instructing even congenital deaf mutes in the same way, and now used no other method, because she found that those who were accustomed to watch the fingers would not give that undivided attention to the lips which was necessary. She found her pupils improved very much in language from going home to their friends, and at the age of 11 or 12, they were able to converse freely with their brothers and sisters. They were thus, in effect, restored to society, and their affliction was almost extinguished. With reference to the persons named by Mr. Smith, she believed they had been educated at Berlin under the combined system, and, therefore, they were not fair specimens of the real German system. Her own pupils had the greatest consideration for persons who were dumb, and repudiated with horror the idea of such an appellation being applied to them. She was confident if this system were more widely followed, immense advantage would ensue.

Mr. M. S. Dipnall said he was associated with an institution which had the largest endowed charity for the blind in England, and he therefore came in contact with a great many afflicted persons. He had been visited by a graduate of Cambridge University, who was not only deaf, but blind, but he brought with him an intelligent lad, who, by touching his fingers, could convey to him what was said. This was one instance which showed that something beyond lip reading was required, and the remarks of Mr. Smith showed that there were a great many adult deaf mutes for whom the finger and sign language was still a necessity. Therefore, while offering his warmest thanks to Mr. Ackers, he did not think they should confine themselves to lip-reading as the only channel by which to reach the intelligence of the deaf and dumb.

Mr. A. Kinsey remarked that it was not wished in any way to interfere with existing institutions conducted on the sign system. There were a certain number of deaf mutes who, by reason of weak intellect, and others who, from the additional deprivation of sight, must still be educated on the French system, but he did not conceive it was at all necessary that large congregations of these persons should be collected in a church for religious instruction which could be imparted to them in other ways. He believed that an easy sermon could be easily followed by a moderate number, for he had been present at two confirmations in Germany where the whole of the service was conducted orally, there being 60 or 70 deaf persons present, the greater part of whom at any rate, followed all that was said by the officiating clergyman. Any one speaking to the deaf must speak deliberately, and without gesticulation, which would throw as great difficulties in the way of being understood as to ask anyone to read from a book which you kept moving about before his eyes. He also thought it was open to question, whether a sermon conveyed in the foreign and pantomime language was perfectly understood; at least, he knew that in many instances this was not the case, and persons unacquainted with the deaf mute method of instruction would be astonished at reading the curious result of such sermons written down by the auditors or spectators. He might mention that Mr. Ackers had treated the historical and medical aspects of the question very fully in a lecture which he delivered before the Gloucester Literary and Scientific Institution last autumn. The medical aspect of the question was very interesting, especially to mothers, who often unwittingly did their children much injury. When deaf children were taught to speak, they were less likely to associate with others similarly afflicted, and consequently to intermarry with them, and this was a great advantage. It would be better if they did not marry at all, but this could not be expected; and Dr. Peat had calculated that the chance of the offspring of such unions being deaf was about 1 in 130, whilst Dr. Buxton put it at 1 in 135; but when two deaf mutes intermarried, the chance was 1 in 10 that their children would also be deaf. Besides, there were other evils arising from both parents being deaf. Dr. Buxton mentioned one case where a child of such parents learned the most horrible language from the bargemen on a canal near where he lived, which the parents were not aware of; and several instances had occurred of accidents to children from neither parent hearing their cries, or being aware of approaching danger. There were at present upwards of 2,000 deaf children receiving no education at all, a great many of whom naturally found their way to the workhouse.

Dr. Edward Symes Thompson said they had as yet heard but little of the medical aspect of the question, but that was very strongly in favour of the German system, and he would mention two or three of the numerous facts which might be brought forward. His speciality was not aural surgery, but diseases of the chest, and he had had an opportunity of noticing that a large number of deaf mutes suffered from such diseases. And this fact had an intimate connection with their being mute, but not with their being deaf, simply from their not using their vocal organs. It followed, therefore, that if they were taught to speak, the danger of lung disease would be lessened. Then, again, those who did not speak had a habit generally of breathing through the mouth instead of through the nose, and thus the cold air passed directly to the lungs, instead of being warmed, moistened, and filtered from dust in the nasal passages, as Nature intended. He would not confine this to those who were born deaf, for he had known several instances of children who had learned to speak, having lost that faculty in consequence of deafness, which was a terrible thing. As a rule, if hearing was lost at the age of six, speech was lost as well. This method of instruction in articulation would also be of great advantage in the case of children with hare lip and cleft palate, where the voice became harsh and unpleasant from being directed through the nasal passages. For these, and other reasons, he desired, on behalf of the medical profession, to bear testimony to the value of the German system, and especially in behalf of having a large number of efficiently trained teachers rather than increasing the number of schools. He hoped next week to draw special attention to this subject in a course of lectures he was about to give at Gresham College, and he should lose no opportunity of pressing it on the attention of the profession.

Mr. Ackers, in reply, acknowledged the courteous manner in which this paper had been received, even by those who did not agree in all its conditions, and said he on his part should be very sorry to say anything unkind towards those who were promoting any system which they believed to be the best for the welfare of the deaf and dumb. It was, however, a mistake on the part of

Mr. Smith to suppose that a deaf person could not understand what was said by a person wearing a beard and moustache, as he could show him if he would honour him with a visit. It was simply a question of habit and education; his daughter could understand him as readily as she could her mother. Mr. Skinner had very forcibly depicted the unhappy condition of those who were totally uneducated, and much as he valued the German system, he would vastly prefer that such persons were taught to converse by signs rather than not at all. After thanking Miss Hull for her valuable testimony in favour of the German system, he said, in reference to Mr. Dipnall's remarks, that he was quite aware of the necessity of sign language being adopted in some cases. He would not interfere with any one who had learned that system, but he would not allow in any school, on the German system, with which he was connected, any pupil who had been for a year under the combined system. That must still be continued for adults, and those who had began with it; and he was, in fact, a supporter, to a small extent, of more than one institution conducted on that system; but he contended that the other was vastly superior for young children, who had to commence their education.

The Chairman, in proposing a vote of thanks to Mr. Ackers, said he was quite satisfied of the superiority of the German system, and he should do all that lay in his power to support it.

The motion was carried unanimously, and the proceedings terminated.

NOTICES.

PROCEEDINGS OF THE SOCIETY.

[The announcements for meetings after next week are omitted from want of space.]

Ordinary Meetings.

Wednesday evenings, at 8 o'clock. The following arrangements have been made:—

May 2.—"Continuous Breaks for Railways," by Capt. Tyler. The Earl of Aberdeen will preside.

Indian Section.

Friday evenings, at 8 o'clock. The following arrangements have been made:—

May 4.—"Thaumato-dendra, or the Wonders of Trees," with illustrations from life, by Wm. Tayler, Esq. Sir Joseph Fayrer, M.D., K.C.S.I., will preside.

Cantor Lectures.

[Members are specially requested to take notice that the hour for this course of lectures is **FOUR** p.m., not eight p.m.]

Monday afternoons, at four o'clock. Third Course on "The Connection of Greek and Roman Art with the Teaching of the Classics," by Sidney Colvin, Esq., M.A., Slade Professor of Fine Art at the University of Cambridge.

Lecture III.—April 30.

Materials of the Study.—Division according to the art employed, as sculpture, painting, and their subordinate arts. Division according to the nature of the work produced, as statues in wood, gold and ivory, bronze, marble, terra cotta, free and decorative statues, reliefs, wall-paintings, vases and vase-paintings, coins, gems, gold ornaments, bronze armour and implements, glass, &c. Historical sketch of the accumulation and distribution of the materials. Excavations and museums.

MEETINGS FOR THE ENSUING WEEK.

Mon.... **SOCIETY OF ARTS**, John-street, Adelphi, W.C., 4 p.m. (Cantor Lectures) Prof. Sidney Colvin, "The Connection of Greek and Roman Art with the Teaching of the Classics." (Lecture III.)

Royal United Service Institution, Whitehall-yard, 8½ p.m. Prof. Barff, "Explanation of a Method of Preventing Corrosion of Iron and Steel as Applied to Naval and Military Purposes."

Institute of Surveyors, 12, Great George-street, S.W., 8 p.m. Adjourned Discussion on Mr. J. Shaw's Paper, "The Rivers Pollution Prevention Act, 1876."

Philosophical Club, Willis's-rooms, St. James's, S.W., 6 p.m. Annual Meeting.

Institute of Actuaries, The Quadrangle, King's College, W.C., 7 p.m.

Medical, 11, Chandos-street, W., 8.30 p.m.

Zoological, 11, Hanover-square, W., 1 p.m. Annual Meeting.

Tues.... Royal Institution, Albemarle-street, W., 2 p.m. Annual Meeting.

Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Discussion on "Street Tramways."

Pathological, 53, Berners-street, Oxford-street, W., 8½ p.m.

Biblical Archæology, 33, Bloomsbury-street, W.C., 8½ p.m.

Zoological, 11, Hanover-square, W., 8½ p.m. 1. Prof. St. George Mivart, "The Axial Skeleton of the Pelicanidæ" 2. Dr. M. Watson, "Some Points on the Anatomy of *Hyæna crocuta.*" 3. Mr. Arthur G. Butler, "Two Collections of Heterocerous Lepidoptera, from New Zealand, with Descriptions of New Genera and Species."

Wed.... **SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. Captain Tyler, "Continuous Breaks for Railways."

Entomological, 11, Chandos-street, W., 7 p.m.

Microscopical, King's College, W.C., 8 p.m.

Pharmaceutical, 17, Bloomsbury-square, 8.30 p.m. Prof. Redwood, "Spectrum Analysis."

Archæological Association, 32, Sackville-street, W., 4½ p.m. Annual Meeting.

Obstetrical, 53, Berners-street, Oxford-street, W., 8 p.m.

Royal Horticultural, South Kensington, S.W., 1 p.m.

Thur.... **SOCIETY OF ARTS**, John-street, Adelphi, W.C., 11 a.m. Annual Conference on the Health and Sewage of Towns. Opening of the Proceedings by the Chairman. Papers and Discussions on—1. Dry Systems. 2. Water-carried Sewage. 3. Escape of Sewage Gas into Dwellings. 4. Discharge of Sewage into Sea. 5. Additional Facts to those stated in the Report of the Local Government Board on Disposal of Sewage.

Royal, Burlington House, W., 8½ p.m.

Antiquaries, Burlington House, W., 4½ p.m.

Linnean, Burlington House, W., 8 p.m. 1. Mr. G. S. Boulger, "*Thlaspi perfoliatum* as a British Plant." 2. Prof. Nicholson and Mr. R. Ethridge, "The Structure and Affinities of the Genus *Alveolites* and Allied Forms." 3. Prof. St. George Mivart and the Rev. Robert Clarke, "The Sacral Plexus and Sacral Vertebræ of Lizards."

Chemical, Burlington House, W., 8 p.m. 1. Mr. Y. W. Thomas, "Some Points in Gas Analysis." 2. Dr. Stenhouse and Mr. Groves, "Nitroso-β.-napthol." 3. Messrs. W. T. Russell and W. Lapraik, "The Action of Pyrogallate of Potash on Nitric Oxide." 4. Mr. W. N. Hartley, "Asbestos Cardboard, and its Uses in the Laboratory."

Society for the Encouragement of the Fine Arts, 9, Conduit-street, W., 8 p.m. A Dramatic Recital by Miss Evelyn, "Nelson."

South London Photographic (at the House of the Society of Arts), 8 p.m.

Royal Institution, Albemarle-street, W., 3 p.m. Prof. Tyndall, "Heat." (Lecture IV.)

Royal Society Club, Willis's Rooms, St. James's, S.W., 6 p.m.

Psychological, 11, Chandos-street, W., 8½ p.m.

Fri....... **SOCIETY OF ARTS**, John-street, Adelphi, W.C., 11 a.m. Annual Conference on Health and Sewage of Towns. Papers and Discussions continued. 8 p.m. (Indian Section.) Mr. William Tayler, "Thaumato-dendra, or the Wonders of Trees," with Illustrations from Life.

Royal Institution, Albemarle-street, W., 8 p.m., Weekly Meeting. 9 p.m. Rev. W. H. Dallinger, "Researches on the Origin and Development of Minute and Low Forms of Life."

Geologists' Association, University College, W.C., 8 p.m.

Philological, University College, W.C., 8 p.m. Prof. J. B. Mayor, "English Rhythm or Metre."

Archæological Institution, 16, New Burlington-street, W., 4 p.m.

Sat....... Royal Institution, Albemarle-street, W., 3 p.m. Rev. Archibald H. Sayce, "Babylonian Literature." (Lecture III.)

The name of the manufacturer of quinetum referred to in Dr. Paul's paper on the "Cinchona Alkaloids," at page 506 of last week's *Journal*, should have been printed Whiffen, and not W. Cuffen.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,276. Vol. XXV.

FRIDAY, MAY 4, 1877.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

CITY COMPANIES AND TECHNICAL EDUCATION.

The following letter has been received from Major Donnelly:—

6, Onslow-crescent, London, 3rd May.

Sir,—I was informed yesterday evening, at the Clothworkers'-hall, that that guild had just voted sufficient money to pay the teachers of the students who might be successful at the approaching Technology Examinations of the Society of Arts, on the same scale as Science Teachers are paid by the Science and Art Department.

It will, of course, take a short time to get the details arranged; but I think it is only right to take the earliest opportunity to make known this liberal offer of the Clothworkers' Company.

It appears to me to give promise of most important results.—Yours faithfully,

J. F. D. Donnelly, Major R.E.

A liberal sum has also been voted by the Court of the Drapers' Company to the Society, for the purpose of providing technical instruction for artisans. As soon as official intimation has been received of these donations, the particulars respecting them will be announced, but until then it would be premature to do so.

BLOWPIPE APPARATUS.

A prize of £10, which has been placed at the disposition of the Council by Col. A. A. Croll, is offered by the Society of Arts, with the Society's Silver Medal, for the best set of Blowpipe Apparatus which shall be sold retail for one guinea. The apparatus must, at least, contain blowpipe, blowpipe lamp or candle, spirit lamp, charcoal or charcoal pastilles and holder, platinum wire, glass tubes closed at one end (matrasses), open glass tubes, platinum-tipped forceps, magnet, hammer and anvil, and four re-agents, viz., borax, microcosmic salt, carbonate of soda, and nitrate of cobalt. These instruments and re-agents, together with any others which may be thought desirable, must be packed in a box. It must be understood that the above list of apparatus, &c., is only intended to include such as are absolutely indispensable, and it is expected that the set will contain additional instruments and re-agents, the selection of which is left to the competitors.

Special attention should be paid to the following points:—

1. Solidity of construction.
2. Compactness and portability.
3. Facilities for packing and unpacking.
4. Number of useful instruments and re-agents in addition to those mentioned.

The Society does not engage to give the prize unless some apparatus appears to show sufficient merit, and some advance on what is now obtainable for a guinea. All apparatus for competition must be sent to Society's House on or before 1st August, 1877. The successful competitor must guarantee that a proper supply of the apparatuses shall always be kept on hand, for sale in England.

CHEMICAL SECTION.

Thursday, April 26th, 1877, W. H. Hartley, Esq., F.R.S.E., in the chair.

The paper read was—

PHOSPHOR-BRONZE AND ITS APPLICATIONS.

By **Alexander Dick.**

According to antiquarian research, bronze formed the earliest alloy produced—some specimens are estimated to have an existence of from 4,000 to 5,000 years; it was not the alloy which we now call bronze, formed of copper and tin, but the result of the rough smelting of cupreous ores, and, of course, contained many impurities. It was used for casting domestic tools, weapons, and images; at a later period for bells, and still later for cannon.

The difficulty of the bronze founder, during the later periods referred to, appeared to consist in the impossibility of obtaining pure copper and tin for his smelting, but even when these became articles of commerce, further difficulties were met with in producing sound and reliable castings, and it is of but a recent date that some light has been thrown on the nature and cause of these difficulties, as also on the way to avoid or remedy them.

In the year 1868, Messrs. Montefiore and Künzel, of Liége, in Belgium, engaged in a series of very exhaustive experiments with bronze and bronze castings.

These gentlemen observed that the tin in bronze continually decreases by oxidation during the process of smelting. They found that the oxide of tin partly goes into the slag and partly is dissolved in the molten metal.

	Tin.		Copper.
Bronze, originally composed of	10·10	+	89·90
Contained after the 1st smelting	9·82	+	90·18
„ „ 2nd „	9·40	+	90·60
„ „ 3rd „	9·16	+	90·84
„ „ 4th „	8·52	+	91·48

The operators found great difficulty in determining analytically the proportions of the oxides, whether in combination with the tin or copper, or whether only mixed up in the metal; they found that "poling," a process by which the molten metal is stirred up with a wooden stick, will eliminate the oxide combined with copper, but has no influence on the oxide of tin; experiments, by passing hydrogen over heated bronze filings, proved equally ineffectual; the oxide combined with the copper was converted into water, and weighed as such, but the oxide of tin remained as in the "poling" process. It was in consequence of this difficulty that Dr. Künzel, for the first time, introduced phosphorus into the molten bronze; this had the desired effect, and the metal, which at first had a dull and covered appearance, suddenly became bright and of metallic surface. Thus, by introducing a small proportion of phosphorus, or phosphuret of tin or copper, of previously ascertained composition, it was found that the total amount of oxygen contained in the molten metal could be ascertained analytically with perfect certainty.

The absolute and elastic resistance of old bronze, that is, bronze containing oxides, is much smaller than that of bronze made with new metal; and, as will be seen by the following experiment, "poling" will improve old bronze, whilst phosphorus greatly improves bronze "poled."

Shavings of old bronze were melted and a bar thereof cast at 1595° C., the remaining liquid bronze was stirred with a wooden stick ("poled"), and a second bar cast at 1668° C. The then remaining metal was deoxidised with phosphorus and a bar cast at 1614° C. The three castings were thus made out of the same crucible and cast in the same manner in three moulds. The results were:—

	Resistence. absolute lbs. per sq. in.	elastic lbs. per sq. in.	Lengthening until rupture. Per cent.
Old bronze	22,982	17,020	2·0
„ poled	24,922	17,709	2·8
„ deoxidised with phosphorus	33,916	19,300	6·8

Thus, by the entire reduction (elimination of oxide) the old bronze had tripled its tenacity and considerably augmented its absolute resistance.

Having so far succeeded in eliminating the oxides from the bronze, the inventors showed that by the further addition of a small per centage of phosphorus to the bronze alloy the qualities of the latter became more and more changed, the grain or fracture became finer, the colour brighter, the elasticity and resistance to strain and compression considerably increased, and when melted it attained greater fluidity.

Similarly, as minute quantities of carbon alter the physical properties of iron and convert the latter into steel, so a minute quantity of phosphorus changes those of bronze and converts the same into phosphor-bronze. It may thus be said in a certain sense that what steel is to iron phosphor-bronze is to ordinary bronze.

Messrs. Montefiore and Künzel next experimented with alloys of copper and nickel, and with manganese (binary alloys), also with (ternary) bronzes of copper, tin, and manganese, with copper, tin, and nickel, as well as with iron alloyed with copper and tin.

The manganese alloys they concluded to be entirely useless, as also those of nickel and of iron. They obtained great tensile strength and hardness with some of these compositions, but their ready oxidation at high temperatures made the qualities of the castings uncertain and impracticable.

Sodium eliminated the oxides contained in the molten bronze, but the slightest surplus of it produced an alloy which could not resist the atmospheric influences, and oxidised with great rapidity.

A minute addition of zinc to ordinary bronze augments the resistance to rupture by reducing involved oxides, but it softens the alloy and causes it to lose its elasticity.

Phosphorus was therefore found to be the only ingredient which will improve bronze by giving reliable results.

The action of phosphorus is twofold—firstly, it eliminates the oxides as stated above, and secondly, it makes the tin capable of adopting a crystalline structure—and, as two crystalline metals form a much more homogeneous alloy than two metals, of which one is not crystalline, phosphor-bronze must necessarily be more homogeneous than ordinary bronze. Homogeneity and absence of oxygen increase the elasticity and absolute resistance of the alloy.

Another great advantage of phosphor-bronze is that its hardness can be regulated by varying the proportions of phosphorus, which, in ordinary bronze, is done by increasing the proportion of tin, whereby the danger of segregation in the casting is greatly augmented. Ordinary bronze, after one or two smeltings, becomes thick-flowing, and putty-like, whilst phosphor-bronze remains perfectly liquid until the moment it sets (solidifies), if, therefore, it is cast just before the "setting" takes place, no segregation is possible.

Combinations of phosphorus with copper, with tin, or with other metals, have long been known by chemists, but Dr. Künzel was the first to employ the same for the purposes above stated.

A number of phosphor-bronze alloys are now manufactured, varying in composition to suit the objects for which they are intended. The scope of their applications is of course very great. The harder alloys are used for casting bells, tools for gunpowder mills, &c.; other somewhat softer alloys are used for engineering purposes, and the still softer for rolling, drawing, and embossing, &c.

The following tables will show the results of tests made by Mr. Kirkaldy, of Southwark-street, with various phosphor-bronze alloys:—

Cast Metal.	Diminution of Section before Rupture.	Resistance in pounds per square inch.	
		Elastic.	Absolute.
	Per Cent.	Pounds.	Pounds.
Pure Copper	3 30	4·4000	6·975
Ordinary Gun Metal, containing 9 parts copper, 1 part tin	3·60	12·800	16·650
Phosphor-Bronze	8·40	23·800	52·625
„ „	1·50	24·700	46·100
„ „	33·40	16·100	44·448

Drawn Metal.		Pulling Stress per square inch. Wire as drawn.	Pulling Stress per square inch. Annealed.	Twists in Five Inches. Wire as drawn.	Twists in Five Inches. Annealed.	Ultimate Extension.
		lbs.	lbs			Per cent.
Various Alloys.	Phosphor-Bronze.	102·759	49·351	6·7	89	37·5
	,, ,,	120·957	47·787	22·3	52	34·1
	,, ,,	120·950	53·381	13·0	124	42·4
	,, ,,	139·141	54·111	17·3	53	44·9
	,, ,,	159·515	58·853	13·3	66	46·6
	,, ,,	151·119	64·569	15·8	60	42·8
Copper		63·122	37.002	86·7	96	34·1
Steel		120·976	74·637	22·4	79	10·9
Iron, galvanised best charcoal E.		65·834	46·160	48·0	87	28·0

A series of interesting experiments with phosphor-bronze was made in Berlin by the Royal Academy of Industry, in order to ascertain the qualities and capacities of the metal whilst under heavy strain, and its resistance to often repeated strains. The first bar of phosphor-bronze was tried under a constant strain of 10 tons per square inch, and resisted 408,230 pulls; a bar of ordinary bronze broke even before the strain of 10 tons per square inch had been attained. A second bar of phosphor-bronze was tried under a strain of 12½ tons per square inch and withstood 147,850 pulls, and a third bar, under 7½ tons strain, broke only after 3,100,000 pulls. On the bending machine, phosphor-bronze, whilst under 9 tons strain per square inch, remained unbroken after 4,000,000 bends, whilst ordinary bronze broke after 150,000 bends.

Major Majendie tested phosphor-bronze as to its liability to emit sparks, when subject to friction, and attained very satisfactory results. The experiments were carried out at the royal gunpowder works at Waltham Abbey. A grindstone of 9 inches diameter was made to revolve very rapidly, so that any point on the grinding face would describe a distance of 2,000 feet per minute; the metal was then pressed against the revolving stone, and the results proved that the harder descriptions of phosphor-bronze emit sparks less readily than the softer samples, and much less readily than ordinary gun-metal or copper.

For frictional purposes the Phosphor-Bronze Company, in London, produces a special alloy by fusing phosphor-bronze in certain proportions, together with another soft alloy of different degree of fusibility, so as to produce by cooling two given alloys. The shell is then formed of a very tough and hard phosphor-bronze and the interior of aforesaid soft alloy. The bearing surface may then be considered to consist of a large number of small bearings of soft metal, enclosed in casings of metal almost as hard as the arbor itself. The microscope reveals this disposition very plainly, and if one of these bearings be carefully submitted to heat, so as to cause the soft fusible metal to run off, the rest will remain in the form of a spongy mass. Bearings, slides, eccentrics, &c., of this peculiar alloy are now very largely in use, and the practical results show that it wears more than five times as long as gun-metal.

Phosphor-bronze is readily rolled or beaten out into sheets. In Russia it has been used as a material for cartridge sheathing, and specimens have stood 120 trials without tearing. Sheets of the alloy stand the action of sea-water much better than copper. In a comparative experiment made at Blankenbergh, lasting over a period of six months, between the best English copper and phosphor-bronze, the following results were arrived at:—

Thickness of the Sheets = 0·236 inches.	Weight before Immersion	Weight after Immersion	Loss of Weight.	
	lbs.	lbs.	lbs.	Per cent.
Sheet of Copper	74·4	72·2	2·2	3·015
Ditto ditto	88·9	86·2	2·7	3·100
Sheet of Phosphor-Bronze	69·5	68·75	0·75	1·123
Ditto ditto	114·3	112·97	1·33	1·195

The loss in weight, therefore, due to the oxidising action of sea-water during the six months' trial, averaged for the English copper 3·058 per cent., while that of the phosphor-bronze was but 1·158 per cent., or about one-third.

Several Governments have experimented on the use of the alloy for making cannon. Without any exception, the results showed a much greater resisting power over that possessed by ordinary bronze. The following instances of the results arrived at will be of general interest:—

In Belgium the ordinary bronze gun burst at the second shot, with a charge of 1 k. 250 gr. (2¾ lb.) of powder, and a cylindrical projectile weighing 8 k. 518 gr. (18¾ lb.) The phosphor-bronze gun supported this charge perfectly; the normal charge was 500 gr. ($1\frac{1}{10}$th lb.) of powder, and 3 k. (6¾ lb.) of projectile.

In France the ordinary bronze gun burst at the second shot, with a charge of 1 k. 500 gr. (3½ lb.) of powder, and 16 k. (35¼ lb.) of projectile, while the phosphor-bronze gun was fired five times with this charge, and burst at the second shot with 1 k. 750 gr. (3⅞ lb.) of powder, and a projectile of 20 kil. (44 lb.), owing to the wedging of this in the barrel. The normal charge was 0 kil. 550 gr. (1⅜ lb.) powder and a bomb of 4 kil. (8⅘ lb.)

In Prussia it was shown in firing with the regulation charges, and diminishing, at each 50 shots, the exterior diameter of the chamber, that the phosphor-bronze cannon only changed their dimensions when the thickness of the metal was below that of the dimensions of a cannon of the same calibre made of steel.

The Phosphor-Bronze Company now supply most of the English railways and nearly all the rolling mills, the Royal Arsenal, and many of the leading engineering firms. Amongst the steamship companies the Peninsular and Oriental line has nine steamers fitted with phosphor-bronze in parts of the machinery, the Temperley line, the Wilson line, State line, Messrs. McAndrew and Co., the Ducal line, Globe line, the North Cape Mail Co., Messrs. Pickernells, Messrs. MacIver and Sons, and numerous other firms, as also 25 ships in H.M. Navy are fitted with phosphor-bronze.

In conclusion I beg to draw attention to the specimens of phosphor-bronze exhibited here—they are separated into different groups, each group is headed by an ingot of the phosphor-bronze alloy used for the manufacture of the various articles belonging to that group.

Specimens of Phosphor-Bronze exhibited at the Society of Arts 26th April, 1877.

In each group is shown an ingot of the phosphor-bronze alloy used in the manufacture of the respective articles contained in the group; also test bars from Mr. David Kirkaldy, of Southwark. These tests were made with bars cast in sand, except those of Group D, which was cast in an iron mould and then turned down, so that the area of the section corresponded to one square inch exactly. The resistance of each bar is marked upon it, and it is interesting to notice the fractures, elongations, &c., of these bars.

Group A.—Contains the soft and malleable alloys. They can be rolled or drawn, and, like iron or steel, thereby greatly increase their strength and elasticity. These alloys have the appearance of copper which, in fact, is their chief constituent. The tests made with phosphor-bronze wire show that if drawn hard, the tensile strength can surpass that of steel wire, while when annealed, it is much tougher than annealed copper wire, its elongation before rupture takes place being 46·6 per cent. against 34·1 per cent. of copper wire. Amongst the specimens here before us is a piece of phosphor-bronze wire drawn so fine that it takes 2,000 yards for the weight of one ounce. The wire is used for wire webs in paper mills, for pit and other ropes where acid waters occur. For telegraphic purposes a phosphor-bronze wire is made which possesses the same tensile strength as iron wire, and three times its conductivity. Copper wire, which has the greatest power of conducting electricity, is too soft to be suspended without the support of steel wire; it "bags" between the poles, as it cannot bear its own weight. Phosphor-bronze tubes of various sizes are for use in boilers, &c., and the finer sort for Bourdon's gauges. The sheathing can be made like the wire, either very tough and malleable or hard and springy.

Group B.—This alloy is of about the same hardness as ordinary bronze, but much superior to it in strength, elasticity, colour, and fluidity when melted. It possesses a rich, gold colour when polished, and the castings have the strength of wrought iron. It can be hammered, but will roll only with difficulty. It is used for steam fittings and harnesses. The Belgian cavalry have phosphor-bronze buckles, and the Garde Civique in Belgium phosphor-bronze gun-actions in use for their Comblain rifles. Messrs. Chubb and Son, and other lockmakers, use it for keys. In engineering works it is used for a great variety of things. On account of its great fluidity in the melted state, this alloy is very suitable for ornamental castings; these leave the moulds so true that but little chasing is required to finish them.

Group C.—The hardness and grain of this alloy approaches that of cast steel; although it will stand a blow with the hammer, it will not improve its elastic and tensile strength by hammering. It is chiefly used for parts of machinery, for pumps, valves, pinions, piston rings, &c.; also for the three-cylinder engine of Messrs. Brotherhood for Whitehead's fish torpedoes. A plunger cast in this alloy remained without any mark of wear after 572 days, where a steel plunger wore out within six weeks. As worm wheels it lasted 18 months against the same cast in gun-metal lasting but a few weeks. An eccentric strap of this phosphor-bronze alloy wore but $\frac{1}{4}$ inch in 18 months, while a similar one in gun-metal only lasted three months. In Her Majesty's Navy it is used for slide faces, and the royal gunpowder-mills at Waltham-abbey, as also many private firms use it for tools.

Group D.—The alloy forming this group is less hard than that of group C.; its grain is very fine, but its main feature is its great tensile strength. The tests show over 26 tons of absolute resistance per square inch. It must be cast in metal moulds, and its chief use is for bolts and nuts, for spindles, pump rods, &c.

Group E.—Bearing metal. The nature of this peculiar alloy has been mentioned already; its applications for rubbing surfaces is of course very manifold, and its use undoubtedly the most extended of all the phosphorised alloys. It is much appreciated for bearings in rolling mills by railways for slides and axle-boxes, and for carriage and loco bearings, for eccentrics, &c., it has given the greatest satisfaction.

Considering the comparatively short time since phosphor-bronze was first known in England, its use is very large—its superior qualities gave it a ready introduction to engineers, and it now proves itself quite an article of necessity with which many branches of industry can dispense no more.

DISCUSSION.

The Chairman said they were very much indebted to Mr. Dick for bringing forward this matter in so complete a manner, especially as it was illustrated with so many practical illustrations. It seemed at first rather surprising that such beautiful materials should be obtained by the action of phosphorus on an alloy of copper and tin. If the alloy were rendered brittle and unworkable by the tin in its composition becoming oxidised, as occurred in the re-melting of old bronze, and if this oxide was reduced by the phosphorus, one could understand a beautiful bronze being produced; but it also appeared that by the addition of phosphorus to the alloy, great hardness was obtained, a very surprising result, especially considering that phosphorus was regarded as a bane by the metallurgist. Phosphorus in iron produced "cold shortness," and in copper it produced "red shortness." There was also the fact that metals ordinarily soft and malleable were rendered hard and brittle by the addition of substances belonging to the same chemical group as phosphorus. For instance, when arsenic was added to lead in the proportion of 40 lbs. to the ton, it produced what was known as shot metal. Again, the addition of antimony to lead and tin gave the hard type-metal. Looked at in this way, perhaps the results were not so surprising, as they were somewhat analogous to what was observed in other cases. No doubt many questions would be put to Mr. Dick, and he himself would like to ask if any careful analysis had been made of these alloys, because it would be interesting to know the proportion of phosphorus in the bronzes of different characters. He also thought it probable that if some of these specimens were etched on the surface with acid, a microscopic character would be brought out which would be very interesting.

Mr. Powell asked if any effluvium were given off, or injurious effects produced on the health of the workmen by the phosphorus in the metal.

Mr. Wright said it would be interesting to hear how these metals worked under the tool.

Mr. Fox said he believed this metal was a patent, and therefore its composition and mode of manufacture must be stated in the specification. As a man of business he should like to know how far it was comparable in price with other metals of similar character, and also what were its special advantages over other metals, for such articles such as were exhibited, harness, scissors, and tools of various descriptions.

Mr. Bernard Dyer, F.C.S., asked if any exact determinations had been made of the electric conductivity of this alloy. The presence of a small per-centage of phosphorus in copper rendered it almost useless for submarine cables, because the resistance was found to be so greatly increased.

Mr. Bancroft asked if the phosphor-bronze wire had been compared with steel wire as regards strength. There had lately been some steel wire advertised, made for an American bridge, the breaking strain of which was to be 70 tons per square inch of section, and at the present time he believed a performer at the Aquarium Theatre was using a steel wire, which would stand a breaking-strain of from 150 to 178 tons per square inch. He should like to ask if the phosphor-bronze wire could in any way be compared both as to strength and price, because, of course, that entered very largely into the question of these things. He had had some little experience in phosphor-bronze, though not with regard to wire, Mr. Dick having kindly given him some information with regard to it some time ago, which he placed before the Society of Civil and Mechanical Engineers. It had been brought into use for certain purposes, and in the case of bearings it certainly put all other metals into the shade.

Mr. Luke said he believed that wherever grit of any kind had access to the bearings, the phosphor-bronze did not stand anything like so well as gun-metal. They had been tried at the Llandore Steel Works Rolling Mills, in the shape of 30 in. bearings, where the friction was at the rate of 900 to 1,000 ft. per minute. The bearings were sent down as a special sample by the Phosphor-Bronze Company, who endeavoured to do the best they could in the early part of the year 1875, but they only remained in use for nine months, whilst the ordinary gun-metal bearings made at Llandore, with a considerable amount of spelter in them, had been in use for 18 months, and were not then complained of, being capable of lasting six to nine months longer. It appeared to him, therefore, that from these rolling-mill engines, going at a great rate, and requiring to be reversed continually, gun-metal lasted better than the phosphor-bronze.

Mr. Wills said it was very interesting to compare the metallurgy of this substance with that of iron, and possibly the two things might throw a considerable light on one another. In the case of cast-iron, you had the iron containing the largest proportion of carbon, whilst wrought-iron contained the least; and in the intermediate stage you had steel containing a definite proportion. In wrought-iron you had considerable tenacity; and in cast-iron great hardness without tenacity—in fact, considerable brittleness. Now, in this phosphor-bronze, apparently by the union of the bronze with phosphorus, you might get an alloy which was very tenacious, or one which was exceedingly hard, but not so tenacious. Thus, by adding a quantity of phosphorus to bronze, you might vary the character of the metal produced, so that phosphorus seemed to act very much in the same way on the bronze as the carbon did on the iron, and it would, therefore, appear that by following out some of these facts, which he thought might be more easily studied in this metal, owing to the greater readiness of working it, some light might be thrown on the metallurgy of iron itself, which was a subject, even in the present day, that was not thoroughly understood. He knew very little of the phosphor-bronze before that evening, and he should like to ask whether the melting temperature became higher or lower after the addition of the phosphorus, and also what was the specific gravity of the alloy. It would also be interesting to compare the action of the phosphorus in these alloys with its action in many of its other combinations.

Mr. Pearsall asked if there were any peculiar chemical advantages in using this alloy. It was a point of the greatest importance for general information to have the opportunity of using a cheap metal which could be easily worked, and would yet resist the ordinary action of friction and also of chemical agents. They all knew the advantages of steeling on certain surfaces, and also of electro-plating, but in paper-making for photographic purposes they had not yet been able, notwithstanding the immense pains which had been taken, and the special machinery which had been erected, to prevent minute specks of metal appearing on the paper, which were supposed to arise from decay, oxidation, or sulphurisation of the metallic parts of the machinery. He should like to know, therefore, whether this bronze had any power of resisting the ordinary sulphurisation which took place with metal, and which they all knew the effect of upon silver. He had seen in a Yorkshire paper an account of some process for printing cotton goods by the use of certain powerful fluid colours, which had been impeded by the difficulty of getting a suitable material for working with hydraulic power and air-pumps, until this phosphor-bronze was discovered, when the difficulty was removed.

Mr. Thomas Palmer, said that in October last he read a paper before the Royal Microscopical Society, the plates of which were engraved by himself. He was not an engraver by profession, but was accustomed to etch plates, to illustrate mathematical problems on copper with nitric acid. On this particular occasion the figures were so complicated and minute that he could not get the copper to stand at all, and therefore tried the phosphor-bronze, using nitric acid containing 300 cubic centimetres to the 1,000, and found it answer perfectly well. He had had hundreds of impressions taken off with the greatest success, and Mr. Sorby, the President, was so much struck with it that he stated his intention to adopt the same material.

Mr. Dick, in reply to the various questions which had been asked, said the quantity of phosphorus employed was stated in the patent, but each manufacturer had certain secret processes, which he did not think it right to divulge, and he must therefore decline to answer as to the exact proportions. He had found no effluvium given off in the manufacture of the metal. The manner in which it worked under the tool depended very much upon the alloy. The soft alloy would drag under the tool, because it was very rough, but the hard kind would splint off like steel. With regard to the comparative price, of course it was higher than ordinary gun-metal or steel, but considering the amount of wear, it became much cheaper. Such bearings as those exhibited would be about 10 or 15 per cent. in advance of ordinary gun-metal, but they would wear five times as long, and taking into account the expense of changing bearings in machinery, this rendered them by far the cheaper. The price of harness fittings was the same as plated goods, because they were already cast, and only required polishing; whereas, generally speaking, these things were forged.

In reply to a further question,

Mr. Dick said that some beautiful specimens of harness fittings on the table were not lacquered, but simply polished. The same applied to gun locks—they would be much cheaper, although the metal was more expensive, because they need not be forged, and only required polishing after being cast. The electric conductivity varied according to strength required. The wire he had made was for Messrs. Siemens. It was directed to have the same tensile strength as iron, and with that strength it would have three times its conductivity, which was, of course, much less than that of copper. He could not say its exact tensile strength as compared with steel wire, but from tests made by Mr. Kirkcaldy, they had found some samples showed a strength of 159,000 tons to the square inch, while steel wire showed 120,000. No doubt steel wire could be made stronger than phosphor-bronze wire, but they had never had any particular strength asked for. He could not understand what was said about the bearings of the Llandore Steel Mills, because he had before him a testimonial dated the 10th June, 1875, stating that as regards wear they were found very much superior to anything which had been tried.

Mr. Luke said it was in July, 1876, he was at the works, and found that these phosphor-bronze bearings had been given up. He had formerly been employed in those works, and having gone down on a visit to the foreman, he inquired particularly about this metal, because he was in a firm in London where it was being largely introduced. The foreman showed him from his book that the phosphor-bronze bearings had only been in use for nine months, whilst the gun-metal ones had been in for 15.

Mr. Lovering said a great many bearings had been supplied in the neighbourhood of Llandore, and he would draw attention to two bearings on the table, one of gun-metal and one of phosphor-bronze, under the same circumstances, and it could be seen at a glance which was the most worn.

Mr. Dick continued that with regard to the fusing point, it was about the same as that of ordinary new gun-metal, but lower than that of old gun-metal, because when re-melted that had a tendency to flow thickly, and therefore a higher temperature was required to cast it. He had not had much experience with regard to its resistance to chemical action. They made wire for paper mills, but had as yet received no opinion as to the result.

The Chairman said they were much indebted to Mr. Dick, not only for the paper, but for the explanation he had given them in answer to the various questions. His own question must have been misunderstood with regard to the proportion of phosphorus in the bronze. He did not desire to know how the bronze was made, or the quantity of phosphorus put in, but was rather curious as to the exact percentage composition of the alloys of different characters of hardness. Of course, this was no secret, because anyone could easily analyse any sample brought before him, and he only wished to know if such analyses had been made. In conclusion, he proposed a vote of thanks to Mr. Dick, which was carried unanimously.

TWENTY-FIRST ORDINARY MEETING.

Wednesday, May 2nd, 1877; The Earl of ABERDEEN in the chair.

The following candidates were proposed for election as members of the Society:—

Blank, Emil, Trump-street, Cheapside, E.C.
Blank, Robert, Trump-street, Cheapside, E.C.
Bradford, R. W., 3, Clement's-lane, E.C., and Frankland, Sutton, Surrey.
Bright, Henry (Mayor of Leamington), 100, The Parade, Leamington.
Butler, James William, Stonebridge-park, Willesden.
Carpmael, Arthur, 24, Southampton-buildings, Chancery-lane, W.C.
Carter, William Allan, 5, St. Andrew-square, Edinburgh.
Farley, Reuben, West Bromwich, Staffordshire.
Loch, C. S., Charity Organisation Society, 15, Buckingham-street, Strand, W.C.
Rankin, James, Bryngwyn, Hereford.

The following candidates were balloted for, and duly elected members of the Society:—

Forbes, James, jun., Chemical Works, Old Ford, E.
Hamilton, Dr. J. Lawrence, 34, Gloucester-terrace, Hyde-park, W.
Jackson, Francis Halhed Ward, 9, Albion-street, Hyde-park, W.
Jackson, Ralph Ward, 26, Cambridge-street, Hyde-park-square, W.
Sanderson, Charles Poyntz, care of the Rev. J. W. Sparling, Crewthorne, Berks.

The paper read was—

CONTINUOUS BREAKS FOR RAILWAYS.

By Capt. Tyler.

In order that no possible misunderstanding may exist, I will ask you to allow me, before I proceed to discuss the question before us this evening, to state clearly my own position with regard to it. Up to the present time I have been, as Chief Government Inspector of Railways under the Board of Trade, perfectly independent as regards this and all other railway questions. I have always persistently adopted the course which my office required, and my inclination dictated, of recommending, by way of improvement in railway working, general principles only in the interest of safety and efficiency; and of holding the balance, as far as lay in my power, evenly between all inventors. About six months ago I was elected President of the Grand Truck Railway of Canada, and an honourable member of a certain house, not very far from this room, who has, from time to time, for some reason unknown to me, taken a kind interest in me and my affairs, inquired, in his place, of the President of the Board of Trade, at the commencement of this session, whether it was intended that I should at the same time retain my office at the Board of Trade. Mr. Westinghouse, whose name is so well known in connection with a continuous break, on seeing, from the question so put and the answer given to it, as reported in the newspapers, that I was likely to leave the Board of Trade, asked the advice of a mutual friend; and then, some time having elapsed, he was good enough, a few weeks ago, to make me an offer of a most handsome and complimentary character, with a view, if I should give up the Board of Trade, to my having a considerable interest in, and assisting him in his business. I had, of course, a previous general acquaintance with his and other contrivances for what are called continuous breaks; but I then began to consider the different systems more carefully. The main condition that I laid down for myself was that I should under no circumstances accept his offer, or consent to associate myself with him, unless and until I could satisfy myself beyond doubt that his system was the best that had been or could be devised; that it was based on principles which deserved to be adopted in preference to all others, and could be proved to be superior in practice; that it should be able to withstand the test of full and public discussion, and fair and practical experiment; and that it should, in fine, possess pre-eminently the qualities which the best break ought to possess. I am still anxiously considering this special subject, from motives of self-interest, and I should be very much obliged if any one would point out to me wherein any other system of breaks is superior, before I finally determine to accept or reject the offer thus made to me, which, having resigned my office at the Board of Trade, I am now free to do. The points I am considering for myself are just those which it is to the interest of the chairmen and directors of the railways of this country also to make themselves acquainted with; and it has occurred to me that a full and fair discussion of the subject would be of great value at the present time, not only to the railway companies in this and other countries, but also to all those who travel by railway. Many improvements, such as the block-system, interlocking of points and signals, *cum multis aliis*, which it has been my duty to recommend from time to time, have made enormous progress in recent years, and are now in a fair way to become generally adopted. But this question of continuous breaks, as affecting every train that runs, and almost every contingency that can happen to it, is really of more importance than all of them put together, and the time has come for a decision in regard to it. I have thought, therefore, that I could not do better than draw up a short paper, as a peg on which to hang a discussion, and that I could not choose a better battle-ground than this lecture-room, where all who are interested or engaged in the subject may come forward to advocate their claims and state their opinions.

After these preliminary observations, I beg to submit to you the following paper:—

It is a singular circumstance in the history of railway construction and working that the power of propelling trains should have advanced so rapidly, and the means of stopping them so slowly, towards what may be called perfection. Railways are now half a century old. The highest speed became practicable and available within a comparatively short period after their introduction. We were able to travel as fast thirty years ago as at the present day; but we are now, in the year 1877, for the first time seriously considering the best principles for quickly reducing the momentum of fast trains, and we are still depending in the greatest emergencies mainly upon the rude and primitive contrivance of employing men to turn handles in different parts of railway trains for applying break blocks to the wheels of a few vehicles. This is the more extraordinary, inasmuch as it is more important, for reasons both of convenience and of safety, to be able, when necessity arises, to reduce than to acquire speed rapidly. It is in consequence of the want of better means of applying break-power that the signal arrangements have become so complicated, and distant-signals have been necessarily placed at such great distances, varying from half-a-mile to 1,500 yards, from stations, junctions, level crossings, or cabins; with the disadvantages of extra cost, of difficulty and uncertainty in working, of their being placed out of the sight of the signalmen, and of employing electric repeaters in the cabins to indicate whether the arms are working, and whether the lights are burning. It is from the want of breaks on every vehicle that special break-vans have been employed on inclines, at increased expense in wages, in wear and tear of material, and in haulage for bringing these special loaded vans up again after their descent with a train. From the want of a larger proportion of break-power, much time is lost on every journey, and the engine-drivers are compelled to slacken speed at long distances from points of stoppage; and the more frequent the stoppages, the greater the time that is thus consumed. We find that the suburban or metropolitan systems of railways have, for this reason, been amongst the first to make use of continuous breaks. The North London, the Metropolitan, and the District Railways have thus adopted, respectively, the chain-break, the vacuum-break, and the air-pressure break. It is from the want of more break-power, properly applied, that most accidents occur, and that almost all the more serious accidents have been attended with fatal consequences. In cases of collision, where engine-drivers have several hundred yards, and perhaps half a mile or more, to bring their train to a stand, but are unable to do so from the want of break-power, the advantages of continuous breaks are obvious, especially on steep gradients, and with slippery rails. But they are hardly less important for the prevention of loss of life and injury in all other cases, as for instance, when trains leave the rails, owing to defects in the permanent way, or to their meeting with obstructions; when failures occur of couplings, springs, axles, tyres, or other parts of the rolling-stock; and when there are accidents at facing-points, or on inclines.

I am quite aware that, in bringing forward this subject, I am taking a leap, not in the dark, but rather into the glare of a fire. There is no other subject so hotly contested in the railway world at the present moment. Not only are there diversities of opinions, but there are also prejudices, and feelings, and interests at stake, which tend to prevent the plain truth, and simple common sense from gaining a hearing. I have frequently had occasion to observe upon the disadvantages which would result if the different companies were to adopt various systems of breaks, and especially where they form continuous routes of communication; but I have been told in reply by railway officers best acquainted with the subject, that it would be utterly impossible for the railway companies to agree on any one break system. Each board of directors has confidence, more or less, in its own technical officer, and looks at the matter, naturally, through his spectacles. The various locomotive superintendents have, according to their opportunities, their special knowledge, their qualifications, or their experience, honestly formed very different opinions; and they would, I am sure, themselves admit that there is at present no chance of their all agreeing together as to any one system of continuous breaks which it would be desirable to adopt in preference to all other systems. Many of them are, indeed, committed to one or another of these systems; and I have too much respect for them to think that they would lightly change the opinions which they have deliberately formed and confidently expressed.

In other questions of railway construction and working, there are not the same difficulties to contend with. In the construction of engines, or the construction of carriages; in devising instruments for working the block-system, or apparatus for interlocking the levers for working points and signals; in applying locking-bolts or locking-bars to facing-points; in the methods of securing tyres to wheels, so as to prevent them from flying off in case of fracture; in the form of rails, descriptions of fastenings, construction of bridges, considerable difference may be afforded; and it is a matter of comparatively little importance how much managers, engineers, and manufacturers may hold diverse opinions, or adhere to differences in practice. But in fitting up engines and vehicles with breaks, other circumstances have to be considered. It is important that, in running carriages through from one line to another, they should be adapted to travel together, and that they should be fitted in this respect, not only with the best, but with the same means of convenience and safety as regards the break apparatus applied to them. This requirement is imperative, and cases of accident will in future be narrowly watched, now that public opinion has become fully alive to the question, to see whether the best system of break-power is in use, and what has been the result. It may, indeed, be considered certain that the best break will before many years have passed become general, if not universal; and that, whether true or not in reference to other matters, the theory of the "survival of the fittest" will certainly prove true in the case of continuous breaks. Before it is too late, therefore, it would be wise for the boards of directors and managers of the various railways, carefully to consider this matter, and to ascertain for themselves which is the best break for general adoption. It is obviously much better that they should come to a general agreement with each other, and generally adopt that which they find to be best adapted for all purposes of practical working and maintenance, than that they should spend money foolishly, in adopting a number of different breaks of various degrees of merit on different lines of railway, and certainly better that they should do so themselves than that any sort of compulsion should be exercised by Parliament or by any Government department. I have seen much, in the last 24 years, of genuine, hearty, honest opposition to required improvement, and of such opposition from the highest quarters. But I have also seen how it has disapeared, as a summer cloud, before the teaching of experience, and the force of public opinion. And I know well that in regard to this, as to many other improvements which it has been my duty to advocate, and my satisfaction to see adopted, fair and open discussion, with public trials and practical working, will brush away premature conclusions and individual prejudices, like so many flies, and cause the best break, whichever it may be, ultimately to be brought into general use.

In discussing the subject in detail, it will be wise to begin at the beginning, and to state what a continuous break is. In the use of a continuous break, properly so-called, the blocks may be applied from one point to all the wheels of every vehicle in a train, whilst the blocks of the ordinary mechanical break are commonly applied by a fireman on an engine or tender, and by a guard on one vehicle only. Breaks may be wholly or partially continuous. They may be so fitted as to be applied along a whole train from one point, or they may be fitted so as to be applied in sections of vehicles; a van, and one, two, or more carriages being coupled together to form each section. If there be broken continuity and several separate sections in a train, then the retarding force in the train will obviously be in several hands, unless there be some further means of applying the breaks on each of these various sections simultaneously from one point.

Now, the first condition required in a good continuous break is, that the means of applying it directly throughout the train in an easy and simple way should be in the hands of the engine-driver. It is the engine-driver's duty to regulate the speed, to look out for signals or obstructions, to bring the train to a stand at the required point, and to act with promptitude in any case of emergency; and the principal objects of a continuous break are, that the engine-driver may have complete control over his train, and may be able to bring it to a stand when necessary within the shortest distance. Having the responsibility, he ought clearly also to have the power of directing the movements of his train, and be able to reduce the speed, or to increase it, at pleasure. Having the first opportunity of seeing danger ahead, he ought to be able himself to use the means of providing against it, and he ought not to be obliged to trust to the guards to apply their breaks, as is now the common practice, in reply to a warning from his whistle. No fact is more certainly established than that the guards frequently fail to hear the break-whistle from the engine, and do not, therefore, make use of their breaks when they are urgently required to do so. In break experiments, with comparatively short trains, we have known cases where guards [and others, specially on the look out for the break-whistle, have failed to hear it. The engine-driver should, therefore, be able himself to produce immediate action on every wheel of the train, when necessary, by some process easy to himself, and certain of action. This should be done, not merely by means of a communication-cord—which, although it cannot always be relied on even for calling attention, is employed in more than one continuous break system for acting upon the break-handles in the van—but by the direct application of the force employed for breaking purposes, whatever that force may be; and the guard, or guards, should also have the power, each from his compartment, of setting the same force in action, when it is required—on the failure of any portion of the rolling-stock, or a carriage leaving the rails, or other cause unknown to, or unnoticed by, the engine-driver. It is not, for many reasons, desirable to afford the means of applying breaks to the passengers; though they should be able to communicate with, and call the attention of, the engine-drivers and guards, if occasion should arise.

As one of the very numerous instances of the want of continuous breaks in the hands of the engine-driver, may be cited the accident last November near Wincanton, on the Somerset and Dorset Railway. In that case, an up-passenger train for Bath was travelling at a speed of 35 miles an hour, when the leading wheels of the engine left the rails, from a defect in the permanent way. The engine ran thus for 200 yards before the driving-wheels left the rails, but it then turned over on its side, 240 yards from the point of first disturbance. The engine-driver was killed, and the fireman and guard, who narrowly escaped with their lives, were severely injured. If the engine-driver had been able at once to apply a continuous break throughout this train, on finding his leading wheels off the rails, it might have been pulled up with scarcely any damage to the rolling-stock, and no injury to himself, or any one else.

Another condition, indispensable for a good continuous break worthy of general adoption, is that it should be automatic in its action, in the sense that the break should be self-applied on every vehicle, in the event of a division in the train. The break-blocks should fly on every wheel, instantly, on the separation of the break-couplings, and this, by direct action, and not through the intervention of secondary means, such as a communication-cord. In order that this condition may be properly complied with, each carriage should carry its own store of break-power, and it should not be dependent upon power supplied from any other vehicle, from which it might become separated. The necessity for this condition has been proved in numerous instances. Two of the most serious accidents in this country, as regards the number of deaths, occurred in consequence of the fracture of couplings and the running back of carriages down inclines, those, namely, at Brierly Hill, on the Oxford, Worcester and Wolverhampton Railway, and at Helmshore on the East Lancashire Railway. And there was a remarkably contrast in two recent instances, the one at Heeley on the Midland Railway, and the other at Morpeth on the North-Eastern Railway, which demonstrated, the former the advantage of a continuous break complying with this condition, and the latter the want of such a break. Both accidents were the result of a defective condition of the permanent way; and both trains were Scotch express trains. At Heeley the train was travelling at a speed of 60 miles an hour, when, in consequence of the road giving way under the engine, some of the carriages suddenly left the rails; and the first thing that attracted the attention of the head-guard, riding in the hind-van, was the automatic action of his break. The break became acquainted with the damage before the man knew anything about it, and by its prompt action, converted what would otherwise have been a terrible destruction of vehicles, with considerable loss of life, into an accident accompanied by comparatively little damage to the rolling stock, or injury to the passengers. At Morpeth on the other hand, where the train was travelling at far less speed, about 25 miles an hour, three carriages were so utterly destroyed as to be undistinguishable; the wheels of one of them, together with the remains of a passenger, were taken out afterwards from the tank of the tender, into which they had been driven; and five passengers lost their lives. Without multiplying individual instances, it is sufficient to state that hardly any accident can occur of a serious character, with separation of the couplings, in consequence of the engine or any part of a train leaving the rails, from failures in the permanent way or rolling stock, or from obstructions, or at points, or crossings, in which it is not an all-important advantage to be provided with a break which will thus at once act for itself irrespective of engines, vans, or other vehicles, and without waiting for the servants of the company to apply it at a time when they may be unable to do so. This desideratum will be the better understood when it is remembered that the destruction to the vehicles, and the loss of life to the passengers on such occasions, is commonly caused by the hinder carriages running forward with accumulating momentum upon the front carriages, and that this result is avoided when, the breaks on each vehicle being instantly self-applied, the momentum of each vehicle is at once checked, and such fatal results are thus avoided.

As a further condition of automatic action, the break-blocks should fly on and not off. They should, in other words, be applied to and not released from the wheels in the event of any failure of the apparatus. This condition will at once commend itself to those who urge, with truth, that the more generally continuous breaks are employed, the more certainly engine-drivers will get into the habit of running smartly up to signals, into stations, and towards buffer-stops or other "dead-ends."

There can be no doubt that this will be the natural tendency, and it must be expected and provided for. Men will never be otherwise than fallible, machinery will never be quite perfect. We weight our signals so that if the wire breaks they fly to danger, and we thus reduce in all ordinary cases what might be a risk of accident to a possible risk of delay. Similarly, it is essential, in employing continuous breaks, to provide that although a train may, on any defects occurring in any of their parts, be stopped prematurely, yet the driver shall not be carried accidentally too far without the means of pulling up. Otherwise, that which is intended as a means of safety might be converted into a source of danger. The argument is sometimes put forward that, however good continuous breaks may be for service elsewhere, they ought not to be used in running into terminal stations. But a few words of actual experience will soon dispel this fallacy. When collisions occur in this way, from trains entering stations at too high a speed, the engine-driver commonly accuses the guard, and the guard the engine-driver. The train is perhaps a little heavier, or the rails more slippery, or there is less proportionate break-power, than usual. But if the engine-driver has control of breaks over his whole train, then he has no occasion to rely on the guard or guards, the responsibility rests with him alone, and he is without excuse if he causes an accident. The most likely mode of producing such collisions is by distributing the break power between two or three men in different parts of a train, without good means of acting together; and the best mode of avoiding such collisions is to place the responsibility and control both together in the hands of the engine-driver. In such a case, no excuse remains for an engine-driver, when he is provided with ample break-power, which he can apply at pleasure, wholly or partially, of which he would not on ordinary occasions employ the full force, of which he would retain a reserve for every case of emergency, and which, if anything should happen to go wrong, would only by automatic action stop him sooner than he expected.

The most remarkable instance showing the necessity for compliance with this condition is the accident that occurred on the 11th November, last year, on the Jersey Central Railroad. A passenger train running to Communipaw Ferry, which ought to have been pulled up at the platform, dashed through the depôt almost with undiminished speed, carried away part of the goods office, crossed the ferry pier, and fell into the river. The engine-driver trusted to his vacuum break, which was not automatic, but his apparatus failed him at the critical moment. If his break had been automatic, and thus self-applying on the failure of any of its parts, the engine-driver would have been previously warned, and the accident would not have occurred.

Having reference, then, to the approach of trains to terminal stations, junctions, level crossings, opening-bridges, buffer-stops, and to every case in which an accident might be caused by a train over-running a particular spot, all of which is comprised in ordinary railway working, the truth of the matter may be correctly stated, by asserting that it is not safe to employ any continuous break which is not automatic, in the sense of flying on or applying itself when failure occurs in any of its parts; and, further, that a continuous break which does comply with this condition of automatic action must afford a higher degree of safety than the existing arrangement of mechanical breaks distributed through different parts of a train, and is the only proper and suitable apparatus to employ.

Another advantage, in practical working, of a continuous break which is self-applying, and requires to be taken off by the exertion of the force employed, that of proving itself to be in good order when the train starts, is not less important. Under other conditions, a train may be started with the break apparatus not coupled up, or with its parts out of order, unknown to the driver, when he starts on a journey; and he may only discover that his break is defective when he finds it failing to act, as it becomes necessary for him to bring his train to a stand. But when he is obliged, by the application of the break-force, to relieve the wheels of the blocks before it is possible for him to start, then there remains no risk—either from neglect of servants, or defect of machinery—of his leaving a terminal, or other station with his breaks not in working order. This is, in fact, a condition of simplicity in working, true in principle, and of great advantage in daily practice.

The next important condition is promptness of action, or application with full force of the blocks to the wheels, within, say, one second, on a train of ten carriages. The necessity for this requirement will be at once realised when it is remembered that in one second a train travelling at 60 miles an hour passes over 88 feet; at 45 miles an hour, 66 feet; and at 30 miles an hour, 44 feet. A train travels, that is to say, 100 yards,—at 60 miles an hour, in 3·4 seconds,—at 45 miles an hour in 4·6 seconds,—and at 30 miles an hour in 6·8 seconds. When an accident occurs in which a carriage leaves the rails from failure in any portion of a train, it may be of great, and even of vital importance, immediately to reduce the momentum of every part of it; and every extra second expended before this action is commenced may be a question of life or death. At Morpeth the engine fell over on its side 84 yards from the point at which, and say 10 seconds after, it first left the rails. This was an extreme case, but if, on the first separation of a coupling, say six seconds after the engine left the rails, every carriage had instantaneously and automatically applied its own break, then, undoubtedly the hinder carriages would have had their momentum so far checked during the four following seconds, that much of the terrible destruction which occurred by the hinder carriages running forward unimpeded upon the tender and some of the leading carriages would have been avoided, and no lives would have been lost. In cases somewhat less sudden, and when an engine-driver finds an obstruction 100 or 200 yards in front of him, the instantaneous application of his breaks will either prevent the collision or materially reduce the amount of damage, will save the passengers from injury, and will avert all risk from the subsequent rebound of the buffers—which is sometimes the cause of the worst damage—even if a collision ensue. In such a case, for instance, as the recent collision at Saltney, on the Great Western Railway, where the engine-driver of a passenger-train was warned by an engine-driver travelling in the opposite direction of an obstruction in his way, in the dark, 328 yards from him, caused by some waggons having, in shunting, been thrown from a siding, the passenger-train might, by the instantaneous action of a good continuous break, have been stopped short of the obstruction. And at Shipton, when 30 passengers were killed, the train, travelling at, say 40 miles an hour, might, apparently, by the instantaneous application of continuous breaks, have been brought to rest without any serious injury.

Another important condition of a continuous break is "simplicity," and on this head I must be allowed to refer to my paper read in this room on 20th May, 1874. I then endeavoured to explain, with reference to the accusations of certain eminent railway gentlemen as to the complicated arrangements which were, by the action of the Board of Trade, being forced upon railway companies, what simplicity, as opposed to confusion, in railway working really meant; and that simplicity in construction and simplicity in working were, in many cases, distinct, and widely different from one another; complication in construction being frequently, and always more or less, necessary to obtain simplicity in working. I then pointed out that simplicity in working was not obtained, "where in long heavy trains timed to travel at high speed, engine-drivers had not sufficient break power to enable them to bring their trains to a stand within reasonable distances, when they could not depend upon the guards hearing their break whistles, and when they had only a limited portion of retarding power under their own control," nor "when they found it difficult to maintain their time-table speed, and at the same time to approach each and every signal in the course of their journeys with the requisite amount of caution, according to the severity of the gradients, the slipperiness of the rails, the proportion of break power, and the positions and view afforded by such signals." I may now add that simplicity as regards the application of railway breaks is not obtained by the system now more commonly employed of break-handles to be turned by different men in different parts of a train; but is obtained when, by more complicated construction, an engine-driver is able easily in an instant to apply ample break-power at pleasure with more or less force to every wheel of his train; is obtained when, every time an engine-driver starts, or attempts to start, his train, the break itself informs him if it is out of order; and is still more obtained when, on the occasion of an accident and the separation of a coupling, the breaks will unfailingly apply themselves on every wheel of the train without the action of the engine-driver or guards, and before even they have time to realise the necessity for it. This is true simplicity in such a case; and that system of continuous breaks which best accomplishes such results in the shortest space of time is so far preferable to all others. As an instance of the want of simplicity of the present system, may be quoted the case of a recent accident at Derby. A night-mail train which ought, on arriving at Derby, to have been stopped at the ticket platform on the west of the station, ran past that platform, and came into violent collision with some carriages beyond it. The fireman, who was not well acquainted with the line or the station, took off his break, in the dark, to allow the train to run forward, on seeing a signal lowered, just at the moment when he ought to have screwed his break on more tightly; and the engine-driver only discovered the mistake which the fireman had committed when it was too late to correct it. I mention this case to show how desirable it is, not merely that the breaks should not be distributed between the fireman and guards in different parts of the train, but, further, that the engine-driver should, in the simplest way, be able himself to apply and release them, without the intervention of the fireman; and the engine-driver should be able to do so without the exertion necessarily bestowed in turning the ordinary screw-break on and off. As long as this common mechanical break is employed, the engine-driver cannot be expected himself to work it; and yet this is the break which, it is fair to say, is still, by reason of its apparent simplicity, in favour with some of the most eminent authorities of the railway world.

The conditions of cost, maintenance, and efficiency cannot, with advantage, be separately considered. Any railway company which adopts a break-system not fulfilling the necessary requirements will undoubtedly be compelled, sooner or later, to change its break apparatus, will thus ultimately incur much extra expense, and will be deprived, in the meantime, of the advantages obtained by the use of the best break. There cannot be very much difference in first cost between different systems, if the same conditions be fulfilled, and if the same materials are employed. Durability and cheapness of maintenance must be, and efficiency is, undoubtedly, of greater importance than comparatively slight differences in first cost. Rubber sacks and rubber reservoirs, as used in some systems of continuous breaks, may be somewhat cheaper at first, but cannot be maintained as cheaply as iron cylinders and iron reservoirs. They must be less reliable, and must, at times, be more apt to fail, as they get old, when they are urgently wanted to act. The constant maintenance of materials of this description—which cannot properly be allowed to work till they burst or fail, but must be renewed at stated intervals—under every vehicle used with passenger trains on a railway would certainly prove, in a series of years, to be a troublesome matter. It is a novel idea in railway locomotive or carriage building to contemplate the use of such materials for permanent work, and for objects of such importance. But, whatever the materials or the form of breaks, they should, at all events, be adapted and adopted for ordinary use, daily, hourly, and on the occasion of every stoppage made by a train. To keep one set of breaks for emergencies, and another set for ordinary use, as on the railway of one great railway company, is introducing a most objectionable principle. The tendency in the course of working such an arrangement from year to year, would be, according to all precedent, and all experience, for tests to be neglected, and for the emergency break to fall more or less into disuse. Apparatus of all descriptions on railways which is not constantly employed for useful purposes, fails to receive that attention which is necessarily bestowed on other apparatus on which practical working constantly depends. Sooner or later, the time would surely arrive when the emergency break, suddenly required for a serious contingency, would fail to act; and then, if loss of life were the result, the laments would be bitter and unavailing. It may be safely asserted that there is scarcely any piece or form of construction or machinery on any railway, or anywhere else, from a hose-pipe to a house, from a distant-signal to a locomotive engine, that is maintained from year's end to year's end in proper adjustment and condition unless it be required for practical use; and, independently of the disadvantage as regards the servants, who may be required to work one set of breaks at one time and another set of breaks at another time, and may not, when an emergency arises, be able readily to make up their minds which handle to fly to, or which lever to operate upon, the system of employing only occasionally and for purposes of test, a break specially provided for cases of extreme emergency, when perfection of adjustment and working is much required, when every second is vital, when luggage may be found in the way, is one which can only be looked upon as almost courting failure and disaster. As bearing upon the opposite principle, of relying continually upon the break which would also be used in cases of emergency, and of providing an indication, constantly before the eyes of the servants of the company of its condition and working, it would probably be wise in the case of pressure-breaks, to affix an indicator on every engine, and in every break-van, by means of which these men might always see at a glance the condition of their break-power, and of its connections.

I have purposely avoided in this paper a multiplicity of details, which it is unnecessary here to discuss, and which would only serve to divert attention from the main points; but without pretending to a complete treatment of this much-vexed question, I have, I believe, referred to the principal conditions which it is necessary for us to consider, in deciding which system is the best for general adoption as a continuous break for railway trains. These conditions are all practical and feasible, and may thus be summed up:—(1) Simple and easy control, especially by engine-drivers, but also by guards of trains. (2) Automatic action in the case of an accident, or of a division of a train, without any interference from engine-driver or guards, so that the break-blocks may on the separation of the couplings between any two carriages be self-applied on every wheel. (3) The break to fly on, and not off, so that the blocks may be applied to and not released from the wheels, on failure of any of the parts, and the train cannot be started unless the couplings are complete and the whole apparatus is in working order. (4) Instantaneous application —say to full force within one second of time— when operated by engine-driver or guard, or when self-applied. (5) Safety and simplicity of working, which does not necessarily imply simplicity in construction, as distinguished from risk and confusion in working. (6) Moderate cost, as compared with efficient durability of parts, and easy maintenance. (7) Constant employment in the conduct of traffic, and not merely employment for testing, and in cases of emergency. (8) The engine-drivers and guards to be provided with indicators, showing at a glance the condition of the break-power, and the continuity of the connections.

Keeping these cardinal points in view, it cannot be difficult, with an unprejudiced mind, to come to a conclusion as to the relative claims of rival inventors. I have mentioned no names, and I express no opinion as to which of the various systems advocated is best adapted for the ends to be accomplished. I invite all who are interested in this subject to take this opportunity of coming forward to state their own views, as to the conditions which should be fulfilled, the best means of complying with them, and the experience which has up to the present time been obtained; and I hope there may be a full and fair discussion commensurate with the importance of the subject. The only other means available to assist in leading to a decision, if doubt should still exist, are further trials; and on this point I would venture to suggest, in conclusion, that any fresh experiments should be publicly conducted on parallel lines, before impartial judges. In this way convincing results would best be obtained. The errors, and uncertainties and discrepancies, real or suspected, incidental to isolated trials by different people in different parts of the country, would be avoided. Similar and rival trains, running side by side, at the same speed, on rails in the same condition, and on the same gradients and curves, might be made to afford exact and obvious means of comparison, not only as to the respective powers of the breaks under trial, but also as to rapidity of application, automatic or otherwise, when worked by engine-drivers or guards, and at different periods of the stoppage. The time has come for decisive action, and the public interests at stake are sufficiently large to warrant a few days expended in experiments of this description, and it would probably be impossible otherwise to arrive at the much-to-be-desired consummation of unanimity amongst the railway companies.

DISCUSSION.

Mr. Galloway said he had devised a system of continuous breaks, which would take effect without the intervention of either engine-driver or guard. The breaks would be connected with the springs of the buffers, and on the engine coming to a stop by a powerful break acting on the wheels of the engine and tender, the pressure would at once come upon all the buffers, and thus upon every wheel in the train.

Mr. Haggard said he proposed a similar plan some twenty years ago, and it was patented by some one to whom he communicated the idea, but it had never been brought into use.

Mr. Hale said the powers of the different kinds of breaks had not been described. He believed it was possible to stop a train at the rate of two miles per second, so that one going at the rate of 60 miles an hour would be brought to a stand in half a minute. He had been engaged in the coach-building trade many years, and had a pet break of his own, which he hoped to bring under the notice of the railway authorities.

Mr. Wells did not think the simple principle of maximum friction had been sufficiently studied in any break yet brought out. It simply depended on surface friction, and he considered that in all existing breaks the surface was much too small.

Mr. Danvers said he had had some experience of different breaks as a traveller, and he must say that the chain break in use on the North London was not comfortable, and it could not, as be understood, ever be automatic. The vacuum and the air-pressure breaks in use on the Metropolitan and District Metropolitan Railways were much more comfortable, but it seemed absolutely necessary in future that automatic breaks should be used, which could be relied on. Captain Tyler had given one instance in which a vacuum break had failed, perhaps because nature abhorred a vacuum, but he could speak most highly of the Westinghouse break.

Mr. Pagliardini thought the first point was to make the break powerful enough, when it would be less necessary to make it continuous, though that seemed a much easier problem. At present all breaks seemed constructed on a wrong principle, inasmuch as the pressure was only exerted on the circumference of the wheels. A friend of his had invented a break, a model of which was on the table, in which, by simply turning a handle, a disc was pressed against each wheel, and this could be done by the same action as cut off the steam, so that it might be termed automatic.

Mr. Brockton said they ought to know what was the shortest space in which a train could be arrested, without doing damage by throwing one passenger against another. Another point of importance was that in the Smith's vacuum, and other patent breaks, india-rubber was employed, which was a most treacherous material, even when no expense was spared to get the best quality. A splinter from a sleeper might be driven into the india-rubber tube connecting the different carriages, and damage the apparatus, and this might happen on the last mile of the journey, after the break had acted perfectly all the way, and so the engineer, relying upon it, might go into a terminal station at too high a speed and cause an accident. He believed that india-rubber was also used in the Westinghouse break, but he understood that if any accident happened to it, it would at once announce the fact by bringing the train to a stand. He had heard that Smith's vacuum break could be made automatic, and should like to know if that were so; also, if, in the case of the hydraulic break, there was any mode of remedying a defect if a tube received an injury.

Mr Haughton, C.E., said this question was a scientific one, on which the public were not generally well-informed, and which was not thoroughly understood. He thought it would be well, therefore, if the merits of the different systems were explained. Captain Tyler had given an elaborate puff to the Westinghouse break, with which he was, as he told them, connected, or about to be. Now, he was also interested in a break, not an upstart one, about which no one knew anything, but one in use on the South-Eastern, the Metropolitan, the Sheffield, the Great Eastern, the Midland, and the Great Northern Railways, and which was about to be introduced on the North-Eastern—Smith's vacuum break. He was not going to attempt to puff it, nor yet to go into an elaborate description of the machinery, but would merely state its general principles. No break could do more than skid the wheels of a train, and all continuous breaks professed to do this, and he believed did do so about equally well. The next point to be considered was, whether this was accomplished easily and cheaply, and the general elements of the vacuum break were its economy, and, as a consequence, its simplicity. When the engineer wanted to place the break on the wheels, he simply had to turn a cock and let the steam into a tube, and it was done instantaneously. There was no complicated machinery, as in the case of most other breaks. They had an automatic apparatus which could be attached, but a most experienced locomotive superintendent told him he did not want anything automatic, but something which his men could understand.

Mr. Brudenell Carter said that railway companies were at present on their trial with regard to continuous breaks. The public were beginning to know this much about it, that such a break was an essential element to the safety of railway travelling, and that unless they were introduced, such accidents as those at Morpeth, Ripton, and other places, would periodically occur. The public had treated the railway companies with great patience and forbearance, leaving them ample time to make experiments and find out which was the best form of break; but, unless something were done soon, the public would get impatient. The present paper afforded an admirable opportunity for railway men to come forward and state what they were doing, and why they were still postponing the adoption of some one of these inventions. Their continued taciturnity would be looked upon with suspicion by the public, who would begin to think that instead of trying to provide for the safety of the public, they were rather endeavouring to amuse them with something under the name of a continuous break, which required less outlay than the genuine article. The public, therefore, could not too constantly express the opinion that the time had come when they would be satisfied with nothing less than the best. They would like to hear why one great company used one break and another another, and also to hear what locomotive superintendents had to say as a counterbalance to the obvious objection to every break which had not an automatic action. The chain mechanism had the obvious disadvantage that it was no stronger than its weakest link, and they ought to know why it was employed. The public would be much dissatisfied if this discussion were left entirely in the hands of those who were interested in particular inventions, and he could only repeat the advice given some years ago ago by Mr. Gladstone in the House of Commons on another matter, and entreat railway managers not only to be wise, but to be wise in time.

Mr. Danby Seymour wished to ask Mr. Haughton if it was possible with the vacuum break to place the whole break power of the train in the hands of the engine-driver, and also to know from Captain Tyler if any effort had been made by the Board of Trade to bring about a conference of railway officials and engineers, in order to ascertain which was really the best break. It seemed very extraordinary that something had not been done by the various companies to compare the breaks in use on the different lines. Their object must be to get the best break, in order to avoid accidents, but seeing the number of vested interests involved, he saw no chance of the desired end being attained unless the Board of Trade would take the initiative. He understood that Smith's vacuum break was in use on the Midland line, and he had lately observed what an excellent system it appeared to be.

Mr. Haughton said the whole break power was in the hands of the engineer, who, by simply turning a cock, could skid every wheel in the train almost instantaneously.

Mr. Harris, who said he was interested in Barker's hydraulic break, wished to ask Capt. Tyler how far the second half of the train in the Heeley accident ran before it left the metals. The progress of a train was considerably impeded when the wheels ran over the ballast, and it would soon come to a stop from that cause alone. He should also like to know how far the engine ran, and also what obstacles the second half met with before it was ultimately stopped. No doubt, the automatic break would come on the latter half of the train before it left the metals, and would have some influence in stopping it; but, when it left the rails, he was informed that all the break-tackle was knocked off the carriages. Any automatic break must be liable to accident, whether chains or india-rubber tubes were employed, and then the break was gone, unless some provision were made for disconnecting the injured part. It was no use bringing out a break which could not be managed by ordinary officials, which was so wonderfully clever that those who had to use it could not understand it. Barker's hydraulic break had this great advantage, that the whole of the tackle could be manufactured by the company which used it, and there was no need to send to America for the machinery.

Mr. Evans said the interests of inventors, patentees, and railway companies had been dealt with, but those of engine-drivers, which were not pecuniary, but personal, did not seem to have been considered. It was very desirable that railway companies should, as speedily as possible, decide which was the best break for stopping a train, and adopt it. There was a question, he believed, whether the Westinghouse break was really applied in the ease of the Heeley accident. His own experience of it was that the action went on with a shock, and the power which forced it on was not sufficient to keep it on, so as to hold the train. Smith's vacuum break, on the other hand, might get out of order at a moment's notice. His belief was that the companies were anxious to avoid expense in the matter, because the amount they paid in compensation for accidents was less than they would have to spend for any efficient system.

The Chairman, in moving the adjournment of the discussion to the following Tuesday, said he had seen a letter in the *Times* protesting against the dictum laid down in the House of Lords in the debate on railway accidents, that continuous breaks were dangerous. This was probably an allusion to a statement made by Lord Ashford to the effect that such breaks might be dangerous; but for his own part, he thought to speak of continuous breaks being dangerous was about as reasonable as to say that it was dangerous for a man to learn to swim, because he might be tempted to remain too long in the water and catch the eramp. He hoped it would not be supposed that the House of Lords was not better instructed than to entertain such an idea. He concluded by expressing his regret at the retirement of Captain Tyler from the Board of Trade, where he had rendered such invaluable service for the last 24 years.

The discussion was then adjourned to Tuesday next, at 8 o'clock.

MISCELLANEOUS.

CHINESE OPIUM.

The trade report of Newchang for 1874, furnished by Mr. Man, Commissioner of Customs, contains some remarks upon the native Chinese opium. He says that all over Sheng-King (another name for the province of Liao-tung, of which Newchang is a part) the poppy may now be seen. Every town in the province is amply supplied from its yield. Mixed in a certain proportion with Indian, the use of the native drug is spreading among the gentry, while a resort to it pure gives the humblest peasant power of obtaining a longed-for, and otherwise impossible, luxury. Passing northwards to Kirin, a province which has as yet but a thin and mixed population, and with great stretches of forest and mountain isolating, as it were, the districts into which its government is divided, in the settled valleys of this territory, the colonisation of which is now proceeding with rapid strides, of every ten acres of available soil, an average of eight is devoted to the poppy. An exodus of rather an extensive scale took place some months since of entire families from the lowlands of Liao-tung, in the direction of the lately-occupied regions eastward of their own country. These people hardly made it any mystery that their object, in thus seeking a new sphere, was to turn to a golden profit the facilities there promised for an enterprise hampered by the nominal taboo at home. In Tsitsihar, a domain until recently rarely visited by Europeans, ungauged as to capability, and where the hold of Government has ever been light, the advent of the banned plant has wrought a kind of revolution. Three or four years ago some emigrants from China, not having the fear of the law before their eyes, tried this venture. Success resulted, passing the wildest hopes; friends and relations poured in upon their track, and notwithstanding a show at the start of great energy in repression, the number of communities obtaining a comfortable livelihood by this means has become so large, and the members thereof are, however, so rapidly increasing in wealth and power, that the military magistrates, even those most willing to enforce the law, dare not take measures which would certainly result in disturbance, and very possibly in defeat. Without any interference on the part of their rulers, a growing population is thus allowed to continue in undisturbed possession of this fresh field of industry. The increased demand for home-grown opium can no longer be attributed solely to the low and advantageous price at which it can be laid down. Successful efforts to improve the quality have begun to influence the results.

To these remarks Consul Robertson has added some information obtained from native sources. Opium, which originally came from abroad, had towards the close of the Ming dynasty (A.D. 1644), the name of Ya-Fu-jung. At that time it was known that the drug could be used for smoking purposes, but its properties were cooling and astringent, and it was used for diarrhœa and fevers, but with what admixture is not known. Subsequently it was made into paste and smoked, hence the present name of opium-smoking, which has also an astringent and antifebrile effect. It relaxes and reduces the system. At first the only sort was Patna, followed afterwards by Malwa, then Benares, and finally Persian, all imported from abroad. Tradition describes Persian as hot and acid, and liable to cause dysentery. It is all sent to the province of Kwangsi, as the chilly climate there is said to permit of its use. Kwangtung (Canton) only consumes Patna and occasionally Malwa. Benares is used in the prefectures of Hui-chow, Chaschow (Swatow), and Kia-ying-chow, and is sent to other provinces of China. It is cheaper than the other kinds. Malwa is only used by one or two out of ten in Canton, and goes chiefly to the provinces.

When China first began to cultivate the poppy it was called "Yung-su-hwa," jar-shaped flower or capsule, and when the juice was extracted it was called white smoke or white tobacco. It is grown chiefly in Yunnan, where it covers the whole place, hence the name "Yunnan white." It is also grown on the hill-tops of Kansuh, but not to a tenth of the extent grown in Yunnan. It is exported from Yunnan to all the provinces, and is also smoked in Canton, being barely more than two-thirds the price of the foreign, but it is not so rich to the palate as Patna. Eight out of ten in the prefecture of Canton smoke Patna and the other two Yunnan. Other provinces use a great deal of Yunnan. Nearly everyone in Hunan, Hupeh, Yunnan, Kweichow, and Western Szechuen, smoked Yunnan, and only the rich used Patna and Malwa, the reason being that, firstly, the price was cheaper; and secondly, it was easier to purchase than the prepared. Patna had to be bought by the ball, and could not be purchased retail. Each ball was 4 lbs. in weight, and cost eight dollars the catty (1⅓lbs.). that is, 24 dollars the ball, whereas the native could be bought by the ounce or the drachm if required. Again native opium is much easier to prepare than foreign.

Although it is impossible to obtain the quantities of opium grown in the various provinces of China, still it is well known that it is very commonly cultivated over the length and breadth of the Empire, and with little or no interference on the part of the Government, and as all the evidence obtainable goes to prove that the native production is increasing, it may fairly be assumed that the taste for it is also on the increase.

CORRESPONDENCE.

ON THE EXISTING AND POSSIBLE COMMERCIAL COMMUNICATIONS BETWEEN PERSIA AND INDIA.

Allow me to rectify a mistake into which the author of the paper "On the Existing and Possible Commercial Communications between Persia and India," was, no doubt inadvertently, led last week, when commenting on my work. After speaking of others, he says of it: —"Here also we miss any mention of routes which are known to have been used, and one to this day used, in traversing Mekrán from east to west, and *vice versâ*. Allusion is made to the possibility or probability of such a line of transit, in a surmise that 'the routes through central Persia by Kerman, Yezd, and Shiraz were minor channels for trade.' But that is all, &c."

Reference to matter immediately following the map, at page 6, paragraph 3,—routes between India and central Asia—shows that I have stated the contrary explicity. The concluding sentence runs thus:—"Beyond Herat, and across Persia, to the westward, are many routes, the chief leading through Meshed, Yezd, and Kerman, but none of them are now sufficiently important channels of trade to be noticed more particularly, and they are, therefore omitted from the map."

In a map plainly entitled, "Principal Caravan and other Routes of Eastern Commerce," the insertion of lines which should represent an existing land-traffic of any moment between India and Persia through Mekrán would have been misleading.

Sir F. Goldsmid admits in his second paragraph that the Indo-Persian commerce now finds an inlet and an outlet through the ports of the Persian Gulf and Arabian Ocean.

In his last paragraph he goes no further than to remark:—"I do not think we should wholly refuse to acknowledge the fact that land-traffic is, at least, possible, between Western India and Eastern Persia, through Mekrán."

JOHN YEATS.

Chepstow, May 1st, 1877.

In the *résumé* of my remarks on Sir Frederic Goldsmid's paper on "The Trade between Persia and India," in the *Journal* of the 27th April, my views having been misrepresented, I shall be obliged by your inserting this note in explanation of them.

I am supposed to credit our perfect railways with being "cheap and convenient"; they are expeditious and convenient, but not cheap to any but those whose object is to purchase time at any price. To carry quantity, they must carry at considerable speed, and speed cannot be obtained at a low price, and in my suggesting that cheap tramways should be used for the transport of produce from the interior to the coast, I did not consider their introduction into Persia a work for the future, as reported, but for the present time. In the future, it may be hoped that the development of the latent resources of the country will have so enriched it, as to employ more perfect means of reducing the cost of transport. And while on this subject, I will add a few words, which may show how such very simple means as I am proposing, may be able to affect materially the trade of a country circumstanced as Persia is.

For many years a tramway of wood, 2½ft. gauge, with strips of iron for the wheels to run upon, has been in constant use for the carriage of lime from the quarries to the works on the Godavery river. On this very simple line of rail, which cost £300 a mile, one small bullock draws four trucks, each containing half a ton. This will seem to many too weak an apparatus to produce a considerable effect on the traffic of any country, especially to those who have only seen fine ships gliding calmly into the London Docks, and have asked no question as to the means by which their cargoes were conveyed from the place of produce to the port of shipment. Of this operation I shall now give a simple instance, showing how a great trade struggles into life.

On the east coast of India, not far from the tramway above mentioned, a very important trade in rice was carried on by the common carts of the country on unmetalled roads. Each cart was drawn by four bullocks, driven by two men, and carried 8 cwts, the distance travelled in a day being about six miles, and the greatest distance from the place of produce to the sea about 30 miles. Under such circumstances as these, a highly important trade existed for years, the difference in the price of grain in that part of India and in markets beyond the sea, making the traffic remunerative in spite of the great loss occasioned by such extremely imperfect land transport. Now, let us apply our wooden tramways to this traffic, and we shall at once dispense with the labour of 19 bullocks and nine men in every two tons carried. By relays of cattle, perfectly practicable where so few are required, but impossible in the case of an unmetalled road, we can, at two miles an hour carry our produce 50 miles a day instead of 6, and I need hardly add that the wear and tear of plant on the tramway would be but a fraction of the expenditure on the living and dead stock by the other mode.

I will not now go further into this subject, but I hope I have said enough to show the possibility of greatly improving an internal communication by an extremely small outlay of capital on an apparatus of the rudest kind.

F. C. Cotton.

WHEAT FROM INDIA, AND THE WAR IN THE EAST.

In the Society's *Journal* of 5th January last, you inserted a letter of mine on the subject of wheat from India. I referred to Mr. Magniac's paper, of February, 1876, about the Suez Canal, and its influence on this trade, and to the report of the East Indian Railway Company, and I gave figures (taken from the *Economist* newspaper) showing that the exports of wheat from Calcutta alone had increased from 13,000 tons in the year ending 30th April, 1873, to 84,000 tons, in the year 1875-6, and I concluded my letter by saying "this increase must be specially satisfactory in view of the cloud which hangs over the Eastern question, and which may, at any time, burst in a war, at all events between Russia and Turkey, and a still further injury to our grain trade with the Black Sea ports."

Since then, the cloud has unhappily burst, and one of its first effects has been that wheat exports from the ports of the Black Sea and the Danube are practically at an end, that wheat has risen in price, 25 per cent. in London and 30 per cent. in the United States (I again quote from the *Economist*, in its article of last Saturday), and that every householder in Great Britain is feeling it in the advance in the price of the quartern loaf, while we have yet to see what effect is produced on the money markets, by the largely increased amounts we shall have to pay for our corn import, and for which we may have to send gold abroad.

In the face of this, it is very satisfactory to see the rapid further increase in the supplies of wheat from India, supplies which may, I believe, be increased almost indefinitely, in process of time, if still further facilities are given to its transport, cheaply and rapidly from the Punjaub, and other great places of production to the sea board. I am constantly told by Mark-lane men that the quality is so good that it is now a mere question of price, and the supply available.

I have before me the Indian newspapers, the *Calcutta Englishman*, of 6th, and Bombay *Times of India*, of 9th April, giving in detail a despatch of the Secretary of State in reference to this trade, the orders thereon of the Governor-General in Council, and the following figures, showing the exports of wheat from all India to the end of February of the present year. Starting from the year 1871-2, when the export was only 637,000 cwts., it had increased in 1874-5 to 1,069,000 cwts.; in 1875-6, to 2,498,000; while, in 10 months of 1876-7, it was 4,839,000 cwts. So that, while 1875-6 had more than doubled 1874-5, 10 months of the present commercial year had again doubled the whole year 1875-6, and it is to be specially noted that all this was before they knew war had actually commenced, and the great rise of price which I have named. I think we may rely pretty confidently on further large exports, and a steady increase in this trade, which will benefit alike India and Great Britain, and, among other advantages, will diminish the "loss by exchange," which forms such an ugly item in recent Indian accounts.

In the despatch of the Secretary of State, a very wise hint is given to the growers of wheat in India, and to all parties concerned, that they should constantly bear in mind the large supplies sent us from other countries, many of them nearer to us than India—above all, from America—and do their utmost to improve the quality, prevent adulteration, &c. May we not hope also that, on their part, the Government of India, both in India and England, will do all they can, by improvement and extension of railways, waterways, and ordinary roads, and by doing it as soon as possible, to cheapen the important item in cost of transport to shipping ports, to save time, and bring the grain in good order?

William Maitland.

Oriental Club, 2nd May, 1877.

NOTES ON BOOKS.

Guide to South Africa. By J. B. Glanville. London: Richards, Glanville, and Co.

This little work is intended to supply emigrants and visitors to the Cape with the sort of information likely to be useful in such cases. It tells them how to get there, where to go when they are there, and supplies them with summarised information about the different towns, districts, or States they may visit. Various statistics relating to the country, its population, industries, exports and imports, finances, &c., are also supplied.

GENERAL NOTES.

National Health Society.—A course of lectures on the following subjects will be delivered under the auspices of this society, in the Rooms of the Society of Arts, at 4 p.m.:—May 9th, Miss Octavia Hill, "Open Spaces." May 16th, Dr. W. H. Corfield, "Knowledge the True Enemy of Disease." May 23rd, Dr. Arthur Ransome, "How to Prevent the Spread of Epidemics." June 6th, Rev. Harry Jones, "Homes of the London Poor." June 13th, Ernest Hart, Esq., "Coffee Taverns for the People." June 20th, Dr. Bridges, "The Influence of Civilisation upon Health."

A method has recently been patented for providing Turkish baths in private houses. The apparatus is simply a sort of portable closet, within which the patient sits, his head being kept outside through an opening in the top. The heat is supplied by a gas or oil lamp. This is stated to answer all the purposes of an ordinary Turkish bath, and to be equally effectual. The inventors are Messrs. Ellis, of Hart-street.

NOTICES.

PROCEEDINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings, at 8 o'clock. The following arrangements have been made:—

MAY 9. — "The Artesian System of the Thames Basin," by JOSEPH LUCAS, Esq., F.G.S.

MAY 16.—"The Practical Use of the Food Collection of the Science and Art Department," by W. STEPHEN MITCHELL, Esq., M.A.

MAY 23. — "The Measurement and Settlement of Musical Pitch," by A. J. ELLIS, Esq., F.R.S., F.S.A.

INDIAN SECTION.

Friday evenings, at 8 o'clock. The following arrangements have been made:—

MAY 4.—"Thaumato-dendra, or the Wonders of Trees," with illustrations from life, by WM. TAYLER, Esq. Sir JOSEPH FAYRER, M.D., K.C.S.I., will preside.

CHEMICAL SECTION.

Thursday evenings, at 8 o'clock. The following arrangements have been made:—

MAY 10.—"A New Process for the Production of Carbonate and Caustic Soda, without the Formation of any Noxious Waste and the Recovery of the Sulphur," by GEORGE E. DAVIS, Esq. WALTER WELDON, Esq., F.R.S.E., will preside.

CANTOR LECTURES.

[Members are specially requested to take notice that the hour for this course of lectures is **FOUR** p.m., not eight p.m.]

Monday afternoons, at four o'clock. Third Course on "The Connection of Greek and Roman Art with the Teaching of the Classics," by SIDNEY COLVIN, Esq., M.A., Slade Professor of Fine Art at the University of Cambridge.

LECTURE IV.—MAY 7.

Methods and Development of the Study.—Archæology at the Renaissance. Archæology in the seventeenth century. Modern archæology—the eighteenth century. English travellers and German critics: Stuart and Revett. The Society of Dilettanti: Heyne, Winckelmann, Lessing. The mystical school: Creuzer. The comparative and historical school: K. O. Müller. Subsequent progress in the interpretation of monuments. Examples of method.

LECTURE V.—MAY 14.

Future of the Study.—Importance of its systematic recognition in England. Unlimited results possible from future excavations. The French and German schools at Rome and Athens—an example to be imitated. National museums; provincial and university museums. Facilities offered by casts and reproductions.

Each member can admit one friend to these lectures. No special tickets are now required for the purpose; the tickets issued to members at the commencement of the session are available for the Cantor Lectures, as well as for the Ordinary and Sectional Meetings.

MEETINGS FOR THE ENSUING WEEK.

MON.... **SOCIETY OF ARTS**, John-street, Adelphi, W.C., 4 p.m. (Cantor Lectures) Prof. Sidney Colvin, "The Connection of Greek and Roman Art with the Teaching of the Classics." (Lecture IV.)

Farmers' Club, Caledonian Hotel, Adelphi, W.C., 5½ p.m. Mr. J. Coleman, "American Farming and American Agricultural Machinery."

Royal Institution, Albemarle-street, W., 2 p.m. General Monthly Meeting.

Royal United Service Institution, Whitehall-yard, 8½ p.m.

British Architects, 9, Conduit-street, W., 8 p.m. Annual Meeting.

Medical, 11, Chandos-street, W., 8 30 p m.

Victoria Institute, 10, Adelphi-terrace, W.C., 8 p.m. Rev. J. Challis, "The Indestructibility of Matter."

TUES... **SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. Adjourned Discussion on Captain Tyler's Paper, "Continuous Breaks for Railways."

Royal Institution, Albemarle-street, W., 3 p.m. Prof. Gladstone, "Chemistry of the Heavenly Bodies" (Lecture IV.)

Medical and Chirurgical, 53, Berners-street, Oxford-street, W., 8½ p.m.

Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. 1. Discussion upon Mr. Souttar's Paper, "Street Tramways." 2. Sir W. G. Armstrong, "The History of the Modern Development of Water-pressure Machinery."

Photographic, 5A, Pall-mall East, S.W., 8 p.m. Adjourned Discussion on "The Silver Bath." Paper by Mr. Thomas.

Anthropological Institute, 4, St. Martin's-place, W.C., 8 p m. 1. Mr. A. L. Lewis, "Note on a Rude Stone Monument in Kent." 2, Prof. George Busk, "Note on a Romano-Gallic Skull." 3. Mr. J. R Mortimer, "An Underground Structure in Driffield, Yorkshire." 4. Mr. John E. Price, "Note on same." 5. Dr. John Rae, "Note on Esquimaux Skulls."

WED.... **SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. Mr. Joseph Lucas, "The Artesian System of the Thames Basin."

National Health Society (at the HOUSE OF THE SOCIETY. OF ARTS), 4.30 p m. Miss Octavia Hill, "Open Spaces."

Geological, Burlington House, W., 8 p.m. 1. Dr. R. H. Traquair, "The Agassizian genera *Amblypterus Palæoniscus*, *Gyrolepis*, and *Pygopterus*." 2. Mr. C. W. Peach, "The Circinate Vernation, Fructification, and varieties of *Staphylopteris? Peachii*, Balfour, a genus of Plant new to British Rocks." 3. Mr. R. Etheridge, Jun., "The Occurrence of a Macrurous Decapod (*Anthrapalæmon? Woodwardi*, sp. nov.) in the Red Sandstone, or Lowest Group of the Carboniferous Formation in the South-east of Scotland." 4 Mr. R. F. Tomes, "The Stratigraphical Position of the Corals of the Lias of the Midland and Western Counties of England and of South Wales."

Royal Literary Fund, 10, John-street, Adelphi, W.C., 3 p.m.

Royal Society of Literature, 4, St. Martin's-place, W.C., 8 p.m.

THUR.... **SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. (Chemical Section.) Mr. George E. Davis, "A new Process for the Production of Carhonate and Caustic Soda, without the formation of any Noxious Waste, and the Recovery of the Sulphur."

Royal Institution, Albemarle-street, W., 3 p.m. Prof. Tyndall, "Heat." (Lecture V.)

Inventors' Institute, 4, St. Martin's-place, W.C., 8 p.m.

Royal Historical, 11, Chandos-street, W., 8 p.m. 1. Mr. Joseph Fisher, "The History of Landholding in Scotland." Mr. M. Moggridge, "Petra and the Dwellings in the Rock."

Mathematical, 22, Albemarle-street, W., 8 p m.

Civil and Mechanical Engineers, 7, Westminster-chambers, S.W., 7 p.m., Mr. C. H. Driver, "Introduction of Railways in China."

FRI....... Royal United Service Institution, Whitehall-yard, 3 p.m. Mr. John Donaldson, "The Thornycroft Torpedo-vessels; their Construction, Armament, &c, and the Results of certain Experiments that have been made with them."

Royal Institution, Albemarle-street, W., 8 p.m., Weekly Meeting. 9 p.m., Mr. D. Mackenzie Wallace, "The Intellectual Movements and Secret Societies in Russia."

Social Science Association, 1, Adam-street, Adelphi, W.C. Mr. F. S. Powell, "Turnpike Trusts and Highways."

Astronomical, Burlington House, W., 8 p.m.

Quekett Microscopical Club, University College, W.C., 8 p.m.

New Shakespeare Society, University College, W.C., 8 p.m. Rev. J. B. Ebsworth, "On the Songs of Shakespeare."

SAT....... Physical, Science Schools, South Kensington, S.W., 3 p.m.

Royal Botanic, Inner Circle, Regent's-park, N.W., 3¾ p.m.

Royal Institution, Albemarle-street, W., 3 p.m. Mr. W. H. Pollock, "Modern French Poetry" (Lecture I.).

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,276. VOL. XXV.

FRIDAY, MAY 4, 1877.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

CITY COMPANIES AND TECHNICAL EDUCATION.

A special meeting of the Council was held on Wednesday last, the 9th May, to consider the following Resolutions of the Court of the Drapers' Company:—

At a Court of Assistants of the Drapers' Company, held at Drapers'-hall, on Wednesday, the 2nd May, 1877,

Resolved — "That with the view of making some immediate provision for improving the technical knowledge of London artisans, and of ascertaining the extent to which the members of this class would be likely to avail themselves of a system of technical instruction, this Court will guarantee to the Society of Arts a sum not exceeding £1,000, to be expended during the next two years, in providing courses of lectures, with demonstrations, in Metal and Wood, and their application to commercial industries. The lectures are to be of a thoroughly practical character, and to be open to artisans and apprentices, under conditions of admission to be hereafter determined. The lectures to be given at the House of the Society of Arts, John-street, Adelphi, and the general arrangements for them to be previously agreed upon by the Council of the Society and the Committee of the Company on Technical Education. The Court, should they consider that the objects in view are not being attained by the lectures, or that it would be expedient to provide by other means the instruction intended to be afforded, are to be at liberty to discontinue them at any time, subject to any arrangements which may have been then made."

Resolved—"That in the event of the lectures suggested in the foregoing resolution being given, the Society of Arts be requested to include in their Technological Examinations for next year the subjects treated on at the lectures, and that, with the view of encouraging regular attendance at them, a sum not exceeding £50 be offered in prizes in those sections of the examinations for which the lectures are intended to be preparatory."

(Signed) W. PHILLIPS SAWYER, *Clerk.*

Also to consider letter from the clerk of the Clothworkers' Company, promising grant of £200 for payment of teachers for Society's Technological Examinations.

It was ordered that the liberal offer of each of the Companies should be accepted, and that the thanks of the Council be returned for the same. Also that the subject be referred to a Committee to consider and consult with the Representatives of the Companies as to the best means of carrying the proposals into effect.

BLOWPIPE APPARATUS.

A prize of £10, which has been placed at the disposition of the Council by Col. A. A. Croll, is offered by the Society of Arts, with the Society's Silver Medal, for the best set of Blowpipe Apparatus which shall be sold retail for one guinea. The apparatus must, at least, contain blowpipe, blowpipe lamp or candle, spirit lamp, charcoal or charcoal pastilles and holder, platinum wire, glass tubes closed at one end (matrasses), open glass tubes, platinum-tipped forceps, magnet, hammer and anvil, and four re-agents, viz., borax, microcosmic salt, carbonate of soda, and nitrate of cobalt. These instruments and re-agents, together with any others which may be thought desirable, must be packed in a box. It must be understood that the above list of apparatus, &c., is only intended to include such as are absolutely indispensable, and it is expected that the set will contain additional instruments and re-agents, the selection of which is left to the competitors.

Special attention should be paid to the following points:—

1. Solidity of construction.
2. Compactness and portability.
3. Facilities for packing and unpacking.
4. Number of useful instruments and re-agents in addition to those mentioned.

The Society does not engage to give the prize unless some apparatus appears to show sufficient merit, and some advance on what is now obtainable for a guinea. All apparatus for competition must be sent to the Society's House on or before 1st August, 1877. The successful competitor must guarantee that a proper supply of the apparatuses shall always be kept on hand, for sale in England.

HEALTH AND SEWAGE OF TOWNS.

The Annual Conference on Health and Sewage of Towns was held on Thursday and Friday, 3rd and 4th May last, the Right Hon. James Stansfeld, M.P., late President of the Local Government Board, in the chair. The Conference met each day at 11 a.m., and sat till 1.30, then adjourned till 2; and sat again till 5 p.m.

The following was the programme:—

Thursday, 11 am.—Opening of the Proceedings by the Chairman. Papers and discussions on—

1st. Dry Systems.
  Pails, Pans, Boxes, Earth, Middens, Cesspools, Ash, and other Closets; their influence on health, cost of collection, commercial value of products, &c.

2nd. Water-carried Sewage.
  a. New facts about Sewage Farms, with or without precipitation or subsidence, profit and loss thereon.
  b. Effluent Waters.
    Subsidence.
    Precipitation.
    Filtration.
  c. Possibility of producing an effluent harmless to health.

3rd. Escape of Sewage Gas into Dwellings.

4th. Discharge of Sewage into Sea.

5th. Additional Facts to those stated in the Report of the Local Government Board on Disposal of Sewage.

Friday, 11 a.m.—Proceedings will be resumed. Papers and Discussions continued.

The papers brought before the Conference were taken as read, the author of each being allowed five minutes to state its substance. Questions relating to the system under discussion were then answered by the reader of the paper, or representatives of the locality where the system was applied.*

The proceedings were opened by the following remarks from the Chairman:—

Mr. Stansfeld said he did not propose to waste time by any unnecessary introductory remarks, because when he considered the variety of the subjects to be discussed, and the limited time at their disposal, it was apparent that the true policy for all, would be to express what they had to say in the fewest possible words. As nearly as possible a year ago it was his privilege to preside in that room, at what was intended to be the first of a series of annual conferences on the Health and Sewage of Towns, and his first duty now, was to welcome those whom he saw around him, and to express the satisfaction of the Council at seeing their readiness to attend their summons the second time, and also to inform them that the returns received from various localities interested in the question were not only more numerous this year then last, but on the whole more complete. The agenda paper was nearly the same as last year, and indeed, however often the conferences were repeated, it could not be very materially altered. There was, however, one new and distinct sub-head to which he wished particularly to draw attention, namely, the escape of sewage-gas into dwellings. In his opening remarks last year, he drew attention to that as a new source of nuisance and danger entirely the creation of our modern water-carriage systems. It was much discussed then, but since that time he himself had received not a few communications, leading to the inference that the attention of gentlemen in the various localities where water-carriage sewage existed, and of sanitary engineers, had been much addressed to this subject. It was a difficulty and a danger not yet surmounted, but he believed it was possible entirely to prevent and avoid it. Some progress had already been made, and he hoped that those who had special knowledge on the subject would give the conference the benefit of it. There was a rule laid down that untried schemes should not be discussed; and although, at first sight, this might not recommend itself to the minds of the more enthusiastic persons—anxious to discuss the newest system which could be submitted for their consideration—he did not think it would be found that any subject, or scheme, which it was really worth discussing, had been excluded. But, having regard to the variety of methods, and the number of localities represented, and that their primary object was to collect and collate experience in English localities, he thought they would all agree that this was a prudent rule to maintain. He had no change of opinion to express himself. He felt that, in large and dense populations, there was much to recommend a water-carriage system. It was scientifically the most complete, the most decent, and, under favourable circumstances, the best adapted for large populations; but, on the other hand, it was a system which involved a very considerable capital outlay, a system attended with difficulties at the point of junction between the sewer and house, and again at the outfall. None could say that the problem of dealing with either of these points was yet absolutely solved, and entertaining those views, he thought it well that they should enjoin a certain amount of prudence and caution on sanitary communities, and warn them against embarking rashly on large schemes of capital expenditure for the disposal of their sewage. One or other of the dry systems, more or less scientifically complete, had certain advantages in some cases. They involved less capital outlay, and though they might be, to some extent, a nuisance, they were not subject to the objection of being dangerous in the way in which sewer-gas was dangerous; and they had this advantage in the present transitional state of public knowledge upon the question, that they were the most easily modified and improved, or put altogether on one side when the time arrived to substitute something more perfect. At the conclusion of last year's conference, the Executive Committee summed up the results; and, as a starting point for this year's discussion, he might draw attention to the conclusions then arrived at, and he would ask his hearers, as the discussion proceeded, to bear in mind the points then arrived at, and to consider whether, in the interval, there had been any occasion to modify any of those conclusions, or in what respect it was desirable to advance beyond them. The first conclusion was to this effect, that under certain favourable conditions a sewage farm, if properly conducted, was apparently the best method of disposing of water-carried sewage. The second proposition was to the effect that there were various methods of dealing with sewage at the outfall, by subsidence, precipitation, or filtration, and by one or other of these methods a sufficiently pure effluent could be procured. Passing for a moment over the third, the fourth was that with regard to various dry systems, if they were properly carried out, the result appeared to be very often satisfactory. The fifth was that the old midden, or privy system, in populous districts should be prohibited by law. The seventh was to the effect that it was conclusively shown that no one system could be adopted for universal use, and that different localities required different methods to suit their special peculiarities. With regard to all these conclusions, this general over-riding one seemed to apply, that in all these cases, whether of water-carriage system or of a dry system of whatever kind, they had no evidence that any one such system had been or was likely to be conducted at a profit, and therefore they felt it their duty to warn sewage authorities to be careful before embarking in large and costly schemes requiring large outlay of capital, under the idea that they might be rendered profitable; and secondly, that, putting the question of profit on one side, the sensible thing to do was, to ascertain in each case the system best adapted to the difficulties and requirements of the locality, which might be carried out at the lowest possible capital outlay and annual expenditure. The third conclusion, which he had passed over, referred to the subject which he had already spoken of, namely, that in towns where the water-carriage system was employed, a sufficient fall, thorough ventilation, proper connection of the house-drains with the sewers, and their arrangement and maintenance in an efficient condition, were absolutely essential to health; and on this he must say one word more. He desired to present that to the meeting in a light which was to himself a new one. He wanted his hearers to ask themselves what was the implied contract entered into between the local authorities and the individual when a water-carriage system was brought into operation. The community laid down the sewers, and the individual householder was compelled by law, or ought to be compelled, to drain into these sewers, and the implied contract he thought on the part of the community was this. If you will carry by your system of house-pipes the sewage to the main sewer, we undertake to carry it away so that it shall not be a nuisance, or the sewers a danger to yourselves or to the rest of the community. But the question arose, whether under the existing state of the law the community could fulfil the contract, and, if it could not, whether it had a moral right to call on the individual to submit to these regulations, unless it obtained powers for itself which would enable it to fulfil its part of the contract. They came to the conclusion last year that there was no reliable means at the point of junction of the sewer with the house-drain, by which the sanitary authority could undertake that there should be no escape of sewer-gas back into the house. He was not aware that there was any method by which, at the point of junction of the drain and the sewer, you could absolutely ensure that result, and if you could not do it at that point, you must carry your point of juncture, where the difficulty arose, higher up to the outside wall of the house, from the sewer to the drain. If you could say that the duty of the community could be accomplished otherwise, the proposition would be answered; but, in fact, you must consider, first of all, whether it was not a part of the implied contract that the local community was to deal with the sewage placed in its charge so as to prevent its being a nuisance or source of danger either to the individual householder or any other part of the community. It seemed to him that this was one of the most important practical subjects to which they could devote their attention.

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* A report of the discussion will be issued in subsequent numbers of the *Journal*. For the convenience of those wishing to have the account of the proceedings in a more compact form, the same will also be published as a pamphlet, which can be had (as soon as ready) on application at the Society's House. Price 3s.

The following are the first of the papers brought before the Conference. The others will be published in subsequent numbers of the *Journal.*

REPORT ON THE PAN, PAIL, AND MIDDEN SYSTEMS OF DISPOSING OF DRY SEWAGE.

By Gilbert R. Redgrave, Assoc. Inst. C.E.

For various reasons, the water-closet system has never yet been generally introduced into some of the most important manufacturing towns of England. It is useless, in the case of these towns, to point out the numerous advantages to be derived from the use of water as a carrier, or to show that, even when a so-called dry system is resorted to, some arrangements must be made for dealing with the slop-water and the rainfall. Even in the midden towns, there is, of course, a more or less perfect system of sewers and drains, as also in the best managed water-closet towns there must always be a properly organised dry collection, for disposing of the ashes and street refuse. A double system is, in fact, everywhere imperative. In the present report we have specially to treat of the dry systems of dealing with sewage, as distinguished from the various methods wherein the agency of water is called into play for the removal of excreta.

Mainly owing to the exertions of the officers and inspectors of the Board of Health, and the admirable reports of the medical officers to the Privy Council, the abominable midden system, as it formerly existed in all old towns, is fast disappearing, and, in its place, we find numerous contrivances for abating the nuisance and evil occasioned by the retention near our dwellings of vast heaps of putrefying refuse. Full descriptions of the improved systems of midden construction, and details of the dry closets, pans, pails, and other appliances, for the reception and removal of fæcal matters, may be found in the Twelfth Report of the Medical Officer of the Privy Council (1869), and the Second Report (new series, 1874.) If we look at the condition of the chief Lancashire and Yorkshire towns some ten years ago we find that the midden or ash-pit arrangement was everywhere in vogue. Into open reeking middensteads was thrown the entire refuse of the house, there to undergo slow decomposition along with the excrement and the slop-water. The Birmingham and Manchester reports of that date give us estimates of the united areas of these masses of putrefaction, and the Public Works Committee of the former town tell us, as late as 1871, that in their town there were 13½ acres of space devoted to such middens, practically open to the air. The manifest improvements of the last few years have removed much that was most objectionable in the old midden system; thus, the Manchester authorities filled up the midden-pits level with the surface of the ground, excavating at the same time, and carting away, the foul and infected earth which surrounded them. They introduced in their place the earthenware bevel-midden, which was perfectly impervious, and, from its small capacity, demanded very frequent emptying. All types of midden construction which limited the storage-area were of necessity improvements, and when the midden took the form of a handy tub, pail, or box, which was entirely water-tight, and was capable of being constantly emptied and cleansed, the main objections to the system were removed. We look upon the pail-system, when properly attended to, and superintended by the local authority, as the most simple and practical plan of dealing with the excreta of a manufacturing population; and it is certainly the only one which holds out any hope of the profitable utilisation of fæcal matters in the future. We propose, in the present report, to examine, first, some of the various modes of pail-collection, and then to describe briefly the processes now in actual operation for the conversion of the excreta into manures. We may consider the pail system under three subdivisions:—

1. Pails used without absorbents.
2. Pails used in conjunction with absorbents.
3. Pails used for the joint collection of the ashes and the excreta.

Rochdale was the parent of the first of these systems, and, under the indefatigable care of Alderman Taylor, the process he introduced some seven years ago seems in a fair way to become generally adopted in the surrounding towns. The Rochdale plan has been so often described that it is not now necessary to go into details. The main features, so far as we need consider them at present, are the systematic collection of the excreta and the dry house refuse at short intervals, in tubs of special construction; the provision of separate tubs for the excreta and the ashes; the careful arrangements for the transport of the excreta to the depot without smell, by the adoption of an air-tight lid to the pails, and the use of vans with indiarubber beads round the doors; and lastly, the excellent mode of book-keeping, by which the work of the carters is checked, and records are obtained of the weight of all materials brought to the yard. In his paper contributed to the conference in May last, Alderman Taylor gave, as the latest result of his work in Rochdale, that there were 5,644 pail-closets emptied weekly, used by 52,000 persons, and giving a gross weight of excreta collected during the past twelvemonth of 5,398 tons. In an analysis of these results, undertaken by Messrs. Rawlinson and Read in their recent report (p. 60), it is shown that from this it would seem that 19·1 cwts. were annually collected per tub, and that each tub was used by 9·2 persons, who thus produced only 2·07 cwts. per head. As the weight of the excreta of an average human being, taken at 2½ lbs. per diem, would give an annual total of 8·1 cwts., it is argued that the system fails to account for 6 cwt. per head, or nearly three-fourths of the fæcal matters. The Rochdale pail-contents are, however, likely, for several local reasons, to be under the usual average, though by no pail system do we ever obtain more than the solids, together with about three-fifths of the liquid dejections. In Halifax, each tub is used by 10·9 persons living in 2·6 houses (the Rochdale proportion is about 2·2 houses per tub), and the weight collected is 77 lbs. per pail per week, or 1 lb. per head per diem, which is the amount generally assumed as sufficiently correct.

I append, in Table I. (p. 571), a series of careful observations by Mr. Spackman, upon the quantities of excreta collected at Birmingham, on the pail system. There is always considerable difficulty in the actual apportionment of the results in similar experiments, owing to the want of accurate information with respect to the number of houses contributing to each pail; but here we have the number of houses indicated in each case. From Table I., we find the average weekly weight per house to be 38·8 lbs., varying from 48 lbs. in van 2 to only 28·15 lb. in van 4. The number of inhabitants per house in Birmingham, according to the latest returns, is only 4·2, and this would make the fæcal matters rather over 9 lbs. per head per week, which is an extremely high average. From Table II. (p. 572), extending over a much longer period the average is even higher, being 48·2 lbs. per house per week, or 11½ lbs. per head per week. This is the highest average we have yet seen.

The proportion of ashes to excreta varies greatly at the different seasons of the year. On the Rochdale plan, the relative quantities collected are respectively as 8 is to 5; or if the annual weight per head of the excreta be taken, as at Rochdale, at 2·07 cwts., the weight per head of the ashes would be about 3·31 cwts. We may here glance at the treatment of the ashes, as it forms part of the Rochdale system. The ashes, as they are received, are carefully screened. The fine ash is used for the manure, and the cinders are burned under the boilers and sold as fuel. The paper, and all animal and vegetable refuse is burned, and the clinkers and broken pottery are ground under an edge-runner with lime, and converted into mortar. The rags, glass, and metal, which are picked out by hand, are collected and sold, the scrap iron and tinned ware being worth as much as 10s. per ton. The cost of collection, from the figures furnished to me by Alderman Taylor, was, in 1875, 1·294d. per pail per week, or 5s. 7d. per pail per annum, the relative annual cost per head being 6·84d. for excreta and 5·33d. for ashes, making total cost per head, 12·17d., or about 5s. 8½d. per ton of pail stuff collected. In their recent report, taking one uniform price for the collection of the ashes and the excreta, during the year 1875, Messrs. Rawlinson and Read state the cost as 5s. 8¾d. per ton. I shall notice the Rochdale manure when treating subsequently of the utilisation of the excreta.

The second sub-division is pails used in conjunction with absorbents. As a type of this system, I must instance the process employed by the Goux Manure Company, and now in operation at Halifax, Aldershot, and in many rural districts. The plan adopted by the company is to surround the bottom and the interior of the pails with a lining of some porous material. In the pails, we have seen, the amount of lining is never sufficient wholly to absorb the liquid, and thus, towards the end of the period during which the pail is in use, the contents are found to be in a semi-fluid state. There is certainly some abatement of nuisance arising from the Goux lining, and a partial immunity from the risk of splashing, but the advantages of the lining, do not, I believe, counterbalance the expense incurred by the extra weight to be carted backwards and forwards from the depôt, and the increased cost of the preparation of the pails. There is, in fact, little sanitary or economic gain in the use of absorbents, and the manure made on this system does not theoretically much exceed in value the simple compost of ashes and excreta. If the material employed for the lining was of itself a fair manure, and had the power of fixing the ammonia; if further, a sufficient supply of the absorbent could be introduced into the pail to retain the whole of the liquid with its valuable constituents, I fear that even then the result, owing to the large volume of liquid to be dealt with, would be at best a feeble manure. For villages and private institutions the Goux process has much to recommend it, though I consider it is scarcely suited for large towns; neither do I believe that by this system it is possible to prepare high-class manures,

Under the third head I include those systems where the ashes are introduced into the tubs, either screened, as at Manchester, or unscreened, as at Nottingham and several other large towns. In the latter plan we have simply the substitution of the tub, or box, for the old middenstead. Where Morrell's closet is used, or the Manchester

TABLE I.

EXPERIMENTS TO DETERMINE WEIGHT, &c., OF FÆCAL MATTER COLLECTED IN SANITARY PAILS AT BIRMINGHAM.

The pails are invariably collected weekly; and those from which the following results are obtained were collected during one week in January, 1877, in the Nechell's and Saltley district, and mostly from 4 and 5-roomed houses. Neither charcoal or ashes are used. The pan is 1 ft. 6 in. diameter, and 1 ft. 3 in. deep, and contains 2·208 cubic feet, or 13·76 gallons. The vans contain 24 pans.

No 1 Van. Collected from 24 houses, mostly of the better class.				No. 2 Van. Collected from 47 houses, mostly labourers' cottages.				No. 3 Van. Collected from 45 houses (various).				No. 4 Van. Collected from 37 houses (various).			
Weight of each pan and contents.			Depth of contents.	Weight of each pan and contents.			Depth of contents.	Weight of each pan and contents.			Depth of contents.	Weight of each pan and contents.			Depth of contents.
	lb.	oz.	inches.		lb.	oz.	inches.		lb.	oz.	inches.		lb.	oz.	inches.
No. 1 ..	52	4	3·5	No. 1 ..	105	0	7·9	No. 1 ..	135	8	10·8	No. 1 ..	103	0	7·6
„ 2 ..	69	0	4·4	„ 2 ..	144	8	11·9	„ 2 ..	102	0	7·5	„ 2 ..	92	8	6·5
„ 3 ..	56	4	2·6	„ 3 ..	156	12	12·2	„ 3 ..	107	8	8·0	„ 3 ..	109	0	8·0
„ 4 ..	50	8	2·6	„ 4 ..	163	8	11·4	„ 4 ..	127	8	10·2	„ 4 ..	72	12	4·5
„ 5 ..	75	0	5·0	„ 5 ..	128	8	10·8	„ 5 ..	107	4	8·1	„ 5 ..	111	0	8·5
„ 6 ..	40	12	1·5	„ 6 ..	112	0	8·8	„ 6 ..	102	0	7·5	„ 6 ..	91	4	6·5
„ 7 ..	59	0	3·3	„ 7 ..	149	12	12·2	„ 7 ..	112	0	8·5	„ 7 ..	82	0	5·5
„ 8 ..	58	8	3·2	„ 8 ..	117	0	8·5	„ 8 ..	104	0	8·0	„ 8 ..	65	0	3·8
„ 9 ..	68	8	4·5	„ 9 ..	136	0	10·8	„ 9 ..	93	0	7·0	„ 9 ..	58	8	3·2
„ 10 ..	62	1	3·1	„ 10 ..	128	8	10·2	„ 10 ..	118	8	9·0	„ 10 ..	57	0	3·0
„ 11 ..	43	9	1·5	„ 11 ..	131	8	10·8	„ 11 ..	136	0	10·9	„ 11 ..	62	0	3·4
„ 12 ..	45	8	2·2	„ 12 ..	140	0	11·4	„ 12 ..	132	0	10·5	„ 12 ..	43	8	1·6
„ 13 ..	86	14	6·3	„ 13 ..	86	6	5·7	„ 13 ..	85	0	5·7	„ 13 ..	62	0	3·4
„ 14 ..	59	12	3·4	„ 14 ..	134	0	10·8	„ 14 ..	105	9	8·1	„ 14 ..	62	4	3·5
„ 15 ..	104	4	7·8	„ 15 ..	71	8	5·5	„ 15 ..	125	0	9·8	„ 15 ..	71	12	4·6
„ 16 ..	68	0	4·0	„ 16 ..	127	0	9·7	„ 16 ..	103	0	7·5	„ 16 ..	55	0	2·7
„ 17 ..	76	2	4·8	„ 17 ..	114	0	8·6	„ 17 ..	95	0	6·8	„ 17 ..	56	0	2·9
„ 18 ..	49	12	1·9	„ 18 ..	139	0	11·4	„ 18 ..	71	0	4·0	„ 18 ..	44	8	1·9
„ 19 ..	80	12	5·8	„ 19 ..	142	0	11·7	„ 19 ..	95	0	6·6	„ 19 ..	70	0	3·2
„ 20 ..	67	4	3·6	„ 20 ..	54	8	2·5	„ 20 ..	116	0	8·1	„ 20 ..	52	0	2·1
„ 21 ..	92	0	6·5	„ 21 ..	113	8	8·6	„ 21 ..	115	0	8·8	„ 21 ..	80	8	5·3
„ 22 ..	63	12	3·5	„ 22 ..	123	8	9·7	„ 22 ..	112	0	8·4	„ 22 ..	65	0	3·5
„ 23 ..	80	4	5·4	„ 23 ..	115	8	8·8	..	..		..	„ 23 ..	75	8	4·9
„ 24 ..	80	12	5·2	„ 24 ..	71	8	4·5	..	..		..	„ 24 ..	53	0	2·8
Total ..	1,590	6	96·6	Total ..	2,905	6	224·4	Total ..	2,399	13	179·8	Total ..	1,695	0	102·9
Less pans	648	8	..	Less pans	649	4	..	Less pans	608	4	..	Less pans	653	8	..
Weight of contents	941	14	..	Weight of contents	2,256	2	..	Weight of contents	1,791	9	..	Weight of contents	1,041	8	..

Weight of empty pans.			Weight of empty pans.			Weight of empty pans.			Weight of empty pans.		
	lb.	oz.		lb.	oz.		lb.	oz.		lb.	oz.
3	81	12	3	81	0	3	80	12	3	80	0
3	83	0	3	81	8	3	82	0	3	82	0
3	80	12	3	85	12	3	84	0	3	81	0
3	84	8	3	79	8	3	85	8	3	83	8
3	78	0	3	80	0	3	81	0	3	79	8
3	79	0	3	81	8	3	87	0	3	81	0
3	80	0	3	80	0	4	108	0	3	82	8
3	81	8	3	80	0	..		..	3	84	0
Total weight	648	8	Total weight	649	4	Total weight	608	4	Total weight	653	8

Table I.—*Continued.*

Average weight of 1 empty pan, 27 lbs. Average depth of contents, 4 inches. Average contents of 1 pan, 39¼ lbs., or 3⅓ gallons. Total contents in lbs., 941·8 lbs. Total contents in gallons, 87¾ gallons. 1 gallon = 10·7 lbs. 208·7 gallons = 1 ton. The solid portion strained off from the whole weighed 118 lbs.	Average weight of 1 empty pan, 27 lbs. Average depth of contents as brought to works, 9·35 inches. Average depth of contents per house, 4·8 inches. Average contents as brought to works, 94 lbs., or 8·58 gallons. Average contents per house, 48 lbs., or 4·38 gallons. Total contents in lbs., 2,256 lbs. Total contents in gallons, 205·92 gallons. 1 gallon = 10·96 lbs. 204·44 gallons = 1 ton. Solid portion weighed 324 lbs.	Average weight of 1 empty pan, 27·6 lbs. Average depth of contents as brought to works, 8·17 inches. Average depth of contents per house, 4 inches. Average contents as brought to Works, 81·4 lbs., or 7·5 gallons. Average contents per house, 39·8 lbs., or 3⅓ gallons. Total contents in lbs., 1,791¾ lbs. Total contents in gallons, 165 gallons. 1 gallon = 10·86 lbs. 206·27 gallons = 1 ton. Solid portion weighed 215 lbs.	Average weight of 1 empty pan, 27·2 lbs. Average depth of contents as brought to works, 4·3 inches. Average depth of contents per house, 2·78 inches. Average contents as brought to works, 43·4 lbs., or nearly 4 gallons. Average contents per house, 28·15 lbs., or 2·6 gallons. Total contents in lbs., 1,041·5 lbs. Total contents in gallons, 94·4 gallons. 1 gallon = 11 lbs. 203 gallons = 1 ton. Solid portion weighed 129 lbs.

The solids were separated by emptying the pails upon screens made of perforated zinc. The holes in the first one were 1 in. in diameter; the portion passing this flowed upon a second one, having ½-inch holes. The third and final one was perforated with ⅜-in. holes.

General Results.—Average weight of 1 empty pan, 27·2 lbs. Average depth of contents, as brought to works, 6·45 inches. Average depth per house, 3·88 inches. Contents of pans as brought to works, 64·5 lbs., or 5·9 gallons. Average contents of pans per house, 38·8 lbs. or 3·56 gallons. Total contents of the 94 pans, 6,031·26 lbs., or 553 gallons. Total weight of solid portions arrested by sieve of ⅜-inch meshes, 786 lbs., or rather more than of the one-eighth of the whole. Weight of 1 gallon of solids and liquids together, 10·9 lbs. Weight of 1 cubic foot of solids and liquids together, 67·9 lbs. 1 ton of solids and liquids together, 205·6 gallons.

TABLE II.

In the following experiments the depth of the contents of each pail was taken, and the weight calculated, from the results obtained in Table I.

	Total Depth of Contents.	Average Depth of Contents as brought to Works	Average Depth of Contents per House.	Average Contents per Pail as brought to Works.		Average Contents per House.		Total Contents.		Solid Portion Strained off.
	Inches.	Inches.	Inches.	lbs.	Gallons	lbs.	Gallons	lbs.	Gallons.	lbs.
24 pans from 38 houses ..	193·5	8·1	5·1	80·5	7·4	50·9	4·7	1,934·5	177·6	320·5
24 „ 44 „ ..	145·75	6·1	3·3	60·7	5·6	33·1	3·0	1,457·0	133·7	198·75
24 „ 28 „ ..	103·0	4·3	3·7	42·9	3·9	36·8	3·4	1,029·3	94·5	131·75
24 „ 38 „ ..	194·5	8·1	5·1	81·0	7·4	51·1	4·7	1,943·9	178·4	234·0
24 „ 38 „ ..	201·25	8·4	5·3	91·3	8·4	57·6	5·3	2,191·8	201·2	247·75
24 „ 31 „ ..	191·75	8·0	6·2	79·9	7·3	61·8	5·7	1,916·7	175·9	239·5
24 „ 31 „ ..	170·5	7·1	5·5	71·0	6·5	55·0	5·0	1,704·2	156·4	252·5
24 „ 31 „ ..	176·25	7·3	5·7	73·4	6·7	56·8	5·2	1,761·9	161·7	264·0
24 „ 30 „ ..	169·5	7·1	5·6	70·6	6·6	60·5	5·2	1,694·0	155·5	239·0
24 „ 28 „ ..	113·0	4·7	4·0	47·0	4·3	40·3	3·7	1,129·1	103·6	144·75
24 „ 26 „ ..	139·5	5·8	5·4	58·1	5·3	53·6	4·9	1,394·6	128·0	208·25
24 „ 72 „ ..	225·0	9·4	3·1	93·7	8·6	31·2	2·8	2,249·4	206·5	376·0
24 „ 24 „ ..	110·0	4·9	4·9	49·1	4·5	49·1	4·5	1,179·4	108·2	156·5
24 „ 32 „ ..	193·5	8·1	6·0	80·6	7·3	60·4	5·5	1,934·5	177·6	152·0
24 „ 37 „ ..	193·5	8·1	5·2	80·6	7·3	52·3	4·8	1,934·5	177·6	263·0
360 „ 528 „	2,529·5	105·5	74·1	1,060·4	97·1	750·5	68·4	25,454·8	2,336·4	3,428·25

360 pails, collected from 528 houses, contained 25,454·8 lbs. of fæcal matters, the solids in which amounted to 3,428·25 lbs., or about one-eighth of the whole.

Average weight per house per week = 48·2 lbs.
Average weight per pail per week = 70·7 lbs.
Average depth per house per week = 4·8 inches.
Average depth per pail per week = 7 inches.
Average contents, in gallons, per pail per week = 6·5 gallons.
Average contents, in gallons, per house per week = 4·4 gallons.

(Signed) Chas. Spackman,
Manager of Ammonia Works,
Scott's Sewage Company (Limited),
Saltley, Birmingham.

cinder-sifter, the aim is to exclude the larger and heavier matters, and to put the ash only into the tubs. I may at once express my belief that every mechanical contrivance I have yet seen for effecting this is a failure, and I am convinced that the mixture of the ashes with the excreta is unattended with any advantage, either from the sanitary or from the economical point of view. In the summer-time, when the pail-contents are likely to be most offensive, the volume of ash is small, and the pails arrive at the depot in a very fluid state. Scarcely ever, however, do we find sufficient ash present to absorb the liquids. The ash is said to act as a deodorant; and it certainly has some small influence in this way, though it merely, I think, retards decomposition, and has no real effect in retaining ammonia and the other valuable components of the fæces. Mr. Leigh says that, where an admixture with ashes is made, no larvæ are ever found in the pails; but we are inclined to think that, with a weekly collection, such a state of things can rarely occur, whether with or without ashes. Upon economic grounds, and having in view the preparation of high-class manures from excreta, we may repeat that the admixture with ashes, as also with earth, charcoal, and other substances used in the receptacles, is undoubtedly a mistake. Space prevents me from noticing the many dry-closets, and similar forms of apparatus for deodorising and intercepting the excreta. There can be no doubt, I think, that among the lowest classes of the population all mechanical appliances are sure to be abused, and, if the user can be prevailed to set in motion the levers, or pull-up handle connected with the dry-closet, he will be just as willing to spread mechanically with a trowel a small supply of the deodorant conveniently placed for use. The proper way of using a deodorant is to apply it in small quantities to the solids only, the liquids being allowed to drain away through a perforated side or bottom to the receptacle. By the careful separation of the solids from the liquids, many of the difficulties of the dry system may be overcome. It is the endeavour to mop up a relatively enormous bulk of liquid which has been the ruin of many good schemes of dry-collection, and most of the failures to produce saleable manures are due to the same cause.

Having thus glanced at the chief modes of pail-collection, I may lay down the following general rules:—That one week is the longest period that should elapse between the times of emptying each receptacle, unless the liquids and solids are kept separate. That the covers used for the removal of the pails from the house to the van should be absolutely air-tight. That the vans for the conveyance of the pails to the depôt should have air-tight doors, and be sprinkled at the bottom with some cheap deodorant. That the introduction of deodorants into the pails is of little use as the quantity that can be applied is almost immediately buried or exhausted. That no system of "filling-up" or emptying the pails into liquid-manure carts should be permitted, but that each pail, with its contents, should be brought to the depôt, and a clean one substituted for it in the privy. That it would be an advantage in the pail-system to provide some ready means for the separation, in the receptacle itself, of the solids from the liquids; and lastly: That the removal of the pails should be entirely in the hands of the local authority, and should be conducted upon some such careful system as that practised in Rochdale.

I may now pass to the second part of the subject:—The utilisation of the excreta for the preparation of manures; and here I may point out, by way of preface, that, after a careful examination of the old-fashioned plan of mixing together the ashes and excreta, the Rivers Pollution Commissioners, in their First Report, state that in nine important towns in South Lancashire and North Cheshire, inhabited by 1,110,000 persons, using 113,000 privies, the 347,000 tons of ash-manure made annually, cost one shilling per head for its collection and distribution, and realised on sale to the farmers only fivepence per head of the population; or, in other words, the feeble manure obtained in this way, amounting to rather less than 6¼ cwts. per head per annum, was not only valueless to the community, but entailed a net annual charge of sevenpence per head for its collection and disposal. Every method which has come under my notice of drying up the fæcal matters with ashes, results in the production of a comparatively worthless manure; and even where, as at Rochdale, under the old plan of manufacture, some considerable pains are taken in making the mixture, and where some outlay is incurred in acid to fix the ammonia, only a low-class manure can possibly be obtained. The true key-note to success in the preparation of saleable manures, either from excreta, or from any form of nitrogenous matter, is concentration. Alderman Taylor is fully aware of this fact, and whereas, under his old plan, his manure, composed of one ton of excreta to 7 cwt. of ash, had a theoretical value, according to the analysis of Dr. Voelcker, of only 15s. 11½d. per ton, he is now preparing to make a manure, of a value of from £4 to £5 per ton, by the evaporation of the pail stuff, with small quantities of ash. Some trials of the machine it is intended to employ at Rochdale for this purpose are given in Table III, of the Appendix, as also the result of a very interesting experiment with the machine now in use at Manchester, for work of a similar kind. Concentration is the object Mr. Leigh has in view at Manchester, and the processes now being carried out at Oldham, by the Carbon-Fertiliser Company, and at Birmingham by General Scott, have all of them the same end in view. It was by the production of a high-class manure, that the Town Manure Company trusted to recuperate themselves for their heavy expenditure at Bilston, and it is by some plan of concentration that the question of dealing with dry sewage, under any, and every mode of collection, must erelong be decided. The market is overstocked with the old, worthless, ash-manure, and towns, after carrying it many miles to the farmer's very door, can scarcely prevail upon him to unload it. It is of imperative necessity that steps should at once be taken, wherever an interception system is practised, to devise some plan of converting the fæcal matters into a form of value to the farmer, even should the process of so doing cost the town more than does its present system, or want of system. The mixed ashes and excreta of the unimproved midden are everywhere becoming a gigantic nuisance, for the only mode of ridding ourselves of them, which is at present recognised, lands us in the still worse nuisance and evil of the "tip."

I will now, in conclusion, point out briefly the chief features of the plans in actual operation for the manufacture of concentrated manures from pail-stuff. The process devised by Mr. Leigh, and now being carried out under Mr. Whiley, at Manchester, is substantially as follows:—The mixture of ashes and excreta contained in the pails is tipped on to a grating, which permits the liquid to strain away, while the solids, which contain also all the ashes, are collected, and after being mixed with sulphate of lime, introduced into a drying machine, patented by Mr. Forrest (for the results of a trial of this machine see Table III. below). The dry residue from this machine is sifted, and the finer portions, which consist mainly of the ash and fæcal matters, are used as absorbents, to take up the urine and other liquids previously strained off. These liquids are, however, first concentrated by evaporation in a Fryer's "concretor;" the reduction in bulk, amounting to 90 per cent., is accomplished by means of the waste heat from burning the refuse in a "destructor" furnace. In consequence of the low degree of temperature employed in the evaporation and the fumes of sulphurous acid, which are evolved from the rubbish and absorbed by the liquid, the whole of the ammonia is said to be fixed, and no loss of the fertilisers to take place. The manure obtained in this way compares very favourably with an ash manure in point of value, and can, I was assured, be made to analyse as high as 4 per cent. of ammonia. The quantity at present made is very small. The

TABLE III.

ROCHDALE.—*Experiments with Mr. Firman's Machine, January,* 1877.

	ACTUAL.		COMPARATIVE.						Value of Product per Ton.		
	Material.	In Process	Parts	Water Evaporated	Product.	Moisture Remaining	Ammonia.	Phosphate.			
		Hrs.							£	s.	d.
No. 1.	768 lbs. Blood .... 494 lbs. Evaporated .... 274 lbs. Product	7	100	64·32	35·67	13·11	13·25	..	9	18	0
No. 2.	768 lbs. Blood .... 336 lbs. Evaporated .... 432 lbs. Product	6	100	43·75	56·02	25·11	12·03	..	9	0	0
No. 3.	608 lbs. Ground Offal............ 458 lbs. Evaporated .... 150 lbs. Product	3	100	75·32	24·66	29·57	2·69	..	2	0	0
No. 4.	180 lbs. Fish .... 146 lbs. Evaporated .... 34 lbs. Product	2½	100	81·11	18·88	7·22	6·29	0·08 (Soluble Phosphoric Acid.)	4	14	3
No. 5.	582 lbs. Urine .... } 589 lbs. 7 lbs. Sulphuric Acid } 572 lbs. Evaporated .... 17 lbs. Product	3¼	100	97·11	20·09	9·21	9·70	7·01	8	1	0
No. 6.	476 lbs. Excreta. (Product boiled over in consequence of no acid being used.) ...... 20 lbs. Dry residue obtained	..	100	..	4·02	7·90	4·18	5·92	3	17	8
No. 7.	460 lbs. Excreta ...... } 467 lbs. 7 lbs. Sulphuric Acid } 433 lbs. Evaporated .... 34 lbs. Product	12	100	92·71	7·39	2·41	8·19	5·47	6	15	1
No. 8.	306 lbs. Excreta .... } 606 lbs. .. 300 lbs. Ground Offal } 525 lbs. Evaporated .... 81 lbs. Product	7	100	86·63	13·36	7·11	6·28	2·77	5	0	0
Experiment with Messrs. Smith and Forrest's Machine.											
No. 9.	4,172 lbs. Excreta, sent from Rochdale } 4,568 lbs. 336 lbs. Fine Ash...... } 60 lbs. Sulphuric Acid added ...... } 4,063 lbs. Evaporated .... 505 lbs. Product	4½	100	84·56	11·05	10·24	4·31	2·61	3	10	1

Commenced filling the machine at 11 a.m.; started the machine at 11.30 a.m.; charge drawn at 4 p.m.

Note.—In valuation, ammonia is taken at 15s. per unit, and calcic ophoshate at 3s. per unit.

refuse matters at Manchester are all burnt in large furnaces; the offal is ground up with fine ash as a manure. The clinkers and ashes are mixed with lime and converted into mortar, which can be sold at a considerable profit. The best cinders are burnt under the boilers. Further details of the Manchester process will be found in Mr. Foster's paper.

At Oldham, the principle of concentration is carried out somewhat differently. The entire collection of the pail-stuff is conducted by the Carbon-Fertiliser Company. The pails, as they arrive at the works at Higginshaw, are tipped on to a screen, which retains the solids, and permits the liquids to drain away into settling vats. The solids, deodorised with refuse animal charcoal, are dried in Milburn's machines, and subsequently on hot floors. The liquids are utilised for the production of ammonic sulphate, by the preparation, first, of ammoniacal liquor, which liquor is redistilled into acid. The crystals of ammonic sulphate are mixed, in varying proportions, with the dried fæcal matters, and manures of four different degrees of strength, are, by this means, obtained. Superphosphate prepared from bone is also added. The highest quality of the Oldham manure, with five per cent. of ammonia and 25 per cent. of tribasic phosphate, is offered at £8 per ton, while the lowest quality, with 2½ per cent. of ammonia and 4 per cent. of tribasic calcic phosphate, is valued at £2 10s. per ton.

In General Scott's process, carried out upon a small scale at Birmingham, a considerable portion of the ammonia is fixed in the form of ammoniacal phosphate of magnesia. The pail-stuff is tipped upon riddles of three successive degrees of fineness, the smallest apertures being ⅜ths of an inch in circumference. The liquids which drain away, constituting ⅞ths of the entire mass, are boiled with calcined dolomite, and the ammonia is distilled over into acid. After about 75 per cent. of ammonia has been expelled, sufficient superphosphate of lime is introduced into the boiler to neutralise the magnesia. The magnesic phosphate thus produced abstracts a further portion of the ammonia from the liquid, fixing it without the employment of sulphuric acid, and the contents of the boiler are run off, allowed to cool, and filtered by means of a Needham and Kite press. The clear liquid then is treated for the final extraction of ammonia and phosphoric acid, traces of which are still left in solution; while the cakes from the press are ground up and mixed with the solid portions of the excreta. This compound is dried on hot plates, and intimately mixed in a disintegrator with the crystals of ammonic sulphate. By this means from 7¼ tons of excreta it becomes possible to prepare one ton of concentrated manure, containing 5 per cent. of ammonia and phosphoric acid, equivalent to 20 per cent. of tribasic phosphate of lime, valued at £6 10s. per ton. In this manure the amount of dryers and "profligate associates" which have been added is reduced to a minimum, and a saleable and valuable material is the result. General Scott claims for his manure a higher value indeed than the above, because the manure, when sown, presents the ammonia to the plant in the form of carbonate, and ammoniacal phosphate of magnesia, in the presence of organic matter, is sufficiently soluble for the purposes of the agriculturist.

All the foregoing plans may still be said to be in the experimental stage; they all present much that is hopeful, and give promise that the difficult question of the profitable utilisation of the excreta is receiving attention from earnest and thoughtful minds.

NOTES ON THE TREATMENT OF SEWAGE AT MANCHESTER, SALFORD, AND BIRMINGHAM.

By **P. Le Neve Foster, M.A.**

Secretary of the Society of Arts.

From the special condition of its locality, Manchester has but small facilities for the water-carriage of its sewage; and the problem has been, how best to deal with the subject without having recourse to that mode of treatment. There are some 67,000 houses in Manchester, and only 10,000 water-closets; it is not unreasonable, therefore, that the treatment of this branch of the system should be deemed of secondary importance, and that the object of the authorities has been to deal with the larger portion which has hitherto been principally served with ash-pits, middens, and privies, and the like. These, however, under the active operations of the Corporation, are fast passing away, and their places being taken by improved cinder-sifting closets, which under compulsory powers, are superseding the old system. At the present time, there are 28,000 closets on the cinder-sifting principle, and 14,000 of the old midden closets still remaining. These latter, however, are gradually being got rid of, and the improved closets substituted in their stead. The change is taking place at the rate of about 200 per week, and it is expected that this rate will increase, and that the whole will be converted in a year and a half from this time. This closet is either put up by the owner, or the Corporation supplies the closet complete for £4 4s. Under the seat the fæces and urine are received in a special metal or wooden pail or tub. By the side is a cinder-sifting arrangement, by means of which the fine ashes fall into the pail or tub, whilst the coarser parts fall on the floor below, and are ready for use use again as a fuel. At the back of the closets is a moveable wooden receptacle, where all the other house rubbish, such as vegetables, straw, house sweepings, &c., are thrown.* Slop waters pass through a grid into the sewers. There is thus a complete division and separation of the three classes of material, and, practically, there is found no difficulty in maintaining this arrangement. The fine ashes, falling into the pail, sink to the bottom, carrying with them the fæces or solid matter. The pails and the excreta are collected regularly, at intervals not exceeding one week, and oftener when possible. A specially-constructed van for this purpose, carries empty pails, to be substituted for the full ones. A close-fitting lid, which hermetically seals the pail, is attached to the full pail, which is then transferred to the cart, and the clean pail placed in its stead. At the back of the van is a division, into which the house refuse is emptied from the box, which is then replaced empty, the door enclosing the whole being locked up until the operation is repeated the following week. The removal is thus effected almost without any nuisance, either to sight or smell, the ashes acting as a deodorant. On arriving at the yard, the pails are emptied into vessels, and the contents treated with sulphuric acid, or sulphate of lime is added, with a view of fixing the ammonia. The urine, mixed with a small quantity of fæcal matter, is, by means of strainers, separated from the solid portions, consisting of excrementitious matter mixed with fine ashes, and is pumped into tanks, whence it runs in a small stream through a pipe, into the "concretor," for the purpose of being evaporated at a low temperature, so as to reduce its bulk. The solid portion is taken into what is termed a "concentrator." The concentrator is thus described by Mr. Whiley, the superintendent of the yard, in a paper read before the Manchester Scientific and Mechanical Society:—"The apparatus consists of a jacketted cylinder, fixed horizontally, with a hollow spindle running through its centre, to which are affixed a number of hollow arms, both spindle and arms being heated with steam. When the spindle is put into motion, the heated arms come into contact with the material with which the machine has been filled, and dash it against the heated surface of the cylinder. This action disintegrates the material, and deprives it of its moisture by evaporation, whilst a fan connected with the machine draws out the vapour as rapidly as it is generated." The apparatus, it is said, will concentrate or reduce 3 tons 12 cwt. of excrementitious matter and ashes to 24 cwt. in two hours (including filling and emptying). From the same source the following description of the "concretor," the invention of Mr. Alfred Fryer, is taken:—"This machine consists of a plated iron cylinder, with openings at each end, rather smaller than its own diameter. It is placed with its axis horizontal, and its interior is fitted with between two and three thousand superficial feet of metallic plates, arranged in spirals, extending from the centre to the sides. When the liquid is introduced to the interior of this cylinder, and the latter is caused to rotate upon its own axis, not only does its inner serface become wetted, but the extended area of the spiral blades become moistened on each surface. Heated gases are then drawn rapidly through the cylinder, and as they pass over the wetted surfaces they absorb the moisture, and thus effect a very rapid evaporation, the liquid remaining comparatively cool, no matter how highly heated the gases may be. The urine is admitted at one end of the cylinder and emerges from the opposite end; and so rapid is the process that a very few minutes elapse before the liquid emerges from the other end, of about the same consistency as treacle, above 90 per cent. of the liquid having been dissipated in the form of vapour. The gases enter the cylinder at a temperature of 600° F., or even a greater heat; but the urine in concentration never reaches the temperature of 130° F., and is generally even cooler than that. At so low a temperature there is no loss of ammonia whatever; indeed, the very slight decomposition of the urea adds its ammonia to the stock. The source of the hot air supplied to this apparatus is derived from the combustion of cinders, &c., and the small portion of sulphurous acid present in it is seized by the liquid, and effectually fixes the small proportion of volatile alkali." The urine thus reduced is mixed with the finer portions of the material from the concentrator, and forms, with animal matter and refuse from the butchers' yards, tripe-dressers, and other animal matter ground up with it, a manure which is sold at the yard at 12s. 6d. per ton. It is readily purchased by the farmers, as fast as it can be made.

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* A model of the closet kindly lent by Mr. Leigh was exhibited in the room below.

The street-sweepings are not at present dealt with; but a considerable quantity of the unsoiled midden-stuff from the old middens yet remaining is got rid of by heating it to redness in a furnace and then converting it into mortar. A portion of the midden-stuff, that is unsoiled by fæcal matter, is carted to to the tip. The soiled midden-stuff is put at once into boats and taken off to a farm in the country, bordering the Irwell, on which the Health Committee have a wharf.

The dry rubbish is sorted and screened, and such parts as are capable of being burnt are made into charcoal, in carbonisers, and this is used for mixing with the manure; other parts, such as the meat tins, are sold at 10s. a ton to the makers of an iron salt, whilst the broken crockery, bricks, clinkers from the furnaces, &c., are ground with lime into a mortar, which sells readily at 4s 6d. a ton. About 300 tons per week are thus manufactured. A steam-engine of 40-horse power works the machinery in the yard, and is fed entirely with the ashes, and rubbish fuel collected; not a single pound of coal is purchased. The Corporation have another yard, where the closets, pails, &c., are constructed and repaired. The machinery for this purpose is driven by a steam-engine, the fuel for which is entirely supplied in like manner, no coal being purchased. By the means thus employed, the whole of the material collected by the vans from the houses on the pail system is either destroyed or converted into a saleable material, and this is effected with little or no offensive smell. The yard, when I visited it, and everything was in full operation, was clean and free from disagreeable odour. The following will give some idea of the nature of the weekly collection made:—

	Tons.
Paper	1
Dead animals (dogs, cats, &c.)	2
Rags	3
Stable manure (from their own stables)	17
Meat tins, old tin, and iron	33
Slaughter-house refuse	60
Broken pots, bottles, glasses, &c.	80
Vegetable refuse (such as door mats, table covers, old straw mats and mattresses)	90
Fæcal matter and fine ashes	1,200
Cinders	1,344

Nothing is at present being done to purify the Irwell from the filthy contents of the sewers, or to utilise them in any way. This is considered secondary to this pail system, and will be attacked when the latter is complete. It must be borne in mind that, by the complete adoption of the pail system, and the abolition of middens and cesspits, the sewers are relieved of a considerable amount of noxious matter that now flows into river. So that when the water-carried system is attacked later on, as it necessarily will have to be, the evil to be dealt with will be, *pro tanto*, diminished.

At Salford, which I visited, I found that the

Corporation there were perpetuating an improved midden system, compelling all to be covered in, though in some instances they were getting Morrell's Automatic Cinder-sifting Closet into use, but the cost (£12) for conversion was operating as a strong check to their introduction.

Birmingham, with its suburbs, has about the same population as Manchester; has 7,514 water-closets and 16,000 pail-closets, and 8,870 ash-tubs, 27,426 privies in connection with 19,154 ash-pits. The pails here collect the fæces and urine together, but no ashes are mixed with them. The contents of the pails are collected in vans similar to those of Manchester, and the night soil and ashes in the ordinary carts. The whole is brought together in yards, at several wharves in the town, where all is mixed, pail stuff and ashes, and loaded into barges. The mixture is conveyed to farmers, who take it, paying about 4s. 6d. a ton. The Health Committee of the town have decided to adopt the Manchester system, and are now constructing the necessary furnaces and apparatus for that purpose.

The water-carried sewage is taken to the outskirts of the town, where it is treated with lime, let into a series of admirably arranged settling tanks on a very large scale, and, after precipitation, a tolerable effluent is obtained, which flows into the small stream in the neighbourhood of the works. The immense mass of sludge which is thus deposited forms a great difficulty. At present it has to be dug into the land, which lies contiguous to the works, and the cost of so doing amounts, as I was informed, to £14 per acre.

Whilst at Birmingham, I had an opportunity of seeing the works which have been for some months past, and are still, in operation for demonstrating the efficacy of General Scott's system of dealing with dry sewage or pail stuff. General Scott takes the contents of the pails, which, it will be remembered, are free from any mixture of ashes or other refuse, roughly strains off the grosser solid matters, and runs the liquids into a boiler, where they are mixed with a sufficient quantity of calcined dolomite to furnish a base for combination with the carbonic acid holding the ammonia in the urine, &c. The mixture is then boiled, and the united action of the alkali and the heat sets free the ammonia, which is distilled over into sulphuric acid, and fixed as ammonic sulphate. When the process has been carried far enough to drive off three-fourths of the ammonia, sufficient superphosphate of lime is introduced into the boiler to neutralise the magnesia of the dolomite. The result is the formation of a magnesic phosphate, to which in the act of formation the greater part of the remaining ammonia in the liquid flies, forming the well known double salt, the ammonio-magnesic phosphate, which precipitates, is being fairly insoluble; the compound is then turned out of the boiler, and filtered in a Needham and Kite press. The liquid filters away, and may if necessary be treated for the extraction of the soluble phosphoric acid, but it has very little ammonia left in it. The solid cakes from the filter press are then ground up with the solids, which were strained off from the pail stuff. The grinding is done in an edge runner, and the mixture is subsequently dried on hot plates. To this dry manure as much of the crystals of ammonic sulphate are finally added as needed, and thoroughly amalgamated in a disintegrator. A highly concentrated manure can thus be formed. Only from two to three tons per week of this manure can be made by the present apparatus at Birmingham. Abour four tons of pail stuff are treated at a time, the works having been erected on a small scale, and solely for the purpose of demonstrating the efficiency and cost of the process. The manure thus made is stated to be saleable at £6 10s. per ton, the value of course depending on the amount of ammonia and phosphate mixed in the manner mentioned above. The cost of producing this manure is stated to be not more than two-thirds of its selling price.

REMOVAL OF EXCRETA AND REFUSE AT ROCHDALE BY THE ROCHDALE SYSTEM.

Experience of the year ending March 31st, 1877.

By Alderman Taylor.

Were it not that the pail system, as carried out at Rochdale, has received a somewhat special notice and criticism, and the notion conveyed that it is far from a success, either sanitarily or commercially, the writer would not have placed the experience of the year before the Conference, seeing that the statement to be made does at first sight appear to warrant the above conclusion. If, however, the question be fully grasped, the disastrous monetary results of the last two years will demonstrate the value of the pail system if fully carried out; that is, not the mere collection and disposal, but the manufacture of the contents into a manure before disposal. The difference in the cost to the town has been about £4,000 per annum for the last two years, the increase arising from the following causes:—

1. The manufacture ceasing, the excreta had to be disposed of in almost a crude state, namely, by just mixing it with fine ashes, and this mixture having 40 per cent. of water, the carriage and cartage was more costly than the manufactured manure.

2. The labour expended on this mixture was much more than on the manufactured manure.

3. The money received for this mixture was about 3s. per ton, after conveying it some 20 miles; whereas the manufactured manure would have realised 20s. per ton, the customer paying carriage thereon.

In the paper placed before the Conference last year, the hope was expressed that the Health Committee would have been enabled to enter upon the manufacture of the whole of the collected excreta. The obstructions and influences proved to have been too great, and it is only since December that a definite step has been taken. Without going into a detailed history of the proceedings, I may state generally, that the idea of disposal of the excreta, when simply mixed with fine ash, as a cheaper mode than manufacturing it perfectly, though at one time paramount, is nearly exploded. Next, some four or five years ago, a steam jacketed tank was in use to evaporate the urine collected from the urinals. The exigences of the works required the removal of the tank from its position, and the impression was strong that the waste fire-heat would accomplish the evaporation as well as steam had done; this proved a failure. Then arose the suggestion of several plans, some of which were tried.

These trials and consequent discussions, though occupying time, and so hindering the adoption of better means, yet have cleared away some fallacies, and enabled us to make experiments which may prove to be valuable, by showing how excreta may be rapidly and economically converted into a high-class manure. Passing over any account of these failures, I will at once state that a machine constructed by Mr. Firman, has been adopted after an experimental trial made with one of his machines. The primary object of the machine was for the drying of blood, slaughterhouse offal, and fish scrap. The writer suggested that excreta should be included in the machine's work. A series of experiments were arranged, and a machine erected in our manure works, its capacity being about 80 gallons. Blood, offal, fish scrap, urine, excreta (the pail stuff) and various mixtures of these articles were operated upon, and the result of the trials was as follows:—

Results of Trials with Mr. Firman's Machine.—January; 1877.

	Article and quantity.	Time in process.	Water evaporated.	Product.	Per cent. of moisture remaining.	Per cent. of ammonia.	Per cent. of phosphate at 2s. 3d. per unit.	Value of product per ton ammonia at 15s. per unit.
	lbs.	hours.	lbs.	lbs.			lbs.	£ s. d.
1	768 blood.	7	494	274	13·11	13·25		9 8 0
2	768 do.	6	336	232	25·11	12·03		9 0 0
3	608 offal.	3	458	150	29·57	2·69	Soluble phosphoric acid	2 0 0
4	180 fish.	2½	146	34	7·22	6·29	0·08	4 14 3
5	582 urine. 7 SO^3	3¼	572	17	9·21	9·70	7·01	8 1 0
6	460 excreta. 7 SO^3	12	433	34	2·41	8·19	5·47	6 15 1
7	306 excreta. 300 offal.	7	525	81	7·11	6·28	2·77	5 0 0

Messrs. Smith and Forrest's Machine.

8	4,172 excreta. 336 fine ash. 60 SO^3	4½	4,063	505	10.24	4·31	2·61	3 10 1

A sample of the products was shown in the Exhibition Room.

Before the 1st of June next a machine will be erected, 13 feet long and four feet diameter, having a working capacity of three tons. The cost of the machine and fixing it will not exceed £450, and the work that it will do, we estimate, will be about 12 tons per day of 24 hours. This estimate is founded, not only on the experimental trials with the smaller machine, but on a trial with a similar but a larger machine, at Messrs. Smith and Forrest's, Manchester. The general description of the machine is that it is a cylinder surrounded with a steam jacket, through the centre of which is a hollow spindle with arms, and a longitudinal rail similar to a yarn reel, the rail acting as a stirrer and scraper. The hollow spindle, which is six inches diameter, is intended for the passage of steam or hot air.

A full description may, however, be seen by consulting the specification of the patent, which was sealed in June, 1876.

The system of collection still retains the approval of the inhabitants; the increase in the number of pails this year being 798, of which 429 were in lieu of old privies altered to the new system, the total number last year being 5,566; this year, 6,364. The still existing number of old privies is 2,417. The Corporation has not yet resorted to obligatory legal means to compel the alteration to the pail system but it is on the eve of doing so; the alterations hitherto have been without compulsion, except in a very few cases, where the nuisance of the old privy was extreme.

The total amount of excreta collected this year by the pails has been 5,643 tons in 317,084 pails, being 39 lbs. to each pail, and the amount of dry refuse (ashes, &c.), 9,277 tons.

It is very satisfactory to be able to state that, by the use of a lid, the invention of our manager (Mr. Haresceugh), the nuisance of smell from the collecting vans, as they pass through the streets, is done away with. A pail with the lid is now in the exhibition of sanitary appliances of the Society of Arts. The cost of the lid will be about 10s.

There is no doubt that the weekly removal of the excreta and refuse from the vicinity of the dwellings, is producing a marked improvement in the habits of cleanliness of the cottage population, and must minister in some degree to moral improvement. This view of the case should always be considered when the question of cost arises, and so also should the sanitary advantages be taken into account. These we take to be demonstrated by the following figures, which are taken from the annual report by the medical officer of health:—

"The death-rate in the borough of Rochdale, for the year ending 31st March, was 22·4 per 1,000; the average of the three previous years being 23·1, and for the seven years during which the pail system has been in operation 23·8. Compared with death-rates in the neighbouring towns included in the north-western counties of the Registrar General's returns, that for Rochdale is lower, both for the present and for the average of three to seven years. The same remark applies to the death-rate from the seven principal zymotic diseases; that for the present year being 3·7, of which more than one-third was due to deaths from measles. The death-rates for fever and diarrhœa also show a steady decline, thus, from fever the death-rate for this year is ·47, as compared with ·57, the average of three previous years; and for the same periods of comparison the death-rate from diarrhœa is as ·70 is to ·90."

In the experience of tho past year, there has been a "Report on the several modes of treating Town Sewage," by Mr. Rawlinson and Mr. C. S. Read, in which the Rochdale system is very freely remarked upon; and on some of the statements there requires something to be said in explanation, that the report may not be referred to in future as being a perfectly correct representation. A phrase, a remark, or a figure, from such an authority may condemn a system, or induce its adoption. On page lvii., in the report on Rochdale, under the head, "The yearly cost of cleansing the pail privies" there is given:—

Cost of collection..........	£3,405
Of manufacturing manure..	3,651
	7,056
And there is deducted 2,002 tons manure sold........	2,002
Showing £5,054 as the cost.	

On page 58, the value of manure deducted is £4,420, which shows the cost to be £2,636, not £5,054, as given on page lvii. It is on the first statement that the annual cost of 8¾d. in the pound is given for Rochdale. If the second statement had been taken, the 8¾d. would have been 6¾d. in the pound. Further, the leading heading in page lvi. over "Rochdale" is "Treatment of Excreta by the Pail System," and then follows a statement of the cost; but, in the cost, the "cleansing of the privies and middens," the cost of the "intercepting sewer," is included, the amount of these two items being £2,570, which, being deducted from the cost of the pail system, would again reduce the 6¾d. to 4¼d. The Commissioners appear quite to believe that 8¾d. is the correct sum to charge to the pail system, for on page lviii, under the head "By the Pail System," that is the sum placed against "Rochdale" in comparison with other towns. So much for the "figure" representation. This "mixing up of costs" will lead to much confusion, which will not be lessened by the "mixing up" of the pail system and the midden system. On page 59, in the remarks on "tips," there is a quotation given from the remarks of the Rivers Pollution Commissions on the "Colley-Hurst Tip" at Manchester; the quotation is too long to give here, but this is the concluding paragraph:—"What to do with the fouled ashes which it (the midden system) accumulates—filthy stuff, too poor to use as a manure—is one of the great difficulties of the local authorities almost everywhere in Lancashire." One of the special features of the Rochdale system is, that it annihilates the requirement for a tip, which fact ought to have been clearly stated when the quotation was given; an omission, as well as a remark by such an authority as the signataries of the report, may be very injurious. But there are the direct remarks, such as, "there is also the inconvenience suffered by trespass on the privacy of the household," on page xxxii, which is a mere idea in the reporter's mind, and is a very erroneous representation. Other instances might be given if space would allow. Then phrases such as that on page xviii., "In all the so-called dry processes (which are not dry)" which covertly attack the Rochdale system are abundant throughout the report, but it is not our purpose here to discuss the advantages and disadvantages, as against the commissioners having drawn attention to their report, only that wrong conclusions may not be arrived at. We have had another experience in the year which I name here, that the views entertained on the question of sewage disposal in Rochdale may be seen. The Corporation has purchased a farm of some 20 acres, near to the town, on which to purify and utilise the sewage proper, namely, the fluid refuse of the town, that is the cooking, washing, manufacturing water, and whatever may be contributed by water-closets, to the use of which no hindrance has been given by objection made in Rochdale. Thus whilst advocating strenuously the Rochdale system to be in practice good, and ministering to the health and comfort of the inhabitants, we as strongly insist on the desirability of irrigation as the best means whereby the economical utilisation of true sewage may be attained.

INDIAN SECTION.

Friday, May 4th, 1877; Sir Joseph Fayrer, M.D., K.C.S.I., in the chair.

The paper read was—

THAUMATO-DENDRA, OR THE WONDERS OF TREES.

By Wm. Tayler

(Late Commissioner of Patna).

I do not think I am far wrong, when I say, that of all material objects which the Almighty Creator has vouchsafed to bestow upon his creatures, the tree, in its many varieties, is, taken all in all, the most beautiful and interesting. And this, too, irrespective of those mysteries which are connected with its birth, germination, and efflorescence — mysteries, which, though familiar to our daily observation, and regarded by the unreflecting as ordinary incidents of nature, and possibly in the present day viewed by the ultra-philosophic mind as the mere accidental conglomeration of fortuitous atoms, are nevertheless deserving of our studious and reverential examination.

But I have no idea, this evening, of entering into scientific or learned disquisition on the physical wonders of vegetable life in general. My principal purpose is simply to show some curious specimens of what may be termed eccentricities, viz., peculiarities of growth, size, form, or habit, which are exceptional and dissimilar from the habits of trees in general.

Such eccentricities are to be found to some extent in European trees, but are much more numerous and singular in those of oriental growth.

I may here mention that my continuous habit, during my long and uninterrupted sojourn of 38 years in India, was to occupy every half-hour which I could spare from my official duties in painting from nature every interesting object which presented itself before me, so that I necessarily have a somewhat large collection of sketches of all kinds. Among these are many trees of different sorts, and in these sundry very curious phenomena are observable, while some peculiarities appertaining naturally to the trees themselves, are so strange and unlike their European brethren, that they are worthy of special notice.

When entering on this subject, it will not be inappropriate to notice the somewhat remarkable fact that the tree is, with one exception, the only material object which is specially and individually described in the sacred history of the creation.

The sun, moon, and stars, the birds of the air, and beasts of the field, are cursorily referred to as having been created, but special and distinctive description is in the vegetable world alone given to the tree, as in the animal world to the serpent, though even then in mysterious connection with the tree.

The tree is thus described in the 2nd chapter of Genesis, verse 9—"And out of the ground made the Lord God to grow every tree that is pleasant to the sight, and good for food; the tree of life, also in the midst of the garden, and the tree of knowledge of good and evil." Or, as Milton's lines describe it—

> "In this pleasant soil
> His far more pleasant garden God ordained;
> Out of the fertile ground he caused to grow
> All trees of noblest kind, for sight, smell, taste.
> And all amid them stood the tree of life,
> High, eminent, blooming, with ambrosial fruit
> Of vegetable gold, and next to life,
> Our death, the tree of knowledge grew fast by."

And it is still more interesting, especially to those who regard, as I confess I do, this earth, purified and renewed, as the abode of future happiness of man, to observe, that while special mention is thus made of the "tree of life," in the beginning of the Bible, the last chapter of Revelation, which describes the glory of the future, exhibits once more the same tree of life as occupying a most important position in the new world.

In the 22nd chapter of Revelation, verse 2, it is written—"In the midst of the street of it, and on either side of the river, was there the tree of life, which bare twelve manner of fruits, and yielded her fruit every month, and the leaves of the tree were for the healing of the nations."

Again, in verse 4—"Blessed are they that do his commandments, that they may have right to the tree of life, and may enter in through the gates into the city."

It is not improbable that the importance thus given to the tree in Scripture, the mysterious virtues described to the tree of life, and the terrible effects of eating, in disobedience to God's command, of the fruit of the tree of knowledge, combined with the transcendent majesty of the tree itself, gave rise to the superstitious reverence, subsequently developed into "tree worship."

That this worship can be traced in most of the countries of the world has been clearly shown by Dr. Ferguson, in his splendid work on "Tree and Serpent Worship," and that India welcomed the mystic development with special enthusiasm can be readily imagined by those who have studied the character of oriental idealism—stones, clifts, hills, hollows, wells, and waters, have all formed subjects of mysterious and mystic interest, with that imaginative people, and it would have been strange had the tree been left un-mysticised or un-translated. Retirement into a forest is enjoined by the laws of Menu to the religious aspirant, and residence for some years in a grove was a necessary preliminary for the Sunyasee Ascetic. The Khonds, a barbarous hill tribe, even now have no visible temples of their elemental gods, but resort, in phrensied multitudes, to the consecrated groves that are drenched with the blood of human sacrifice, and haunted with the dreaded ghosts of miserable victims untimely slain.

One of the earliest ideas of the tree—with the poetic orientalist—is, that it is a material representation of the Trinity. It points in the elevation of its higher branches to heaven, its roots strike down to Tartarus, but the tree itself is of earth, thus forming a Brahminical triad, which is expressed by the Sanscrit word, "Bhurbhuvaswah," a trisyllabic, monoverbal myth, which, like the mysterious A. U. M., comprises the elements of Brahma, Vishnu, and Siva. But this is a large subject, on which I can, in a lecture like this, only briefly touch.

History abounds with interesting incidents of the devotional romance with which man, in his instinctive aspiration towards the grand and beautiful, has invested the tree, and the strange collatural incidents to which the feeling gave rise.

As Ferguson in the introduction to his splendid work, justly and eloquently remarks:—

> "With all their poetry and all their usefulness, we can hardly feel astonished that the primitive races of mankind should have considered trees as the choicest gifts of God to man, and should have believed that their spirits still delighted to dwell among their branches, or spoke oracles through their rustling leaves."

The oak, if oak it was, under which Abraham received his celestial guests, in the plain of Mamre, was for many years regarded with extreme veneration, and is said to have been worshipped down to the time of Constantine. The burning bush in Horeb, where God appeared to Moses, was known before and generally venerated as sacred. The fleece which the Argonautic expedition went to recover was hung upon a sacred tree.

The classical gods had each and all special trees assigned to them, to Jupiter, the oak; to Apollo, the laurel; to Minerva, the vine; to Venus, the myrtle; to Hercules, the poplar; and so on.

Ashera, as mentioned in the Bible, is now generally held to be the mere image of an idol god made of wood, the symbol of Ashtaroth, the partner of Baal.

The great *Diana* of the Ephesians was originally only the stump of a tree. The miraculous powers of the "oak of Dodona" are too well known to require exposition, and the sanctity of the oak, in the days of the Druids, is too familiar a fact to need special notice.

These, and the thousand other legends, are sufficient to show what influence the tree had acquired in the mind of man, and how extensively it was mixed up with the superstitious fancies of the human mind.

In Germany especially, tree-worship, even after the conversion of the people to Christianity, was extensively prevalent, and it is to this worship that the social elevation of the Christmas-tree, which has now been adopted in England, is probably to be ascribed.

But there is one strange legend dating from the earliest days, and taking its origin from the pages of the Old Testament, which, though absurd in itself, is worthy of quotation, showing how readily the human mind, even in civilised times, accepted the most extravagant phantasy when applied to the tree.

This is the legend of the True Cross, and is thus told by Fergusson—

"When Adam was on his death-bed, he sent to Seth to try and regain admission to Paradise. This, of course, was impossible, but he was allowed, by the angel who guarded it, to look in at the gate. He saw, among other things, the tree which had borne the fatal fruit, its roots then extending to hell, but its upper branches reaching to heaven. The angel gave him three seeds, recommending him to place them in Adam's mouth when he died. He did so, and they produced three trees, a cedar, a cypress, and a pine.

"These afterwards united into one, and their branches performed many miracles. Solomon cut down the tree, and tried in vain to use its trunk to support the roof of his palace.

"It disdained such an use, and was consequently thrown across the brook of Cedron to be trodden upon.

"It was rescued from this ignominy by the Queen of Sheba, and buried below the pool of Bethesda, which owed its healing properties to its virtues. It came to the surface when wanted for the Cross, and afterwards was buried in Calvary, where it was recognised by the Empress Helena in consequence of its miraculous healing powers. It was taken to Persia by Chosroes and recovered by Heraclius, and afterwards, as is well known throughout the Middle Ages, a piece of the wood of the true Cross was prized by emperors and kings beyond all other earthly possessions. So great, indeed, was the demand, that it was endowed with the property of self-multiplication; but even this did not suffice to bring it into contempt, and as late as 1248, Philip Augustus erected the Sainte Chapelle to enshrine a morsel of the wood of the tree of Paradise.

"The Sainte Chapelle may thus be considered as the last, as it probably is among the most beautiful temples ever erected to tree worship; and while we thus find trees, objects, if not of actual worship, at least of reverential adoration amongst ancient nations, we recognise even in the present day in different quarters of the globe, remarkable superstitions in connection with trees, as connected with the destiny of nations, or the lot of individual men."

Many instances in which superstition has thus vested the tree with supernatural attributes might be quoted, but time forbids my entering on them. I will only give one modern but not uninteresting example, which shows that the same idea is prevalent in the 19th century.

The following extract was taken during the Ashantee war from one of the leading journals:—

"There are new tales of portents at Coomassie; one especially, of the truth of which we are assured, is certainly at least a very singular coincidence. The word Coomassie means, 'the town under the tree,' and was so called because the founder sat under a broad tree surrounded by his warriors while he laid out the place for the future town. The market-place was marked off around the tree, and it naturally became the great fetish tree of the town. On the 6th instant, the day upon which Sir Garnet sent his ultimatum, or his summons to the king, a bird of ill-omen was seen to perch upon the tree, and half an hour aftewards a tornado sprung up, and the fetish tree was levelled to the ground! This caused a profound sensation in Coomassie, which was no little heightened when Sir Garnet's letter arrived and proved to be dated upon the day upon which the fetish tree had fallen."

And here I may mention that a letter I received from Sir Garnet Wolsley confirms this statement in all points.

Having troubled you with these few general remarks on the traditional sanctity of the tree, I must, for the better understanding of some of the eccentric phenomena which I am about to show you, diverge, for a few moments, into the region of scientific physiology in regard to two different principles in the growth and development of trees, a subject which, though, doubtless, familiar to many here present, may perhaps not be thoroughly known to all.

I will then—apologising to the learned among the audience for the liberty I am taking—remark, that trees are divided, as far, at least, as their mode of growth is concerned, into three classes, expressed by long and, perhaps, rather unintelligible names, viz., "acrogenous," "exogenous," and "endogenous."

Well, with the first—viz., "acrogenous," we need have little concern, which will, perhaps, be a relief to some of my auditors. But the other two, I must ask permission to explain, though very briefly, and, I hope, sufficiently simply, as to be understood, even by those who have never given a thought to the subject.

"Exogenous" then and "endogenous" are Greek words, which ought correctly to be pronounced with the hard G, but this is, by the way, when the system of School Board spelling is carried out, we shall doubtless obtain unexceptionable accuracy. Now the meaning of the first word "exogenous" is "outside growing," or growing from the outside. "Endogenous" quite the contrary, *i.e.*, "inside growing," or growing from the inside. The last syllable "genous" meaning growing, or born. "Endo" and "exo" being respectively within and without.

Having thus given you a small specimen of philology—that sublime science to which the late Premier devoted himself, when he abandoned his high political position—I will show you why it was desirable that you should have some correct idea of this difference in the mode of growth, and expansion. And to explain this more clearly, I must tell you that the great majority of trees with which we are familiar, both in India and England, oaks, elms, ashes, banians, peepuls, and mangos, are "exogenous," *i.e.*, they grow from without, and if you ask exactly what this means, I will beg you to imagine to yourself an ideal or artificial tree, shaped and manufactured by any gentleman, lady, or child, in this room, commencing with a small round piece of wood like an ordinary stick, and suppose that each day, on going to bed, or on first getting up in the morning, he or she wrapped the stick round with a piece of thick paper or leather. This daily wrapping, perhaps, I need hardly say, would gradually increase the circumference of the stick, and the augmentation would go on exactly in proporition to the number of leathern or paper rolls wrapped round it!

Here you have the "exogenous" growth precisely exemplified. The tree, trunk, branches, and twigs gradually increase by layers of wood from the outside; and if you cut the trunk of such a tree horizontally, you will perceive a series of circles, which more or less indicate the age of the tree, an additional layer being generally added year by year.

Now the "endogenous" tree's procedure is exactly opposite to this. Their growth is from within, *i.e.*, by a curious process, perhaps more easily conceived than described, a gradual thickening of the stem takes place, commencing from the lower part, or crown of the leaves; for the leaves of endogenous trees appear, at the very first year of growth, almost, if not quite, as large as after fifty years of age.

Well, the vessels or fibres, or whatever they may be most correctly called, spread from the leaves downwards and outwards, so as to press from the inside to the outer coat. Thus, in the next year, when the first leaves have fallen off—as they do each year—a new crown of leaves is formed, and they again send down their fibres; not outside, but inside, the stem, or trunk. So that there is a continued yearly thickening from within, and pressure or expansion to the outer coat; and thus, the external skin, or bark, by resisting the pressure, becomes harder and harder—like the obstinate, unintellectual man, whom we sometimes meet with—while the centre remains comparatively soft, sometimes even hollow! so that half of a tar-tree, when split, forms a kind of natural canoe, which is often used by the natives. Whereas, in the "exogenous" tree, the centre, being pressed from without, becomes the hardest portion—what we call the "heart" of the tree.

I have offered this brief explanation, because it is necessary for the appreciation of some of the "eccentricities" which I shall refer to, and I will now proceed to exhibit some of the individual trees, which are more or less remarkable, either for phenomena of their own, or for incidents connected with them.

Mango-tree.

First, then, regarding the "mango." There is nothing connected with this tree, that, strictly speaking, falls within the catagory of marvels or eccentricities; but there are incidents and facts associated with it which entitles it to a place in this paper.

I have never been able to discover that there is any religious or superstitious feeling connected with the mango (called *âm* by the natives). The tree is an honest commonplace tree, growing as other trees grow, and fructifying in the ordinary every-day style.

But, superstition apart, the mango is the largest known fruit-tree, and the abundance, regularity, and excellence of the fruit itself, has given it a prominent place in the affections of the people.

To plant a mango tree is an act of benevolence; to plant a mango grove entitles the benefactors to everlasting reward, more especially if the planting is sanctified by the ceremony of marriage. The consequence of this feeling is—and it is the most sensible result with which I am acquainted in the catalogue of "good works" to be placed to the credit of the Hindoo—that all India is studded with mango "topes," or groves, many of them miles in extent, and all of them presenting a luxuriant mass of unfading green, in picturesque and graceful contrast to the parched and arid ground which the adorn. It is, in fact, a most important gift of our all-bountiful and teeming mother, and the Government of the country might have done incalculable benefit to the nation by paying some attention to its propagation and culture.

The following extract from "Sleeman's Rambles and Recollections" will, perhaps, interest you. Speaking of some mango groves which he had seen, he says:—

"Some of these groves hsd already begun to yield fruit, and all had been married. Among the Hindoos, neither the man who plants a grove, nor his wife, can taste of the fruit till he has married one of the mango trees to some other tree (commonly the tamarind tree) that grows near it in the same grove. The proprietor of one of these groves that stands between the cantonment and the town, old Berjore Singh, had spent so much in planting and watering the grove, and building walls and wells of pucka masonry, that he could not afford to defray the expense of the marriage ceremonies till one of the trees, which was older than the rest when planted, began to bear fruit in 1833, and poor old Berjore Sing and his old wife were in great distress that they dared not taste of the fruit whose flavour was much praised by their children. They began to think that they had neglected a serious duty, and might in consequence be taken off before another season could come round. They therefore sold all their silver and gold ornaments, and borrowed all they could, and before the next season the grove was married with all due pomp and ceremony, to the great delight of the old pair, who tasted of the fruit in June, 1834. The larger the number of Brahmans that are fed on the occasion of the marriage, the greater the glory of the proprietor of the grove; and when I asked old Berjore Sing during my visit to his grove how many he had feasted, he said, with a heavy sigh, that he had been able only to feast 150. He showed me the mango tree which had acted the part of the bridegroom on the occasion, but the bride had disappeared from his side. 'And where is the bride, the tamarind?' 'The only tamarind I had in the grove died,' said the old man, 'Before we could bring about the wedding, and I was obliged to get a jasmine for a wife for my mango. I planted it here so that we might cover both bride and bridegroom under one canopy during the ceremonies, but after the marriage was over the gardener neglected her, and she pined away and died.' 'And what made you prefer the jasmine to all other trees after the tamarind?' 'Because it is the most celebrated of all trees, save the rose.' 'And why not have chosen the rose for a wife?' 'Because no one ever heard of a marriage between the rose and the mango; while they take place every day between the mango and the chumbaelee (jasmine)."

I have here several sketches, more or less associated with the mango, both the individual tree and the tope. The first represents a portion of a mango tope, or grove, at Arrah, at least which was at Arrah twenty or thirty years ago, but which has long since bitten the ground, and contributed its pyretic aid in the service of the iron-horse, a fact to be debited on the wrong side of the Railway Account and Public Works Department. The second sketch represents my own encampment, at the Sonepore Fair, in 1858, shortly after I had incurred the displeasure of Government, and been removed from my office of Commissioner of Patna for my misdeeds.

Sonepore is a village, nearly opposite to Patna, and has, for many years past, been the scene of a provincial meeting at the commencement of the cold weather. From time out of mind, a native fair had been held there, where horses, elephants, cattle, and a thousand other things were collected for sale. Of later years, the European inhabitants have established a social meeting, where all the neighbouring residents—civilians, military men, judges, planters, and others, congregate—live in tents under the shade of the mango trees, and pass some fifteen days in unfailing jollity, with balls, races, games, and other festive amusements.

The trees in the sketch are young ones, very different in appearance and form from those or elder growth, which are shown in the former sketches.

The mango tope—beneficial as it ordinarily is to the people, and useful as it has proved to us—was, on one great occasion, instrumental in occasioning terrible loss to the English. In 1857, when the authorities were shut up in the Arrah garrison, and a detachment of 400 picked soldiers were despatched from Dinapore for their relief, they were waylaid by the rebels in the mango topes, which line the road in the Alahabad district, and driven back into the river with terrible slaughter. The picture represents young Ross Mangles (the son of the former East India director), who now wears the Victoria Cross, in the act of supporting a wounded soldier whom he found lying in the road in the retreat. A large picture, representing this scene, was, for some time, exhibited in the Crystal Palace; but it was totally incorrect, as it represents our young hero carrying the soldier on his back, which was not the case. My sketch, both of dead and living, was taken, strange to say, from life; Mr. Mangles stood for himself; and my son-in-law, in a military dress, stood first for the wounded soldier, and then lay down for the dead one.

The following is the account given by Sir John Kaye, in the third volume of the "Sepoy War":—

"But Dunbar determined to push on to Arrah. The moon was now waning, and, before midnight, darkness closed upon the advancing force. The Sikh skirmishers had been drawn in, and our people were moving forward, unsuspicious of the presence of an enemy, when, in the vicinity of a dense mango grove, a tremendous fire was opened upon them."

Again—

"I have said that, with Dunbar's relieving force, went Mr. M'Donnell and Mr. Ross Mangles, of tho Civil Service.

"They did excellent service on the way. The local knowledge of the former enabled him to act as a guide, and the rifles of both were in constant requisition. In the first attack on our columns, Mangles had been stunned by a musket ball; but he soon recovered himself, and was helping the surgeon who accompanied the force to bind up the wounds of his comrades, or carrying water to them in their agony.

"When morning dawned he shouldered his piece, and stepped on with the rest towards the nullahs, resolute to sell his life dearly. In the flower of his youth, a man of a fine presence, with a long stride and a firm hand on his two-barrel, our men looked to him, in the morning light, as to one who, though without official command, had natural right to be obeyed; and he did much good service as he went by his animating influence upon others and by his personal prowess.

"Though, by reason of his stature, a conspicuous mark for the enemy, and 'though dozens of poor fellows,' as he wrote afterwards, 'were knocked over close to him,' by the blessing of God he escaped unharmed. He escaped to do a noble deed. A soldier of the 37th, who had been struck down, and was left helpless on the ground, where he would presently have been murdered by the Sepoys, implored the young civilian not to desert him. So, amidst a destructive fire of musketry, Ross Mangles, the younger, halted, and knelt down, bound up the man's wounds, hoisted him on his back, and strode on with his burden. He had fasted for 24 hours, he had watched for 48; but, notwithstanding this want of food and rest, he declared afterwards that he had 'never felt so strong in his life.'"

Here are two sketches, which exhibit what may be called the only phenomenon connected with the prosaic mango. They were drawn at Mymensingh, during my period of banishment from Patna. The first shows the mango of its natural size, with its unpleasant residents; the second, which is a caricature, exhibits the companion of my exile, horrified by the sudden ebullition of mysterious inmates of the fruit, while the khansaman, or butler, behind her chair, represents in dumb show his sympathy in her alarm. The sketches are from nature, the only liberty taken being with the size of the residents in the second sketch.

I will, with your permission, read the memorandum which I wrote at the time, under the first impression created by this disagreeable little creature.

"Mymensingh mangoes deserve mention in my 'random notes,' because they are painfully, pre-eminently bad; and, on the usual principle of *quieta non movere*, nobody seems even to have attempted to improve them.

"The story is, that some unusually sacred and particularly malicious fakir, *inter sanctos sanctissimus*, having had his saintship offended in the province, got the Devil on his side (without much difficulty, it may be supposed), and cursed the mangoes; and they are cursed ever since.

"The said curse assumes the form of a malignant little beetle, which, at some period of the fruit's existence, contrives to enter, and henceforth takes up his abode, dwelling inside, with a house of pulp all around him, and apparently taking short excursions over his fruitful territories, according as his fancy leads him. The effect on the mangoes is shown in the picture, and not one in a hundred escapes the visitation. There is the fruit, showing the ravages of the accursed beetle. Here is the little black beast itself, just the style of insect that you may imagine called into existence under the anathema of a black wizard; sometimes he is white, however, and looks like a maggot made round.

"It is a phenomenon, and by no means a pleasant one for mango-lovers, for you seldom see one of the fruit here without its tenant. I have lived in many lands in India, but never saw this before, though folks say the curse extends to several districts of Eastern Bengal. I asked several zemindars, and other natives about the insect, and whether anyone has taken the pains to ascertain the cause, mode, time, or manner of its entrance into the fruit. The same inconsistent answer was received from all, 'Hum kea jani,' What do I know? What, indeed, unhappy beings! and what should you know, when you never learn anything, and your master never teaches you? This wretched apathy is the real curse and not the insect. The 'Hum kea jani' is the social blight of the Hindoo, it keeps their cattle thin, makes them burn their manure, shut up their women, and choke their sick with mud. What do they know about insect ravages? The effect on a stranger of this diabolical little scamp, who jauntily rushes out of this pulpy cave directly the mango is cut, may be imagined. As to the liberated prisoner himself, the sudden entrance into a world of light and life after such long seclusion, within its darksome cell, seems to cause him no embarrassment whatever; he enters at once upon new scenes and horribly new responsibilities with all the life and much more than the energy of some of human fruit-eaters, and doubtless fully performs his allotted task in the world, whatever that may be perhaps as effectually as the magnificent mortal, who is horrified by witnessing his intrusion into the pulp of the mango."

BANIAN-TREE.

For sanctity, size, eccentricity of growth, and other peculiar features, the banian and peepul are, *par excellence*, the trees of India. Both of them are striking in appearance, both are associated more or less with religion; each is intimately connected with the other, and in fact, they represent bride and bridegroom, when first committed to the soil by the superstitious native. I will deal with the banian, or *Ficus indica*, first:—

Speaking of this tree scientifically, I may observe that it belongs to the great family of the "urticaceæ," and is, strange to say, own cousin to that very unpleasant vegetable, the "stinging nettle." The tree, stupendous as it appears, is in truth a "fig tree," and the small red berry which it bears, and which on the emergency of a general famine, affords food to many thousands, is a miniature, but *bonâ fide* fig.

It is difficult to describe, and almost impossible to exaggerate the grandeur and magnificence of this extraordinary tree, after some years of growth. It has, in fact, formed a theme of exquisite description by some of our ablest poets, and before I enter upon a prosaic account, I will give you the poetical portraiture drawn by one or two of these celebrated word-painters.

Southey, in his "Curse of Kehama," thus writes:—

> "'Twas a fair scene wherein they stood,
> A green and sunny glade amid the wood,
> And in the midst an aged banian grew,
> 'Twas a goodly sight to see
> That venerable tree.
> For o'er the lawn irregularly spread,
> Fifty straight columns propt its lofty head,
> And many a long depending shoot,
> Seeking to strike its root,
> Straight like a plummet grew towards the ground.
>
> Some on the lower boughs, which crossed their way,
> Fixing their bearded fibres round and round,
> With many a ring, and wild contortion wound,
> Some to the passing wind, at times with sway
> Of gentle motion swung;
> Others of younger growth, unmov'd, were hung,
> Like stone-drops from the cavern's fretted height,
> Beneath was smooth and fair to sight,
> Nor weeds nor briars deform'd the natural floor,
> And through the leafy cope which bowered it o'er,
> Came gleams of chequered light.
> So like a temple did it seem, that there,
> A pious heart's first impulse would be prayer."

Referring to the sentiments expressed in these lines, it is curious that Bishop Heber, describing one of these trees, remarks, "The first impresion on coming under its shade was, 'what a noble place of worship!'" Thus unconsciously re-echoing the sentiment which has led in ages past to the worship now known to have been almost universal. Milton also thought the noble tree worthy of his pen, and thus writes of it:—

> "Branching so broad along, that in the ground
> The bending twigs take root, and daughters grow
> About the mother tree, a pillared shade,
> High over-arched, with echoing walks between.
> There oft' the Indian herdsman, shunning heat,
> Shelters in cool, and tends his pasturing herds
> At loop-holes cut in thickest shades.'

These lines are said to have been written especially in description of the "Kuveer Bur" the largest banian in the world, which is thus mentioned by Bishop Heber, in his interesting journal:—

> "Another curiosity in this neighbourhood is the celebrated bur or banian tree, called, "Kuveer Bur," from a saint who is said to have planted it. It stands on, and entirely covers, an island of the Nerbudda, about twelve miles above Broach. Of this tree, which has been renowned ever since the first coming of the Portugeuse to India, which is celebrated by our early voyagers and by Milton, and which, the natives tell us, boasted a shade sufficiently broad to shelter 10,000 horses, a considerable part has been washed away with the soil on which it stood within these few years, by the freshes of the river, but enough remains, as I was assured, to make it one of the noblest groves in the world, and well worthy of all the admiration which it has received."

There are endless phenomena connected with the life, vegetation, and growth of this tree. Two of these are especially referred to by Dr. Hooker, in his interesting work on the Himalayas. In writing regarding a well-known banian tree, which he says was still the pride and ornament of the Botanical Garden in Calcutta, he mentions two essential peculiarities, to which I shall shortly direct your attention. The first is, that the banian, unlike all other trees, hardly ever vegetates on the ground, but generally from seeds deposited by birds in the crowns of palm trees. The second is, that it throws down from the branches descending roots, or props, which, light and flexible at first, eventually become firm, and thicken into stems.

I will, in the first place, say a few words in regard to the second characteristic thus mentioned, and which, in fact, is the peculiarity which separates the "banian," and one or two of its congeners, from all other trees in nature's garden.

The phenomenon mentioned by Dr. Hooker, with respect to the vegetation of the tree on the crown of the palm, I pass over for the present, merely remarking that, although this is beyond doubt, strange as it is, the usual mode of vegetation, yet the banian is very frequently planted by the natives of India, and, when so planted, the incident is generally accompanied by all the solemnities of the marriage ceremony; an auspicious day is carefully selected, and the young couple are committed to mother earth. On these occasions the banian is universally considered as the lady, while the peepul tree, or *Ficus religiosa*, is regarded as the gentleman.

What is the cause of this distinction I have never been able accurately to ascertain, and can only conjecture the reason to be, that the banian extends her influence with so much subtlety and perseverance, sometimes like Delilah to the destruction of those whom she embraces; but the fact is undoubted. The two trees are married in due form, with all the pomp and circumstance, the music and rejoicing, of that world-wide ceremonial. Both are planted in close proximity, and, as an inveterate punster once observed to me, the "seedy couple invariably reach the honours of a green old age." It is interesting to observe them after some years of married life, when the foliage is thick, so closely united that the union is only discoverable by the different shades of green, the husband being always the greenest of the two.

The extraordinary growth of the banian is well worthy of careful observation. The three pictures which you here see, represent portions of a wonderful tree which I sketched carefully from life many years ago, in the district of Beerbhoom, in Bengal; all are parts of one and the same tree, which has stretched its multitudinous branches over an immense extent of country, and actually overshadows more than 400 temples. One of these is specially interesting, as showing precisely the manner in which the insidious feelers in their descent to earth swallow up every object in their way.

There is one other curious thing to be noted in this sketch. You will see in the centre of the picture a regular knot, the secret of which is evidently this: it overhangs the passage to the woman's bathing-place, and it is evident that some impatient damsel, not having the fear of the bur tree, or its resident deities before her eyes, and not fancying the daily obstruction which her bright eyes met with on her way to the water, tied three pendents—while yet in their infancy—into a loose knot, and the uncompromising shoots, after performing this compulsory circle, stedfastly continued their course, and reaching the ground in safety became a firm and upright pillar. But the most remarkable evidence of this extraordinary power of the pendent roots of the banian has been lately exhibited in the celebrated Temple of Juggernauth. The great Hindoo Temple of Juggernauth is notorious throughout the world. Built at a cost of half a-million sterling, it is black with age. After seven centuries, this sacred edifice, which has defied the elements and encroachments of age, has been suddenly found to be on the verge of destruction. The seeds of the banian and peepul tree have got under the foundations; the whole fabric has been loosened.

The ruin was first indicated by the fall of some large stones, just after the idols had left the temple on the last Car-Festival. Had they fallen a few minutes before, they would have been smashed to atoms.

This catastrophe has, as may be imagined, caused great consternation, and is likely to have disastrous effect on the *prestige* of the great Juggernauth.

It is a curious coincidence that the most celebrated Hindoo temple should have been thus undermined by trees held sacred, if not divine, by the whole Hindoo nation. Is it accident—or Nemesis?

Eternal Tree (Allahabad).

The superstitious reverence with which this tree is regarded throughout India has given birth, as superstition always does, to various stratagems, invented for the delusion of the ignorant multitude and the benefit of the priesthood in one of the most singular instances. This I had the opportunity of witnessing for the first time in Allahabad during the late tour of the Prince of Wales in India.

Under the large fort at Allahabad are extensive subterranean vaults and chambers, communicating with each other by narrow passages, and in one of these there grows, or are said to grow, the two stems of the eternal tree. Every year multitudes of deluded devotees flock to the city, and gladly give their little offerings for the glorious privilege of visiting, touching, and possibly carrying away a twig or piece of bark from this holy stump. The tradition regarding the tree is that it was planted at the beginning of the creation (a period in the idea of the Hindoos considerably more than 6,000 years ago), at some station in the north of India, six or seven hundred miles from Allahabad; that immediately after its birth, it extended the roots some twelve hundreds miles to the south, and reappeared above ground in the city of Gya, where it is now shown and venerated, forming an appropriate spot at which pilgrims are first fleeced when they enter the holy city. This long subterranean journey of the roots, however, was not performed without an intermediate up-rising, but the celestial tree, arriving at the sacred "Tribeni," or meeting of the waters at Allahabad, threw up within the dark subterranean vaults of the forts, two stalwart trunks, which have been there ever since, and still live to bless and comfort those who are privileged to see and touch them, and have the means for paying for it. The day I visited these wondrous trees, during the late tour of the Prince of Wales, the dark passages were crowded with visitors, odoriferous with enthusiasm, oil, and unwashed clothes; we saw and touched the stems, they were beyond doubt living trunks, and I made this sketch on the spot. The secret of this phenomenon I leave to the imagination of my hearers, but will now mention that a lady who had accompanied me to the fort, but was naturally unwilling to enter with the crowd into the unpleasant subterranean passages, obtained from a sergeant of the regiment stationed at Allahabad, a prosaic version of the mystery, viz., that every second or third year, in the dead of the night, two new stems were introduced, and represent in their turn the everlasting greenness of the eternal tree.

I am now about to show you the banian in a new phase. This sketch shows what in all probability will rather puzzle you. A date tree, to all appearance, out of the centre of a banian. This phenomenon is common throughout India, at least, wherever the palm-trees grow. In Behar, where I was for many years, it is exceedingly common. It is, I imagine, probable that anyone looking at this sketch would be inclined to say, with some confidence, that the seed of the date had fallen in the banian tree, and there taken root; the idea would be natural, but totally wrong, for the fact is precisely the reverse, as I will explain.

You will not, I hope, have forgotten what I explained to you about the endogenous or "inner growth" of the palm trees, and it is to this peculiarity that this somewhat unintelligible phenomenon, or freak of nature, is to be attributed.

Now, when we call to mind the infant exogenous or "outer growing," we cannot fail to remember the minute infinitesimal babyhood, even of the gigantic oak, on its first appearance on the bosom of the mother earth, the little tiny stem, with its still tinier leaflets scarce distinguishable from the smallest weeds around, yet holding out to the experienced eye the reality of its future grandeur. There are few of us, probably, who have not watched the gradual development of the stem and twigs, the expansion of the leaves, and all the various approaches to arborescent majority; well, all this gradual growth is wanting in the "endogenous" tree, and perhaps you will be surprised to hear that in the palm tree, the head of the infant is as large and well developed as in the aged man, and the head, once formed, employs its intellectual power in forming its own body. Remembering this, you will better understand this process which I am about to describe.

It is when the palm tree is in the period of confiding infancy that some careless bird drops the seed of the banian into the frond or upper cluster of leaves; the seed takes root, as it will do anywhere, and the first thing it does after it has germinated, is to commence the ungrateful work of destroying its infant cradle by sending forth its shoots downwards towards the roots of the imprisoned victim.

Meanwhile both trees grow, the palm tree perpendicularly, from within, struggles to the skies, the banian pushes forth its powerful branches on either side, while its tendrils, those "daughters" whom Milton describes, steadily perform their deadly task, gradually interlacing themselves over the lower portion of the prisoner till it is concealed from sight.

This process continues for years, but always has one termination, the embrace of the banian, mother and daughters, is fatal, and the imprisoned palm is killed—a victim of misplaced confidence.

My sketch shows the same phenomenon, but in a different stage of progress. It was taken by me when I was last in India; it is on the Isle of "Elephanta," in Bombay, and is the most perfect specimen of this kind I have ever seen. The palm tree still elevates his head, but has not many more years to live.

I would here direct your attention to a sketch, the only one not taken from nature, but copied from an engraving in Dr. Hooker's work. It represents a bridge, formed from the living pendent branches, whether of the banian, or some other species of the ficus, I do not exactly know, but I believe of the *ficus elastica*, or india-rubber trees. The picture shows the wonderful extent, pliability, and strength of these extraordinary tendrils.

This sketch shows the married couple, which I have before described, in full leaf, the diversity of the foliage being shown by a line as straight as if it had been ruled, the bright leaves of the husband "peepul" above, those of the banian below, her efflorescent vigour being evidently diverted by the tendrils which she has already cast down. This subject I obtained during my visit to Mymensingh in 1858.

The other sketch exhibits an older couple, distinguishable not by the colour of its foliage, but of the branches, those of the banian being dark, those of the peepul, comparatively white,

Peepul Tree.

The peepul, or *Ficus religiosa*, I have already mentioned, and especially as the privileged being who represents the husband of the banian when they are planted together. But its especial peculiarity is its sanctity, as the bo-tree, originally in connection with Gautama Buddha. Knighton, in his "Forest Life in Ceylon," writes:—

> "It was whilst sitting beneath a bo-tree (the *Ficus religiosa* of botanists), a tree ever since sacred to his disciples, that Gautama finally prevailed, and became the greatest of beings. Immediately previous to this consummation, he was attacked by a formidable host of demons, but remained tranquil, to use the figurative language of his biographers, 'like a star in the midst of stormy clouds,' and the demons, when they had exerted their utmost power without effect, passed away like the thunder cloud retiring from the orb of the moon, and causing it to appear in greater beauty.
>
> "At the tenth hour of the same night, he (Gautama) attained the wisdom by which he knew all things or omniscience; at the twentieth hour, he received divine eyes, by which he saw all things, or omnipresence. Omnipotence was subsequently added, and from beneath the bo-tree, the man rose with all the characteristics of a god."

To give an idea of the reverence entertained for the bo tree, the following description of the arrival of a branch at the city of Anaradhapoora is worth quoting:—

> "Thirty years afterwards, a slip of the tree sacred to Budhists, under which Gotama had attained the exalted dignity of the Budhaship, was transported with great ceremony, and the constant exhibition of miraculous power, to the capital of Ceylon, there to flourish as an object of worship to Budhists, to the present day. The branch was placed in a magnificent vessel, highly ornamented for the purpose, on the highest part of the ship that bore it to Ceylon. The vessel bearing it, we are assured, skimmed briskly over the water, impelled by the favour of its protector, and reckless of winds and currents; for twenty miles on every side the water was hushed to stillness, the most beautiful aquatic flowers sprung up in its path, and ornamented the ocean, whilst the enchanting strains of heavenly and seraphic music were wafted round the sacred vessel in its course.
>
> "Tisso, at that time king of the island, received the precious relic, with all the honour due to such a miracle-producing object.
>
> "'At the time when shadows are longest,' says the Singhalese historian, 'the monarch entered the superbly decorated capital by the northern gate, in the act of making offerings, and passing in procession through the entire city and out of the southern gate, he entered the Mahamgo garden, the garden which had been hallowed by the presence of four successive Budhas. There, with sixteen princes, his sons, he raised up the bo-tree upon the very spot in which it had been planted in former ages."

The same writer says:—

> "The sacred 'bo-tree' is still an object of worship in Anarahdapoora. It is stated by the priests to be two thousand three hundred years old; and it certainly has all the characteristics of extreme age."

The same author, writing of a celebrated saint, says:—

> "From this wonderful reformer's hair a tree sprang, says tradition, bearing a Thibetian character, that is a character in the sacred language of Budhism in these regions, on every leaf.' 'Nonsense' says the European reader politely. But, here are two French missionaries

of learning, intelligence, and experience, who saw the tree with their own eyes, who saw the characters, and are unable to explain the matter at all, but hear their testimony in their own words:—

"It will here be naturally expected that we say something about this tree itself. Does it exist? Have we seen it? Has it any peculiar attributes? What about its marvellous leaves? All these questions our readers are entitled to put to us.

"We will endeavour to answer as categorically as possible.

"Yes, this tree does exist; and we had heard of it too often during our journey not to feel somewhat eager to visit it. At the foot of the mountain on which the lamasery stands, and not far from the principal Buddhist temple, is a great square enclosure, formed by brick walls.

"Upon entering this, we were able to examine at leisure the marvellous tree, some of the branches of which had already manifested themselves above the wall. Our eyes were first directed with earnest curiosity to the leaves, well-formed Thibetian characters, all of a green colour, some darker, some lighter than the leaf itself.

"Our first impression was a suspicion of fraud on the part of the lamas; but, after a minute examination of every detail, we could not discover the least deception.

"The characters all appeared to us portions of the leaf itself, equally with its veins and nerves. The position was not the same in all. In one leaf, they would be at the top of the leaf; in another, in the middle; in a third, at the base, or at the side. The younger leaves represented the characters only in a partial state of formation.

"The bark of the tree, and its branches, which resemble that of the plane tree, are also covered with these characters. When you remove a piece of old bark, the young bark under it exhibits the indistinct outlines of characters in a germinative state; and, what is very singular, these new characters are not unfrequently different from those which they replace. We examined everything with the closest attention, in order to detect some trace of trickery, but we could discern nothing of the sort; and the perspiration absolutely trickled down our faces under the influence of the sensations which this most amazing spectacle created. More profound intellects than ours may, perhaps, be able to supply a satisfactory explanation of the mysteries of this singular tree; but to us, we altogether give it up. Our readers possibly may smile at our ignorance, but we care not, so that the sincerity and truth of our statement be not doubted."

A few days ago I was talking with Dr. Hooker on the subject of this phenomenon, and his explanation was certainly not in accordance with the poetical or superstitious idea thus represented by these travellers. He said that the whole appearance of these divine inscriptions was caused by insects. Such an explanation coming from such authority must be conclusive to the matter-of-fact inquirers, but a great damper to the romantic. The remaining sketches show some rather noticeable trees, which, however, I shall not have time to describe at length. They are the

1. *Adansonia digitata*, or "Baobab," familarily called monkey bread-fruit tree.
2. The silk cotton tree, *Bombax malabarica*.
3. A Ficus, exact species unknown, at Malabar Point, Bombay.
4. Peepul tree, at Patna, which has thrown out horizontal branches like the banian.
5. *Borassus flabelliformis*, or "fan palm," with man cutting the tree for the toddy.
6. Trees in the grounds of the Governor of Bombay, at Malabar Point. They are a species of "Ficus," and being exposed to the sea breeze, they have all bowed themselves to the wind, exactly at the same height, and thus present an uniform slope, which, viewed from one end, presents the appearance of a grass bank.

I took a sketch of the peepul when I was last in India, as the tree is in itself a phenomenon. In its ordinary growth, as I have shown, the branches of the peepul rise more or less perpendicularly, while those ofthe banyan are thrown out horizontally, but are supported at intervals by the pendent tendrils which they throw down. This tree, the husband of the banian, has clearly imitated his better half, and how long the branches will be supported without its props, future visitors may tell.

Adansonia.—Monkey bread-fruit tree. This is an enormous tree, native of Africa, *Adansonia digitata*, is so called from Michael Adanson, a French botanist. To the negroes, the *baobab* is perhaps, the most valuable of vegetables. The leaves are used for leaven, its bark furnishes indestructible cordage, and the bees form their hives in the cavities of its trunk. The negroes, too, often shelter themselves from storms in its time-worn caverns. The baobab is indisputably the monarch of African trees. Several measured by Adanson were from sixty-five to seventy feet in circumference, but not extraordinarily high. The bark furnishes a coarse thread, used in Africa for cloth and ropes; the small leaves are used as bread in times of scarcity, and the large, of covering their houses, or by burning, for the manufacture of soap. This tree may be styled the Juggernauth of the forest from the style in which it grows, its large branches terminating in an abrupt end, from which the small branches are given off. Ropes made of the baobab tree are indestructible; there is a saying, "As secure as an elephant bound with a baobab rope."

Adanson supposed this tree to exceed almost any other in longevity. He inferred that the one he measured, and found to be thirty feet in diameter, had attained the age of 5,150 years. Having made an incision to a certain depth of a stem, he first counted 300 rings of animal growth, and observed what thickness the tree had gained in that period. The average rate of growth of younger trees of the same species was then ascertained, and the calculation was made according to the supposed mean rate of increase.

Cotton Tree (Bombax).—One of the most striking and picturesque trees in India is the silk cotton tree—Bombax. Its peculiarity is that its flowers, which are large and of a brilliant red, do not deign to share the admiration of the spectators in company with the leaves, but withhold their splendour until the leaves have fallen off, when they burst forth in inconceivable splendour one mass of burning crimson, producing an effect in the midst of the green trees around, that is easier conceived than described.

Its exceptional peculiarity, however, is its root, which, differing from all other roots, divides itself into thin layers, which are cast in the most fantastic shapes. Here are the sketches:—1. Without flowers. 2. With flowers just opening. 3. Celebrated tree at Kishnaghur with flowers.

Having now shown you some of the eccentricities of Indian trees, I would wish to lay before you one or two very remarkable instances of the same wondrous power which we have seen exerted in the roots and tendrils of Indian trees, exhibited in those of English growth, showing that the powers of nature are much the same in every quarter of the globe, though modified by the accidents of climate and position, and also that the marvels or eccentricities of tree growth are connected with superstition not in oriental countries only, but in the most civilised of European nations. I daresay some here present will have heard of the very strange incidents connected with the tomb of Lady Anne Grimston in Hertfordshire. As far as I have been able, after much inquiry, to ascertain, Lady Anne Grimston was, if not an unbeliever, at least a sceptic, and was occasionally heard to say that she would as soon believe that trees would, after her death, grow out of, as some say, her heart, others her tomb, as that there should be a resurrection of the body from the grave. Lady Anne Grimston, as had her ancestors before her, died; she was buried, and a substantial tomb enclosed with an iron railing, was erected over her remains. A few months after burial seven small saplings of an ash tree appeared close to the tomb; they were allowed to grow; superstition probably preventing all interference; they grew, and after some time they raised the solid tomb some distance from the ground, at the same time supporting it with their branches, and at the present time, in exact accomplishment of the alternative suggested by Lady Anne, seven full grown ash trees are in full foliage around the tomb, the principal tree having germinated from that part of the tomb in which the heart of the deceased was situated.

One other remarkable instance of mysterious, or at least unaccountable growth, is now, and has for many years, attracted attention and surprise at Ross, in Herefordshire. The story, which has been related to me by several eye-witnesses, is this—

The Man of Ross is a name and character which has been immortalised in the well-known lines of Pope. He was peculiarly partial to the elm tree, many of which he had cherished with peculiar devotion. So long as he lived, no one presumed to interfere with his cherished favourites, but after his death several trees made their appearance at the door of the church, gradually forced their way into the interior, passed through the man of Ross's pew, and grew up together inside the church, where they are still growing side by side, occasionally lopped when rising so high as to touch the roof.

Whatever may be thought of these two incidents, whether the supernatural had ought to do with the physical facts, or whether the peculiarity of the natural events have given birth to the miraculous interpretation, I may fairly leave to the consideration of my hearers. But they are interesting in connection with my present subject as showing how readily, even in the most civilised times, trees in the power of their growth are brought into relationship with the marvellous.

One disgusting instance, in which the marvellous power of vegetable growth was utilised in the work of cruelty, was lately related to me by a friend who heard it from an eye-witness :—

> "A criminal in Burmah was sentenced to torture. He was placed on a spot of ground, his arms were tied over his heart, and his legs drawn apart, a thorny bamboo was planted under him. He was kept alive until the tree grew, and was subjected to the awful tortures of the bamboo gradually growing around his legs, and day by day inserting its thorny ends into his flesh."

The other English trees, of which you see the sketches, are a cork tree, said to have been planted by Bishop Ridley, now in the grounds of the Bishop of London's palace at Fulham; and the other, a mulberry tree, to which it is said that Bishop Bonner used to tie the heretics for the purpose of scourging them.

And now, as I conclude my paper, perhaps some may ask what is the use, profit, or purpose of such an exposition. Why need we, as rational beings living in the nineteenth century, and some of us, perhaps, painfully convinced that we are, after all, a mere accidental product of fortuitous atoms—the lineal descendants of the "fungus"—and only a few generations removed from the monkey—why should we take interest in the eccentricities of trees, or care whether branches or roots follow their ordinary modes of growth, or deviate into irregularities? Why care whether barbarous or civilised victims have in their ignorance and superstition attributed supernatural attributes to the tree, worshipped the ill-shapen stump, or trembled at the quivering leaves?

Such a question is what might be expected in this critical age, but to this I would deferentially answer, that the eccentricities of trees are so far useful that they attract us, to the more careful study of the processes of nature and the works of the Creater, which we ordinarily regard as matters of course; and secondly, that those superstitions, irrational and absurd as we deem them, are yet to some extent indications of that universal aspiration after the unseen, that irresistible consciousness of a future and spiritual life, which, in the present sceptical and materialistic age, is especially valuable. And it may be fairly said that if there are "Sermons in Stones," the tree in its wide circle of miraculous developments may be accepted as a preacher, and in the universality of the reverence which has through all ages and all lands, from "Abraham's oak" to the "Fetish tree" of Coomassie, been bestowed upon it. We may recognise and profit by the eloquence of its silent address, and, while we delight in the beauty of its leaves, the luxuriance of its branches, and the solemn grandeur of its shades, we may hail it as a powerful and living witness to the great truth of a future world, and the reality of a life beyond the grave.

DISCUSSION.

The Chairman said Mr. Tayler's paper—on a very interesting subject, indeed—had opened up a wide field for discussion. He knew there were several gentlemen present who could add information on the subject, and no doubt the meeting would be very glad to hear their remarks.

Mr. Fitzgerald asked if it was positively known whether any of the trees spoken of in India were of very great age?

Mr. Tayler stated that some were said to be of fabulous age, particularly the Kuveer Bur in the island he had mentioned, in the River Nerbuddah, which was said to be some 5,000 years old. That was a banyan tree, which spread over the whole island.

Mr. Fitzgerald inquired whether it was known to be actually the same wood, or whether it was a renewed production?

Mr. Tayler replied that nobody could say. Each of the delicate fibres that sprang forth descended and touched the ground, gradually hardening and enlarging into a fresh stem; they were all part of one and the same tree, but nobody could point to the original tree itself, or say what its age really was. The original tree might have disappeared altogether. It was quite old when Milton wrote the lines he had read, which were, in fact written about the very tree.

Mr. Fitzgerald said that was only 200 years ago. Was there evidence that it had existed there for 2,000 years?

Mr. Tayler said undoubtedly for many more. They, of course, had only ocular evidence from the tree itself beyond tradition, and what all the people there said. From all that appeared, it might have existed from the beginning of the world, because it propagated itself dying and leaving children which it was impossible to distinguish from the parent.

Mr. Hale, thanking Mr. Tayler for his valuable paper, had not been aware until he heard it read that there was so much to be said connected with trees. He was not previously aware that these trees were so worshipped as they appeared to be in India. Nor had he ever heard of the curious marriage ceremony described.

The Chairman, obtaining no response to his invitation for further remarks, would with permission say a few words, first returning the best thanks of the meeting to Mr. Tayler for his charming paper, the interest of which had been materially enhanced by the illustrations from his own pencil of the subjects he had so graphically described. In listening to the paper, many like himself must have had objects familar to them through many years most pleasantly recalled to memory, and they must have also desired to witness for themselves these beauties of nature. Mr. Tayler had touched but one feature only of an exceedingly interesting subject, a very large one, to do justice to which would require many lectures. He alluded not merely to that particular subject of the banian or ficus or peepul trees, but to that of forests generally, not only in India, but throughout the world, though perhaps especially to the importance of those in India, lying within the tropics, and with its vast expanses of its arid lands where the earth is as iron and the sky as brass, and, every tree, therefore, of tho highest importance and to be highly valued, in such countries especially were forests of benefit. India happily abounds in forests, although there are many large tracts of country, as for example Scinde, part of the Punjaub, and elsewhere in central India, which are almost rainless, and with very little vegetation, yet on the slopes of the Himalayas and other mountain ranges, on the detached hills in central India, in the Deccan, and along the eastern and western Ghats, there are grand primeval forests—many parts of which probably no human foot has trod—great sources of wealth lying as yet undeveloped. Still part of thom had within the last 20 or 30 years come under the consideration of the Government, which had at last recognised their value not only for timber for house and ship-building, for railway sleepers, and tho many purposes for which the workman requires wood, but also for their general essential importance to the human race. The benefits of forests were great, and of more than one character. First might be mentioned their direct value as timber for fuel, for their fruits and products, such as india-rubber, dyes, and other productions it would take too long to mention. They also provided grateful shade to the people, and there were other important advantages not perhaps so immediately recognised, but of wide application. Much, no doubt, was due in the growth of forest vegetation to the physical attributes of climate and soil. The forests covered the mountain slopes down which rapid torrents rushed, irrigating the plains and swelling the great rivers which rolled from north to south until they poured their waters into the ocean, and if it were not for the trees clothing the sides of the hills, those waters would rush down in devastating torrents, tearing down bridges, overthrowing buildings, and carrying everything before them. Thus they retained and diffused moisture of which otherwise the country would be deprived, and consequently rendered sterile. The presence, then, of trees and vegetation on the hill sides had the beneficial effect of impeding the downward rush of the streams, as well as moderating and regulating the supply of water to the plains, and they influenced the surface drainage, preventing those sudden torrents which would follow from denudation of the mountain slopes. They supplied a moderate quantity of moisture during the rainy season, and they retained sufficient, holding it fast, as it were, to supply the canals and reservoirs where irrigation was required during the dry season. He could give no better illustration of the relative influence of moisture upon vegetation and of vegetation upon moisture, than the district of the Terai, a tract of land from 15 to 30 miles in breadth, lying along the margins of the lower ranges of the Himalayan chain of mountains. Beyond that lay another district of about the same breadth, called, in the native dialect, the Bahadar. That, in fact, was one great filter-bed of sand and vegetation, through which the descending water slowly permeated. The water passed down through the earth until intercepted by a bed of clay, and then reappeared on the surface in the form of springs and wells—a general diffusion of the subsoil moisture. That belt of land, the Terai, was full of magnificent forests, and it would at once be seen how much they must influence the surrounding country by their effect upon the supply of water to the streams and to the country generally. It would take too long to detail, even if he were able, the various wonders of that vegetation which Mr. Tayler had left undescribed. That gentleman had told them of the glories of the banyan and the peepul—both trees of the fig tribe—and he had also alluded incidentally to another, the *Ficus elastica.* The tree bridge from which a drawing of Mr. Tayler's had been taken, he had himself crossed. It lay among a range of hills to the south of Burrampooter. There grew one of these trees, sending down its airy shoots, which had been so trained as to form a bridge, over which the people passed, and even great weights could be carried. Indeed, such bridges were not uncommon. Then, the india-rubber tree produced an important article of commerce, which had day by day become more valuable for many purposes; so much so, in fact, that it had been deemed necessary to import other kinds of india-rubber producing trees into India. It had been said that the Para tree had, accordingly, been largely imported, and it promised to produce as good india-rubber as the *Ficus elastica.* They had heard also from Mr. Tayler, among other species, of the cotton tree, or seemul, which, as that gentleman had told them, they were not to mistake for the common cotton shrub, for it was a grand, towering tree. No words could paint the picture presented by that tree in the month of April, when covered with its mass of crimson flowers, which only appeared after the leaves had fallen. Other magnificent trees, the *Butea Frondosa,* also bore brilliant scarlet blossoms; and there was the *Rotifera tinctora,* with its beautiful red berries, all presenting a brilliant blaze of scarlet at the same period. The great forests and woods existing in that part of India, and also extending to the south, with their ever-changing summer and autumnal tints, were rivalled only by the great tropical forests of America. Those all produced valuable timber, the ebony among the rest. South of the Nerbuddah the teak was found and also in Burmah. That tree was now being carefully cultivated in India where several plantations of it had been laid out. Then it had been found that the mahogany of Honduras throve in Bengal—so much so, that when during the great cyclones of 1864 and 1868, when some magnificent mahogany trees were blown down they were sold to the timber dealers at Calcutta for the same price as was fetched by the Honduras. It seemed a thousand pities that many kinds of trees had not been cultivated in Bengal, which might have been planted here and there, because plantations had succeeded where they had been tried. In the Nilgerries another valuable tree had been imported—not so valuable perhaps as had been anticipated—the *Eucalyptus,* or blue gum tree, to which all sorts of virtues had been attributed. Its chief merits were that it yielded good wood, gave excellent shade, and was indeed an ornamental tree. Where such trees were, certain morbid and mephitic conditions of the atmosphere would be counteracted. As to the medicinal virtues attributed to it he would give no definite opinion. Then there was the cinchona, a very valuable tree now growing on many of the hill-ranges of India both in the south and in Bengal towards Darjeeling, and many others too numerous to detail. Those vast forests, great sources of national wealth, were all but unknown in their value, and were uncared for until about 30 years ago. In or about the year 1846 the Government of Bombay first deputed Dr. Gibson to assume some sort of supervision and care over these forests with the view of providing wood for the dockyards. The supervision then extended to Madras and from Dr. Gibson passed on to General Cotton and Colonel Michael. With them was afterwards associated Dr. Kleghorn, and now happily the whole forest system of India was more or less under supervision. A large tract of forest country had been demarked and laid out, and (speaking under correction) some 6,000,000 or 7,000,000 acres of forest had been brought under the supervision and care of the Forest Department; but there were still endless tracts of forest which were untouched, and lay beyond the supervision which the civil officers could give to them. However it was well that so much had been done, and since these forests had been preserved by the conservancy, great grass fires no longer took place, the air was no longer dry and arid, the young trees were no longer scorched, nor the old trees burnt. Further, they promised to give a good supply of timber, as it had been found in more than one of these districts that the returns had more than justified the outlay made in the experiment; indeed, where £15,000 had been expended, £30,000 had been returned. Speaking of the Oudh forests, with which he had been most familiar, it was an exceedingly satisfactory thing then to know that such was the case, and to know that these great sources of national wealth were no longer to be left undeveloped. There were other subjects of great importance to India, but none more important than this, not only for its direct bearing on the supply of timber and fuel, and the immediate wants of the individual, but for the great effect it must have on the climate and physical attributes of the country generally. Mr. Tayler had alluded in the earlier part of his paper to the ancient traditions and religious notions about trees. He had spoken of them as being surrounded by mystic ideas and reverenced with a superstitious regard, which, in fact, had become a sort of culture or tree worship. Those things had altogether passed away here with the Druids, or remained only in the children's Christmas-tree, or the holiday associations of the May-pole. Still they had not perhaps altogether disappeared from other parts of the world, and they certainly remained yet in India, and the Adansonia which had been spoken of was still regarded with superstitious awe, and looked upon as the abode of a dryad or wood nymph, or demon, or something of the kind. But although we had ceased to regard with superstitious awe the tree, it was still reverenced among us, because looked upon as one of the best gifts Almighty God had given. Think what we should be without it in this country! And that was but little even, compared with what it contributed to the general benefit of the whole human race. He would say with the quotation given by Mr. Tayler, "meddle not in the mystic and superstitious," but he still might say that "the leaves of the tree are for the healing of the nations."

Sir Geo. Campbell, M.P., had been very much gratified by the interesting manner in which Mr. Tayler had recommended the subject of trees, and the tree interests of India, not only to the gentlemen, but to the ladies assembled. They were also very much obliged to the chairman for the practical view he had given of the subject. The Society of Arts was perhaps more inclined to look at the matter from a practical point of view, and would endorse all that had been said. Both Mr. Tayler and the chairman had drawn attention to the great importance of the subject. Perhaps, however, the chairman had taken too sanguine a view of the work of the Forest Department for India, and though quite agreeing with his estimate of the value of what they had succeeded in preserving and supervising, it might be said they had come in to shut the door after the steed had been stolen; or in other words, after nearly all the most valuable timber in India had been destroyed. It was to be feared that as long as the exertions of the Forest Department were turned only to preservation they would find that there was not much left to preserve of the original timber, and second growths would never be so valuable. But though it might be impossible to restore the forests of India, second planting could be successfully carried out, as it had been elsewhere; as for instance, in the teak forests of the south. Allusion had been made to the extension by artificial planting of such trees as that which produced that great and most valuable article of commerce, india-rubber, and probably it was the case that the savage tribes to whom its production was due did destroy the trees in a very lamentable manner. In India there was always the great advantage that the climate produced timber with extreme rapidity. Those accustomed to tree planting in England knew how slow was the growth of timber, so that when a man planted, it was not himself, but his sons and grandsons, who reaped the benefit; but it was far otherwise in India, and if the system were followed out there of planting timber, teak, india-rubber, and other trees, a satisfactory result would be obtained. He would prefer its being done in comparatively small spaces to the grand preservation of 6,000,000 acres, which had been described, as probably that preservation had been attended with some over-zeal on the part of the Department, and, perhaps, injustice and disregard to the rights of many classes in India. He concluded by moving a vote of thanks to Mr. Tayler for his interesting paper.

Mr. Botly, in seconding the resolution, said the allusion Mr. Tayler had made to the action of the Government in fostering plantations in the country, was especially valuable in connexion with the projects for irrigation and the like for the benefit of India, which they had so often heard discussed in the room.

Mr. Tayler, in acknowledgment, felt after the chairman's able speech, that his paper had been like one of the tendrils of the banian, which take root and afterwards become trees themselves; his paper had taken root in the brain of the chairman and had produced very solid results indeed. He would not say he felt like the African lion who heard another lion roar, gave one in answer, and thought the last much louder and better. Indeed, he had really listened with very great interest to the chairman's remarks on the trees of India, and begged to return the meeting his most hearty thanks for their attention.

Mr. James T. Wood writes:—"I am sorry that absence from town will deprive me of the pleasure of hearing

Mr. Tayler's paper. I had hoped to draw the attention of the meeting to the protection which the forest of the Sunderbunds affords against the cyclone waves of the Bay of Bengal. This forest, described as nearly 200 miles in length by 50 miles in breadth, skirts the sea shore and crosses the delta of the Ganges, extending from the mouth of the River Hooghly on the west to the mouth of the River Megna on the east, which last was the scene of the late fearful disasters. A series of extraordinarily high waves, when the momentum of the waters is kept up by a cyclone such as has been known to blow the largest ships high and dry on the land, will roll on for a very long distance over water, or over smooth land; but, if the waves were broken by an elastic breakwater, the momentum would be checked, and the water would find its level by a gradual flow. The forest of the Sunderbunds affords such a breakwater, and even if a cyclone wave were to cross its whole breadth, the energy of the wave would thereby be so diminished as to afford the inhabitants of the country more inland plenty of time to save their lives and property from the slowly rising and temporary inundation. The French engineers planted the shores of the Bay of Biscay with pine forests, with the object of preventing the sand being blown into the interior, and the operation was attended with perfect success. If these views be correct, not only should the forests of the Sunderbunds be carefully preserved by the Government, but broad belts of additional forest should be planted parallel to the tidal course of the Rivers Hooghly and Megna."

EXTRA MEETING.

The discussion on Captain Tyler's paper on "Continuous Breaks," was resumed on Tuesday evening, the 18th inst., W. Galt, Member of the Royal Commission on Railway Accidents, in the chair.

The Chairman remarked that the meeting was not called to discuss the merits of any particular break; the object of the meeting, and the object of Captain Tyler, was rather to discuss the different properties that a break should possess than in reference to any individual break. There was in that view a very wide field opened for discussion. Whether the hydraulic break, or the vacuum, or air break, or the ordinary hand break, was the best, were important questions, and a great deal might be said of the different qualities which these appliances should possess.

Mr. F. T. Haggard said of course they always felt indebted to Captain Tyler for the exertions he had made at all times on behalf of the public to recommend and introduce appliances which he would style "life-saving." The British public had been nursed in the cradle of locomotives. Messrs. Lawford and Horton's report showed that England had beyond dispute the finest train service in the world, and they would all resolve as Englishmen to keep it. Some, as a panacea against accidents, said (and he had conversed with railway directors and managers on the subject) that we should make a reduction in speed, but he would ask anyone in the room whether he would be willing to come to that idea. He was ready to battle the proposition on any ground, that at a high rate of speed, if the continuous break were adopted, the public would be safer going at a speed of 60 miles an hour than they would be at 30 with the old system of hand breaks. As he was not able to speak practically on the point, however, perhaps Captain Tyler would say whether he was right or wrong. Passenger traffic in the United Kingdom was rapidly increasing; there were something like 800,000,000 trips made on the railways in a year, or something approaching that number, and if only one minute of time were saved in each of them no less than 555,000 days would be gained; though a minute did not seem much in itself, in the aggregate it counted. Captain Tyler then had with that view advocated the use of the continuous break as one of the most valuable additions to our railway improvements, and in one of his reports occurred the following passage:—"There is indeed one great requirement which has not progressed as much or as rapidly as might have been desired, and which has got to be generally adopted, viz., an improved application of break power to railway vehicles. When a form of continuous break could be decided upon, cheap in construction, simple in action, easily adjusted, not requiring frequent repair, not liable to get out of order, applied at the will of the engineer, and available in each part in the event of the train being suddenly divided, with those and numerous other properties which a good break ought to possess, then a very great step would have been made towards safety and efficiency in railway working." That recommendation must command the assent of every thinking man. During the last few years, engineers and locomotive superintendents had been viewing this matter in the same light; for they were fitting up and experimenting with continuous breaks of various kinds. He agreed, however, with Captain Tyler, that engineers and superintendents would never agree on one idea, and probably there would be in England three or four sets of continuous breaks in operation, which would be all the better for the respective inventors. The other day he heard from a railway director that he was very sorry to hear that there was a probability of continuous breaks coming into use; and the chairman of one of the largest companies said he believed they would lead to more accidents than they would save. What should put such an idea into their heads? The Royal Commission had advised railways to adopt a break which would pull up in 500 yards, and many, he believed, would do it in less than that. The idea was that an engine-driver would come into a station at 60 miles an hour, trusting to pull up his train with the break. But engine-drivers ought not to be allowed to use machinery in that way. With a continuous break, it might act for a thousand times, and the thousand and first it might fail and lead to an accident. No machinery could be so perfect as to be safe against any accident; and during the thousand cases in which it worked properly, it might save many accidents by pulling up in front of an obstruction. Some breaks had been long enough in use for engineers to be fully aware of their merits, but you would never find a railway fitted up with any new break until it had been in use for at least a twelvemonth. The railway companies of the kingdom spent annually about three-quarters of a million in compensation for accidents and damage, besides the loss they sustained in the destruction of their own rolling-stock. If, then, the companies spent 14 millions in doing away with these accidents, they would lose nothing, and the lives of the public would be saved, which was by far more important than any monetary considerations. In conclusion, he thoroughly endorsed Capt. Tyler's view. The Royal Commission recommended that a break should be adopted which would pull up a train in 500 yards; and, if an accident were to happen which it was proved could have been prevented by such a break, he pitied the company when the jury came to award damages. Juries rode by rail, and he believed that no law would be so effectual in bringing a good break into use as this power of awarding damages. He was sorry they were going to lose Capt. Tyler from the Board of Trade; but, if he associated himself with any particular break, he was quite sure it would be because he considered it the best, and no one could be a better judge. He had offered to fit up, at his own expense, a continuous break on the railway on which he travelled; but the company did not even answer his letter.

Mr. Lewis Olrick said Capt. Tyler had so well described what a break ought to be, that seeing, according to the Chairman's ruling, particular breaks were not to be mentioned, he had put the vacuum break on the discussion. He was quite independent of any break patent, but he was an engineer who had whistled on the foot-plate, therefore had some practical experience, and had taken a great interest in the trials of the various breaks. The first point was that the break should be under the control of the engine-driver, who should have the entire responsibility for the train, and in that he quite agreed; the driver ought to be the captain of the ship, while the guards were in the position of first and second officers. But he thought they ought to be a superior class of men, better paid, who were all mechanics. This was the case in America, where they had a better class of men. The next point was that the break should be automatic, and this was most important, because sometimes an accident might happen before either driver or guard was aware of it. Then Captain Tyler said that the break blocks should be held away from the wheels, so that if the machinery failed, the blocks should fly on the wheels, and stop the train, and avoid the fatal results which unfortunately happened too frequently. Another great advantage of tho blocks being held away from the wheels, was that the train could not start if the break was not in order. The next point was the promptness of action in applying the full force of the blocks to the wheels within a few seconds after the application of the break. Some people might not realise the importance of these few seconds, but a few figures would show the value of this point. At 60 miles an hour, a train went 88 feet per second, and would run 26,936 feet before it came to a stop, which, with ordinary train resistance, would be in about ten minutes. If, however, you could apply a break power equal to one-tenth of the weight of the train, it would stop in 1,200 feet, in 27 seconds. If twice that pressure could be applied (which he did not think was possible at present) it would stop in 600 feet, and in 13½ seconds. The ordinary speed of a train was about 50 miles an hour, or 83½ feet per second, and the train would be brought to a stop in 836 ft. if one-tenth part of the weight of the train could be brought to bear upon it. Therefore, if three or four seconds were wasted before the break-power was applied, that meant so many times 83 feet towards the ruin and death of many passengers. The next point was simplicity of working, which, as had been explained, was not the same as simplicity of construction. In this was involved the question of breaking up and re-making of trains, which, in ordinary working, was a matter of great importance, and must be taken into account in choosing a break. Captain Tyler had also pointed out that durability and cheapness of maintenance were of more importance than the first cost. The constant employment of the breaks was also mentioned, and no doubt when an engineer was in the habit of using a break, he got accustomed to it, and would not be likely to fumble at a moment of danger. It was also necessary that there should be indicators, showing at a glance the condition of the break-power, quite as much as a gauge to show the pressure in the boiler. Mr. Danby Seymour considered it very extraordinary that railway companies had not done something to compare the merits of the breaks now before them, but the fact was that in 1875 a number of trials were carried out under the auspices of the Railway Companies' Association, to afford information to the Royal Commission inquiring into railway accidents, and was under the superintendence of Mr. Woods, C.E., and Colonel Inglis, and the experiments were carried out with the greatest care; in fact, they were the best which had been made up to that time. He had in his hand a table showing the whole of the results in such a manner that any impartial observer could see which was the best. At the trial there were present one of Clarke's chain breaks, Smith's vacuum break, the Westinghouse automatic break, the Westinghouse vacuum break, the Steel-McInnes's air break, Clarke's hydraulic break, Fay's break, and Barker's hydraulic break. There were eight kinds of break tried under exactly the same conditions on the same line, and with the same gradients, by men competent and impartial, the trains being made up of two vans and 13 carriages, besides the locomotives. He would not tire the meeting by going through all the experiments, but refer only to one or two which gave results more than equal to ordinary requirements in stopping trains. In one of the experiments he spoke of, the signal was given by tho rear guard or at some intermediate point in the train to the driver, which resulted in the immediate application of the break. Another was made for the purpose of showing that the train could be stopped by means of the continuous break applied from the rear. After carefully digesting the tables, he had arrived at a conclusion as to the best break, but supposed he could not make the comparison, as the chairman had deprecated the mention of names. But as the chairman was not in that position on the last occasion, he would state that Captain Tyler had requested that they would fearlessly tell him the faults of the break as well as its good qualities, and he did not think he should be doing any harm by stating the opinion he had formed on the result of the experiments made by the Royal Commission.

The Chairman thought it as well not to mention names or make depreciatory remarks, but that whatever good qualities might be possessed by the breaks should be pointed out.

Mr. Olrick, in continuation, said that since those he had mentioned, another very valuable experiment had been made on the North British Railway with the Westinghouse automatic break and Smith's vacuum break, a trial which in one respect was more valuable than those carried out by the Royal Commission, inasmuch as an instrument was used for measuring the speed of the train, and also the number of feet it passed over before it came to a stop, two matters of the greatest importance to have carefully registered. But the train had only break blocks put on one side, and although excellent results were given, if break blocks had been used on both sides of the wheels, better would have been obtained, and less strain would have been thrown on the wheels and axles. As he was not to be at liberty to mention names he would say no more.

Mr. Herbert Harris said the last speaker had spent a good deal of time in telling the meeting what they already knew from the professional papers. Captain Tyler certainly in the previous discussion came forward and said in a straightforward business-like way that he had an offer from Mr. Westinghouse to join him, and that he would be obliged to any gentleman who would discuss the merits of that break or any other; but it seemed now they were not to do so. Captain Tyler had laid down several conditions with which he said continuous breaks ought to comply, and the first question which suggested itself upon those conditions was whether they were the really true and necessary requirements for a continuous break or not; and next whether the Westinghouse or any other break complied with them.

The Chairman said that was a very proper subject for discussion, whether any particular break offered superior advantages over another. It was only desirable to avoid mentioning in disparaging terms any, excepting perhaps the Westinghouse break, which Captain Tyler had offered as a subject of remark.

Mr. Harris said the first condition Captain Tyler had laid down was that of control, and most engineers would agree with him that the engine-driver ought certainly to have it, for as the previous speaker had very graphically put it, he was the captain of the ship, and as there were very few accidents on railways of which the engine-drivers would not be cognisant before anyone else, there was no reason, if there was good communication between the guard and passengers and the driver, why the latter should not be able to obviate, or at all events to mitigate them. The next point to be considered was that of the automatic action. He was not himself prejudiced on the subject, because the break he happened to be connected with possessed the automatic action as well as the direct; but many eminent railway authorities entirely disagreed with Captain Tyler on that point, men who had experience quite as large as his, and they said the automatic system was not necessary, but on the contrary it was unnecessary and unadvisable to have it. Automatic action had been designed especially to protect railway passengers, to whom Mr. Haggard had so feelingly alluded, from a class of accident which rarely or never occurred, viz., the separation of a train. He would ask any practical railway man how many instances he had known of such an accident occurring.

Several members said they had known plenty of instances.

Mr. Harris asked if they alluded to passenger trains, and said, if so, he would advise those connected with the railways on which they had occurred, to see that the couplings were made stronger. Capt. Tyler had spoken of the Heeley accident, and, perhaps, for the purpose of illustration, he might be permitted to exhibit an enlarged drawing from that gentleman's own report. [A diagram was produced.] Reliance had been placed on that plan of the site of the accident, by Capt. Tyler, to show the value of the break in case of the separation of a train. At that particular point it would be seen that the gauge widened, so that, when the express train to which the accident occurred was running north to Sheffield, the leading wheels of a Pullman car attached to it fell within the rails, and went on tearing up the line for 210 yards, while the fore part of the train ran exactly 880 yards from where the rails were torn up. Referring to the evidence then given, the second guard, who was riding in the first van, stated that the train was running about 50 miles an hour, when he felt a jerk, and immediately applied the air break, but, notwithstanding that, the front part of the train ran on for half a mile, showing the effect of the Westinghouse break when actually put to trial. Speaking for himself, he considered that the putting on of the break really caused the accident; for, if the engine, and the three carriages attached to it, crossed the defective part of the line safely, maintaining a high rate of speed and with wheels perfectly free, it was quite logical to suppose that the rest of the train would have been able to get over the obstruction, and to go on in safety. He had, in fact, been told, by an old pupil of Brunel's, that, when once riding on an engine, he came to a spot where the platelayers had taken up a length of rail, and the driver, instead of shutting off steam, crammed it on, went at the obstacle, and cleared it train and all. Therefore, he was of opinion that if the Westinghouse break had not come into operation at that particular moment, the Heeley train would have surmounted the obstruction. At all events it was clear that in that accident the break could not have been of much use. It ought to be added too that the trailing wheels were off the line at the time, and that just before the stop occurred the engine had been reversed. Captain Tyler had compared the result of the Heeley accident, as far as loss of life and property was concerned, to that at Morpeth, and had stated that its presence at the former saved life, while its absence at the latter caused the loss of five lives; but there he must entirely disagree, because at Morpeth the engine, after running 84 yards, turned over on its side, and it was evident, therefore, that the two cases were not parallel, as half the Heeley train kept perfectly straight and ran on, while it was the palatial Pullman car, which, in the way so stately a structure might be expected to act, gracefully turned over on its side. In the Morpeth accident the carriages telescoped one into the other, and they all knew what a fruitful cause of loss of life that was. No doubt the hind part of the other train pulled up within a little over 200 yards, but the cause of that was that the wheels were running on the ballast all the time, a much better break than anything they could ever hope to get. Then Captain Tyler suggested that the break should fly off the wheel and not on, but perhaps it was not of much importance how that might be, so long as it came on the wheel somehow. Still he had insisted that the automatic break was always supposed to fly off and never to fail, but instances could be cited where it had failed to fly off. Instantaneous action was the next point insisted on, and it must be agreed that the break ought to be prompt; but it was of no use for the break to be prompt if it was not also powerful; a break might not come on with full power for two or three seconds, and might yet pull up quicker than a break which would act in one. Safety and simplicity of working was the next point, qualities which of course all machinery ought to possess; but had the Westinghouse break shown them? If Captain Tyler would look at the report of the Royal Commission he would see that several eminent engineers said the Westinghouse break was very complicated and not at all simple in its working. Moderate cost was the next, which was of course desirable, and then came constant employment, which was only a fair condition, for every break ought to be in constant use, and ought to show by every day use that it was fit for any emergency. Then as to the next point, it was undeniable that the engine-driver ought to know that his break was in perfect order, just as he ought to have the same knowledge about his engines. Captain Tyler ended by saying that the time had arrived for trial, and there both the public and professional men would go with him. Speaking as an interested man, he would say that the sooner the time arrived the better he should be pleased, and he should only stipulate for one thing, that the trains and breaks with which the trials were made should be in ordinary work, just taken off the lines while in use and fairly tried, and then let the best win.

The Chairman, not wishing to be misunderstood in what he had stated, would remark again that he had spoken not of the Westinghouse but of other breaks. Captain Tyler had said that if any other break could be proved to be better than the Westinghouse he would not accept the situation that had been offered him, and of course it must necessarily be that in attempting to prove there was a better break than the Westinghouse, that break must be compared with it. He would only add that with regard to any other break than the Westinghouse depreciatory remarks ought not to be made.

Captain Tyler thought that full, free, and fair discussion should be invited from the gentlemen present.

Mr. Olrick, on a point of order, remarked that as the last speaker had been allowed to say a great many things against the Westinghouse break, he, as an old and practical engineer, ought to have been allowed to put forward his experience of it, simply from the trials which had been made on the North British Railway.

The Chairman said it had been understood the Westinghouse break was alluded to, and it came to the same thing in the end.

Mr. Olrick said the vacuum break was included.

The Chairman said any one might refer to any break he pleased, and either run it up or down as he chose.

Mr. Harold Brown would relieve his mind by a sort of confession of faith. He was not a Westinghouse man, but a vacuum break man—Smith's, having been connected as legal adviser with the vacuum break almost since its first introduction into England. He had indeed travelled to some extent outside his profession with regard to it, devoting considerable time to the study—not merely of Smith's, but of the other breaks; and it might be useful to the meeting to have the views of one who was not a railway-man nor an engineer. Addressing himself principally to the breaks before the meeting, Smith's and Westinghouse's, he must say that he had not quite so open a mind as the lecturer had professed on the subject; and he would state the conclusion he had arrived at. The details of the breaks, particularly those of the Westinghouse, were too numerous to discuss now; but a great deal had been said of the views of railway officials, and certainly he would like to hear them; but all would agree that it would be very sanguine to expect them to give their views. In the first place, those officials were in a confidential position, advising their Boards on one of the greatest questions at the present time that had ever come before them—not merely as regarded the public, but also in point of expense; and if any of them were to express decided opinions in public in favour of a particular break, the effect would be to at once send up the price of that break. It was, therefore, absurd to expect expressions of opinion from them. All were agreed that they ought to have a continuous break, but he would ask to be excused for not mentioning Saundrs', the Heberlein, Fay's, and Barker's hydraulic, Steele McInnes's, and many others which had given more or less efficient results, while asking the meeting to come to his own conclusion on only the three systems in the United Kingdom, which were really in the running, viz., the chain break (Clark and Webb's), the Westinghouse break, and Smith's vacuum break; they had very little to fear from any of the others. A continuous break was a break capable of being applied from any point in the train to every wheel of every carriage in the shortest possible space of time. As to the point from which the force should be applied it should be able to be exerted at all events from the engine—whether from any other point of the train was a matter open to discussion. As to its application from the guard's van in sections, that with Captain Tyler, he thought undesirable, and with regard to the passengers, Captain Tyler had considered it also undesirable, it should be in their power to apply it. But that was, perhaps, a point open to discussion; signals had been entrusted to them, and in course of time they might have breaks—when they had been educated up to the requisite point. The chain break was not in the contest, as it could not be applied in a long train by the engine-driver or the front guard, while both the other breaks answered the conditions he had down at present. Taking the general conditions with regard to the public, the first question was that of power. According to the Railway Commissioners experiments it was sufficient if a train, going 60 miles an hour, could be stopped within 500 yards; but it really was not sufficient, and a train could be stopped in perfect safety in 300 yards. It could be done at a shorter distance, but even at 300 yards it was unpleasant enough. and even in a case of emergency, one would rather run a little risk than incur the very uncomfortable consequences involved in getting an odd 20 yards advantage. The other considerations affecting both railways and the public, were ease and simplicity of working, and the question of expense. Captain Tyler had ignored the expense, but as to the other point they would agree that the break must not require either skill or intelligence or presence of mind in its application. It must be a break which could be put on by anybody, because engine-drivers and guards, skilful and careful as they were, could not be expected in terrible emergencies to retain presence of mind sufficient to deal with complicated machinery. They knew they had the lives of hundreds of passengers in their hands, and they should be in possession of something which, by simply turning a handle, would apply all the force of the break and bring up the train. Unless that condition were answered, the break would not be satisfactory. Westinghouse's pressure break consisted of a series of rigid cylindars and pistons fitted throughout the train, the piston-rods being connected with the break rods and levers. The break was operated by compressed air being driven into the cylinders at the required pressure. This expelled the pistons, and so applied the breaks. The air was compressed by a pump on the engine, and the maintenance of the required motive power or pressure was attained by means of a reservoir of compressed air, fitted to the engine, and to every carriage. It would be as well to trace the origin and growth of the system, because on that would depend their conclusion as to its merits. The original idea of the continuous pressure break was a pump on the engine to drive air through pipes into cylinders, drive out the pistons, and apply the breaks. But that was found to be too slow to be suddenly used on emergency, and hence Westinghouse's modification, by placing a large reservoir on his engine, which he filled during the progress of the train with air at a very high pressure, varying from 60 lbs. up to any pressure required, then, by releasing the compressed air at any given signal, he increased the rapidity of the operation of his break, the air rushing through the pipes and cylinders drove out the pistons and applied the break at once with great speed and force. This naturally produced a very great strain on the different parts of the apparatus, the couplings, and so on. Speaking, not as a practical mechanic, but simply from common sense, that pressure must be a very great defect in any break, as it applied the break first, and at the highest pressure on the front part of the train; and, moreover, the great and sudden bursting pressure produced leakages. This, by a natural process of development, produced in Mr. Westinghouse's second modification and improvement of a reservoir of compressed air on each carriage, released on signal, so as to apply the breaks with more evenness, and greater speed and force, to every carriage in the train. But a few faults inherent in this system must be pointed out. The break, on first going on, produced a tremendous shock on the front of the train; it also very much strained the rolling-stock and the appliances of the break. The break, again, must always be in use for emergencies and accidental stoppages, and the consequence was that Westinghouse must always have his break kept working up to danger point, involving continual pumping to keep up the supply of compressed air in the reservoirs. They had not, so far, heard of one of Westerhouse's reservoirs bursting, but he hoped he should not be over one when it did. But the great fault of Westinghouse's break still remained, and that was the great strain on all parts of the pipes and couplings, producing leaks fatal to efficient working. When that was discovered, the automatic break was brought forward. Westinghouse found there must be leaks, and that they must be stopped, and he ensured the detection and cure of the leaks by putting on the break. The term automatic had, in fact, been much misapplied; it was entirely wrong to call a break automatic, unless it meant that an accident to any part of the train would put it on; and that was not so with Westinghouse's break, because an injury to any part, except to his own apparatus, would not apply it more than any other break. Indeed, unless a carriage could be fitted with nerves, automatic action could never be obtained. The legitimate use of a really automatic break was when a train breaks asunder, and such accidents rarely happened. They had heard of terrible accidents from luggage trains breaking asunder and running down inclines and into passenger trains, but purely passenger train accidents of that kind, which the use of any automatic brake in the world could have prevented, through the whole of our railway history might be counted by units. Any train could be fitted with a break to act when the train parts asunder and therefore no particular break need be called automatic. Thus the only particular application he could see of Westinghouse's break was that sometimes it went on when it was not wanted. Westinghouse had fitted his break with a complicated system of valves and appliances which ensured that, when once it went on it would not come off, unless by the application of a greater force from the engine, and sometimes an engineer might let his steam run down so that he could not get it up again at once, or as the pumps were of very delicate construction indeed, there might be a defect there. Again an engine might be changed at the station while the train stood with the breaks on, and a new engine attached with an old pump of inferior power; the consequence would exhibit the next defect of Westinghouse's apparatus, which was that it would not come off when it was wanted so to do. Then the apparatus was very costly, much more so than that of the vacuum break; beyond its prime cost there was the expense of continually oiling and cleaning the pumps and cylinders, and all parts of the apparatus, while the oil would pick up the grit and wear it out much quicker than even the india-rubber sack. He would now come to the vacuum break, which consisted of an ejector on the engine connected by pipes throughout the train, with a collapsible sack under each carriage. The heads of the sacks were of iron, and were connected with break rods or levers, so that the collapse of the sacks applied the breaks. He had said that the mere turning of a handle ought to be sufficient, and in Smith's break it was. That apparatus utilised one of the great natural forces, and one that was most equable in its operation, not produced by Smith but by nature, viz., the pressure of the atmosphere. Even with his perfect ejector he could not get more than 13 or 14 lbs. to the inch, and the consequence was it was always elastic. It had in fact many merits; it was always elastic; the pressure was never dangerous, it was not a bursting pressure, and hence there was no strain on the pipes and couplings; and it did not matter how ignorant or careless or inexperienced the man was who had to apply it, for even if he kept the steam turned on he could not hurt, the only result would be he would pull his train up a little quicker. The only thing necessary was, he must keep his hand on the handle, and he could not do any damage. Again the shock of its application was very gradual, and was very little felt; the maximum force was always at hand, and there was no wear of the apparatus except during the actual period of the application, whereas Westinghouse's pumps were always going, and his reservoirs always being strained—hence the leaks he had mentioned. In Smith's there was no waste of steam, for it was never used except when not required for driving. With reference to speed of application, it could be put on at its full power in one or two seconds just as quick as Westinghouse's, at any rate of speed the train might be going. The best stoppages that were made on the Midland Railway with it were at 60 miles an hour within 282 yards.

Mr. Herbert Harris asked if a pure vacuum could be got in two seconds?

Mr. Brown said they could skid the wheels in two seconds, and with any reasonable number of carriages, and that was all they wanted.

Mr. Herbert Harris asked how many pounds of vacuum he considered necessary before the wheels were skidded?

Mr. Brown said that depended on the length of the lever; but those practically connected with the break could answer such questions better. Captain Tyler was very emphatic about the india-rubber, perhaps rather too emphatic. No doubt india-rubber was a ticklish thing to deal with, but if it were properly cured at a high temperature, it was one of the most lasting of materials. The proprietors of the vacuum break had been most particular about it, and had only the best quality. Mr. Westinghouse employed it for his couplings, and as far as the sacks were concerned, the best proof was the actual test of experience. Some were running now in America which had been in use for five years, and on the Metropolitan and St. John's Wood Railway some had been in use for nearly three years, and had made nearly three million stoppages. With regard to expense, which was a very important point, the Westinghouse break was about twice as costly in the first place, and much more expensive in repairs and working. The vacuum break did not cost one penny in repairs, according to the reports they received from engineers. Captain Tyler wanted to throw over that question, but he considered it very important. What was wanted, was the universal application of the continuous break, not merely to royal trains, Pullman cars, and expresses, but on every train, and eventually on goods trains as well, and cheapness meant universality. He quite agreed that efficiency must not be sacrificed on the score of expense, and it was a peddling economy which hesitated about putting on continuous breaks, because one accident would cost more than the fitting of a whole line. The Abbots Ripton accident was said to have cost the Great Northern Railway £50,000, which would probably have fitted up the whole line even with Westinghouse breaks. It could not be denied that this question of expense was important as affecting the introduction of the break. It was a great loss to the country that Captain Tyler should resign his official post, but he had informed them that he had an offer from Mr. Westinghouse, and that bore considerably on the question of expense. It would be an insult to put him down as a cheap man, and if Mr. Westinghouse wanted him he would have to pay for him, and he could only say that he believed it would seriously interfere with the universality of Westinghouse's break. In conclusion, he said they were engaged in a great contest, but they were not fighting for filthy lucre alone, but in the cause of railway enterprise, progress, and above all, humanity; and no matter what the result might be, he trusted they would all fight fairly, as honourable men, and let the best break win.

Mr. Cameron said that to take a very low view of the question, there could be no doubt that the introduction of the continuous break would pay, and that simply as a question of time. He calculated that on the whole, including what passengers were willing to pay for increased speed, saving in the wages of drivers and stokers, and in coke burnt, there would be a clear saving of more than one penny by pulling up quickly instead of slowly; giving on an average 4s. 2d. per train, or £62 10s. per annum on each train.

Captain Fairholme objected to Mr. Brown having dismissed friction breaks altogether as unworthy of notice, for having spent the last five years in perfecting them, he was quite sure they were worth attention. In these breaks, the momentum of the train, which cost nothing, and which was the source of danger, was utilised as a means of safety, and he had heard the opinions of many engineers to the effect that if it could be carried out properly, it was the right system. The objections taken to it, in this country, had been solely in consequence of its being associated with the chain break, which was not considered safe, because as Mr. Brudenell Carter had pointed out, the strength of a chain was only that of the weakest link. But there was no reason why it should not be worked with a cord, as was done on the Continent without the smallest difficulty. Captain Tyler laid it down as an axiom that the break should not be worked by means of a cord, but its value all depended on the way in which it was worked. There was no necessity to have it along the sides of the carriages, with a large compensating wheel in the van to prevent it hanging in festoons; if arranged on proper wheels along the centre-line of the carriages, as was done on the Continent, there was no more difficulty than in any other form of continuous break. The proof of this was that several severe accidents had been avoided by the self-acting character of this break. On the Paris and Vienna express, when going from Munich to Vienna, the rails having been loosened, two centre carriages fell over in exactly the manner described by Captain Tyler when referring to the accident on the Midland; the breaks first opened the steam-whistle of the engine, and then applied the breaks, before the driver knew anything of the accident. The same thing occurred to another express running down a steep incline in Bavaria, where the axle of the tender broke; but the driver was immediately able to prevent the train over-running the tender, and so an accident was avoided. The greatest railway in the country had adopted the friction break. The engine-driver had a reserve of power on this system, by using the engine and tender breaks combined, and such a case as Captain Tyler referred to, where the fireman made a mistake, could not occur, because the instant the driver remarked it, he only had to give his break a kick and it would apply itself immediately. He considered it an advantage to have the break power in two or three separate mechanisms, so that if one failed the other would not; and by having it in groups you could apply any power you liked. Both on the London and North-Western Railway and on the Continent he had seen a train running at 53 miles an hour stopped in a few seconds without the smallest shock or difficulty. The shocks of continuous breaks generally arose from the way in which the carriages are coupled up, and the way the drawbars are arranged, with too much elasticity. Friction breaks were generally arranged in groups, and ordinarily one group was used at a time, so that they were all kept in working order.

Mr. Arthur Harris wished to correct one error in the report of the previous discussion, which reported Mr. Seymour as saying that he had been much pleased with the working of the vacuum break on the Midland Railway, the truth being that it was the Barker hydraulic break he referred to. He might also say that it was a break in ordinary use, not a special trial.

Mr. Clarke said the chain break was worked at the trials at Newark with a train of 15 coaches, and within the last four weeks he had fitted up some trains which were now regularly running. There was nothing to prevent a chain break being worked over trains of 20 coaches by the driver, or either guard at pleasure. There was also another point worthy of notice, that on the London and North-Western trains they did not use the continuous break except in cases of emergency. That was at the option of the engineer's and traffic department, over which he had no control, but it was not a necessary incident of the system, and on the Great Northern the break was used every time the train was stopped. To meet that case, instead of having one weight for the maximum force, he divided it into two, one giving the average break power required for stopping, and a supplementary one to be brought into use on special occasions. He was told that the break was a perfect success on the Great Northern Railway. The question of cost was a very serious one. If either the Westinghouse or Smith's vacuum break were introduced largely, to work them efficiently every engine would have to be fitted, including the goods engines, because they were sometimes used for passenger trains. In this country there were about 14,000 to 15,000 engines, and at an average cost of £50 a-piece, this would come to nearly a million sterling. His system was now being largely used in this country, there being about 1,500 vehicles now fitted with it; it derived its power from the momentum of the train, which cost nothing, and that million of outlay would be saved. It might be a question which was the cheapest as regarded the fitting of the individual carriages. He could not say what was the cost of the other systems, but with his own he could say definitely, because it was done with the ordinary railway plant, and the exact returns were made, and it averaged £12 for an ordinary carriage, while for the vans containing the source of power, an additional £12 was required. If the aggregate number of vehicles were taken at 40,000 to 50,000, it would be seen that the cost would mount up very rapidly. As to the repairs, the reports he received from the railway companies were very favourable.

Mr. Herbert Harris remarked that he had been precluded from going into a detailed description of the Barker hydraulic break—with which he was connected —but Mr. Brown had given full particulars of the Smith's vacuum. He would only say that Barker's was, at least, twice as powerful.

The Chairman said it would evidently be desirable to again adjourn the discussion; but he saw Mr. Allport present, and perhaps he could give the meeting some information.

Mr. Allport said he had heard nothing but descriptions by inventors of their own breaks, many of which were very inaccurate. He did not, however, feel disposed to correct all these inaccuracies, and thought the discussion had better be left in the hands of the parties interested.

Mr. Vigors wished to ask one or two questions, as one of the public. Mr. Brown said that the Westinghouse and the Smith's vacuum breaks were the only two at all worthy of notice; but he had travelled many miles on the Midland Company's line, where Barker's break was used; it was very easily applied, and he had seen the pressure go up from 5lb. to 50lb., in two seconds; and it appeared to him that it ought not to be ignored. Mr. Brown said it was not likely to come to anything; but if it were not of any use to rival inventors, it might be of some use to the public. With regard to the vacuum break, any mischievous boy with a bradawl could spoil the whole of the bags in a couple of minutes, and nobody be any the wiser until the train went on.

Mr. Yeomans seconded the motion for adjournment; but thought the question had better be left in the hands of railway engineers.

The Chairman said Captain Tyler appeared to have had two main objects in view in his paper, one to describe the particular qualities which a break should possess, and the other to ascertain by discussion whether the Westinghouse break was really the best. There were only two ways of ascertaining this, either by discussion or by a practical trial. He did not know whether the various companies would be disposed to go to the expense and trouble of another trial similar to the one which was held two years ago, but unless they would, he feared they would have to be content with discussing the question, though he must say he felt somewhat like the Welsh judge, for on hearing each successive speaker he was almost convinced that the particular break he advocated was superior to any other. It would be very desirable that the companies should all agree to a trial of all breaks which were brought forward, and undertake to adopt the one which competent and impartial judges appointed beforehand should decide was the best; but failing that, they must be content with a full discussion of their relative merits.

The discussion was then adjourned to this (Friday) evening.

Mr. Olrich writes:—At the adjourned discussion on Captain Tyler's paper, on Tuesday evening last, on the above subject, the chairman altered his ruling;—"That the names of the breaks should not be mentioned," after three speakers had finished their remarks, and as I was one of the victims to this rule, I beg to ask your permission to complete my remarks, which would otherwise appear to be unfinished. From a very careful perusal of the experiments carried out on the Midland Railway before the Royal Commission, I find that the Westinghouse automatic air break effected a stop from a speed of 50 miles an hour in a distance of not more than 777 ft. All the other trains in the same experiment, fitted with other breaks, ran a distance of about 50 per cent. more than this before they came to a stop. The superiority of the Westinghouse automatic air break was about in the same proportion in the other series of experiments, and as an independent engineer not interested in any particular break, I have come to the following conclusion:—That the Westinghouse automatic break has shown itself by these trials to be at present the only break which is a thoroughly efficient one, and which complies with all the conditions so ably laid down by Captain Tyler. Referring to the experiments carried out in December last, on the North British Railway, on Smith's vacuum break and Westinghouse automatic air break, an ingenious apparatus for recording speed in miles and distance run in feet, after the application of the break, was used, thus affording great accuracy as compared with observation by ever-so-careful men as used in the experiments before the Royal Commission. By this apparatus the superiority of the Westinghouse break over its competitor was proved beyond doubt. To take one example, in which both the trains had the break applied at a speed of 50 miles an hour, I find that when they had run 400 feet, Westinghouse had reduced the speed of his train to 40 miles an hour, Smith to 48 miles. When about 500 feet had been run, Westinghouse's speed was 35 miles, Smith's, 47 miles. When 700 feet had been run, Westinghouse's speed was 20 miles, Smith's, 42 miles. When 798 feet had been run, Westinghouse's train had come to a stop; Smith's train was still running at a speed of 38 miles an hour, and Smith had to run a distance of 1,250 feet before the train came to a stop. The above facts, which are beyond dispute, show clearly to an unbiassed mind the great and important difference between the two breaks. If we call the efficiency of a theoretical perfect break 100, the percentage of efficiency of Westinghouse's break was 65, and that of Smith's, 30. In conclusion, I merely wish to add, that the result of the experiments on the North British Railway was that the directors unanimously decided upon adopting the Westinghouse automatic air break, which they considered by far the best break after very careful experiments.

TWENTY-SECOND ORDINARY MEETING.

Wednesday, May 9th, 1877; The Rev. J. C. CLUTTERBUCK in the chair.

The following candidates were proposed for election as members of the Society:—

Bromley, Massey, Great Eastern Railway Company, Stratford, E.
Emery, F. J., Burslem, Staffordshire.
Stroudley, William, London, Brighton, and South Coast Railway Company, Brighton.

The following candidates were balloted for, and duly elected members of the Society:—

Baynes, Malcolm Charles, Forest-lodge, West-hill, Putney.
Fairholme, Captain Charles, R.N., 9, Victoria-chambers, Westminster, S.W.
Frankland, Edward, F.R.S., 14, Lancaster-gate, Hyde-park, W.
Gurney, John, J.P., Sprowston-hall, Norwich.
Hanson, John, Savile-town, Dewsbury.
Ricarde-Seaver, Francis Ignacio, Conservative Club, S.W., and 14, Buckingham-street, Strand, W.C.
Soper, William Lawrence, 8, Oat-lane, Wood-street, E.C.
Tribe, Edward Samuel, 10, Woburn-place, W.C.

AND AS HONORARY CORRESPONDING MEMBER:—

Bacceli, The Hon. Professor Guido, D.M., Via della Farina, No. 50, Rome, Italy.

The paper read was—

THE ARTESIAN SYSTEM OF THE THAMES BASIN.

By Joseph Lucas, F.G.S.

The axis of the hydrographical basin of the lower Thames crosses that of the great physical basin of the chalk at an angle of about 30 degrees. The chalk rises from under the central plain of London clay, and forms hills on the north, west, and south, but lies below sea-level on the east side of this basin. The margin of the tertiary strata, abutting against the chalk hills at varying levels, dams up the water accumulated in those hills, in such a manner that, if the chalk were transparent, an observer on the cross of St. Paul's would see himself surrounded on three sides by a wall of water, breached in places by transverse valleys, and rising elsewhere to greater elevations than the summit of that pinnacle.* This part of the chalk water system has already been described by the Rev. J. C. Clutterbuck and Mr. Homersham, C.E., in Hertfordshire, and elsewhere, and by myself in the north downs of Kent and Surrey. At the several lowest levels attained by the margin of the clay in question, the major portion of this water flows out in springs, which proceed, over the London clay, to join the River Thames, while the remainder descends with the dip of the strata under the tertiary beds, into the artesian system of which this memoir treats.

The River Thames having breached the chalk hills on the west is, in that part of its course, fed by chalk springs. It leaves the chalk and begins to flow over the clay country at an elevation of less than 100 ft., and, at a distance of 30 miles east of this point, with the average fall of about 3 ft. in a mile, it again meets the chalk east of London. The river itself describes a gentle curve beneath this average gradient, while, at the same time, the chalk has passed to considerable depths beneath its bed, and the margin of the clay abutting against the chalk hills has risen to considerable heights above it. The water in the chalk, which is syphonised by the curve of the strata beneath the tertiary beds, presses upwards against their under surface, and, on being liberated by a boring, rises to just such a height as is due to the pressure at that point.

On a line of section across the basin between two opposite springs, a series of such points are found to lie on a very shallow concave curve. For want of a better term, however, I have called the upward limit of ascent of the liberated water the artesian plane. A line passing through a series of points of equal altitude in this plane is an artesian contour.

The bed of the main river, in part at least, and parts of the lateral valleys, are cut down below the artesian plane, so that the water released from the chalk rises above the ground. Such districts I have termed areas of overflow, as distinguished from districts equally artesian in amount, but in which, from the greater elevation of the ground, the water will not rise to the surface. The exact limits of the areas of overflow in the Thames basin have never been determined. It appears, however, that there is a central area through which the main river flows, which sends out branches like so many fingers up the lateral valleys leading to the chalk hills.

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* Proc. Inst. C.E., 1842-43-50-76. "The Chalk Strata considered as a Source for the Supply of Water to the Metropolis."—S. C. Homersham, C.E., in *Journal of Soc. of Arts*, 1855.

The tract described in the present memoir is bounded on the north by the Thames, and on the west by the Mole, and includes the basins of:—

1. The Ravensbourne.
2. The Wandle.
3. The Beverley.
4. The Hog's Mill River.
5. The Abrook or the Rythe.
6. The Mole (in part.)

In this area the artesian principle of overflow is developed to a remarkable degree, a result which is brought about by the circumstance that between the point at which the Thames quits the chalk and enters upon the tertiary plain, and that at which it again flows upon chalk, east of London, the river sweeps, in a south-easterly direction, nearly the whole way across the tertiary area. From the confluence of the Mole its general course is north-east by east, till the chalk again forms its bed. The River Mole, which flows through the chalk hills from Dorking to Leatherhead, quits the chalk at an elevation of 100 feet, and joins the Thames in 7½ miles, in a bee-line, at about 20 feet above Ordnance datum, thus having a fall of rather more than 10 feet in a mile. The Thames itself sweeps almost under the shadow of the chalk hills, for at Thames Ditton, at 20 feet, it is only four miles from Ewell, where springs issue from the chalk at 100 feet. This gives a fall of 20 feet in the mile, or 80 feet in all, an amount greater than that of the artesian plane by some 30 feet, to which height the water from the chalk would, in consequence, naturally rise above the ground at Thames Ditton.

The Thames itself, and its tributaries on the tract in question, all lie below the artesian plane, consequently all the basins above-named contain natural areas of overflow.

The facies of the artesian plane is determined by observing the levels of the water in the chalk skirting the tertiary area, and the height to which the water rises in wells sunk to the chalk within that area. Thus, the Mole at Leatherhead, the springs at Ewell, and the Wandle at Carshalton and Beddington, the Cray between Foots Cray and St. Paul's Cray, and the Darent at Farningham, are all at 100 feet above Ordnance datum. The water contour which passes through these points, a distance as the crow flies of five and twenty miles, can be traced through the tertiary area as an artesian contour. The water in the Crystal Palace well rose to 100 feet when the well was first sunk. This is, therefore, a point on the curve, which crosses the Ravensbourne Valley nearly two miles north of the point at which the surface contour at 100 feet crosses the bed of the stream. In the same way, any number of points of intersection of the artesian and surface contours may be determined. A line passing through these points is the boundary of the artesian area of overflow, and on these principles the areas of overflow given on map have been determined.

THE RAVENSBOURNE VALLEY.

In the Ravensbourne valley there are not, to my knowledge, any existing overflowing wells, and as the resources of the chalk have been very heavily taxed, it is probable that the artesian principle of overflow may be destroyed in it. The existence of the area of overflow being a matter of inference, I was much pleased to learn from Mr. George Eastell that when the well at Elmer's-end was first sunk, the water from the Thanet sand flowed four feet above the surface.

The depression in the metropolitan area extends into the Ravensbourne valley. It will readily be seen that no artesian contour at Ordnance datum would, under the natural conditions, appear on the map. At the present date, however, the contour of the water at rest at Ordnance datum runs south of the Kent Water Works, the Naval School, Gordon's Brewery, Peckham, Stockwell-green, and Wandsworth-gaol. North of that line the water from the chalk never rises to Ordnance datum. The amount of the depression, which is continually increasing, may be gathered from the materials in the tables annexed.

On the south side of the Thames it has not yet reached the chalk itself. The tendency of all waters in communication is to fill up the artificially formed hollow or basin-shaped superficies of the area of depression by pumping, so as to restore the figure of the original artesian plane. A consequent admixture of waters is thus superinduced, without which, I fear, the deep-seated chalk would ere this have been drained to the dregs.

With our knowledge of the position and extent of the large quantity of water in store in the chalk hills, it becomes evident that the metropolitan area of depression is caused by sheer lack of capacity among the fissures in the chalk to transmit these upper waters to the centre of out-draught. Increased intercommunication among the fissures, together with the replenishment of the chalk from the flood-waters in the upland districts, form one of the many practical benefits to which the science of hydro-geology will lead.

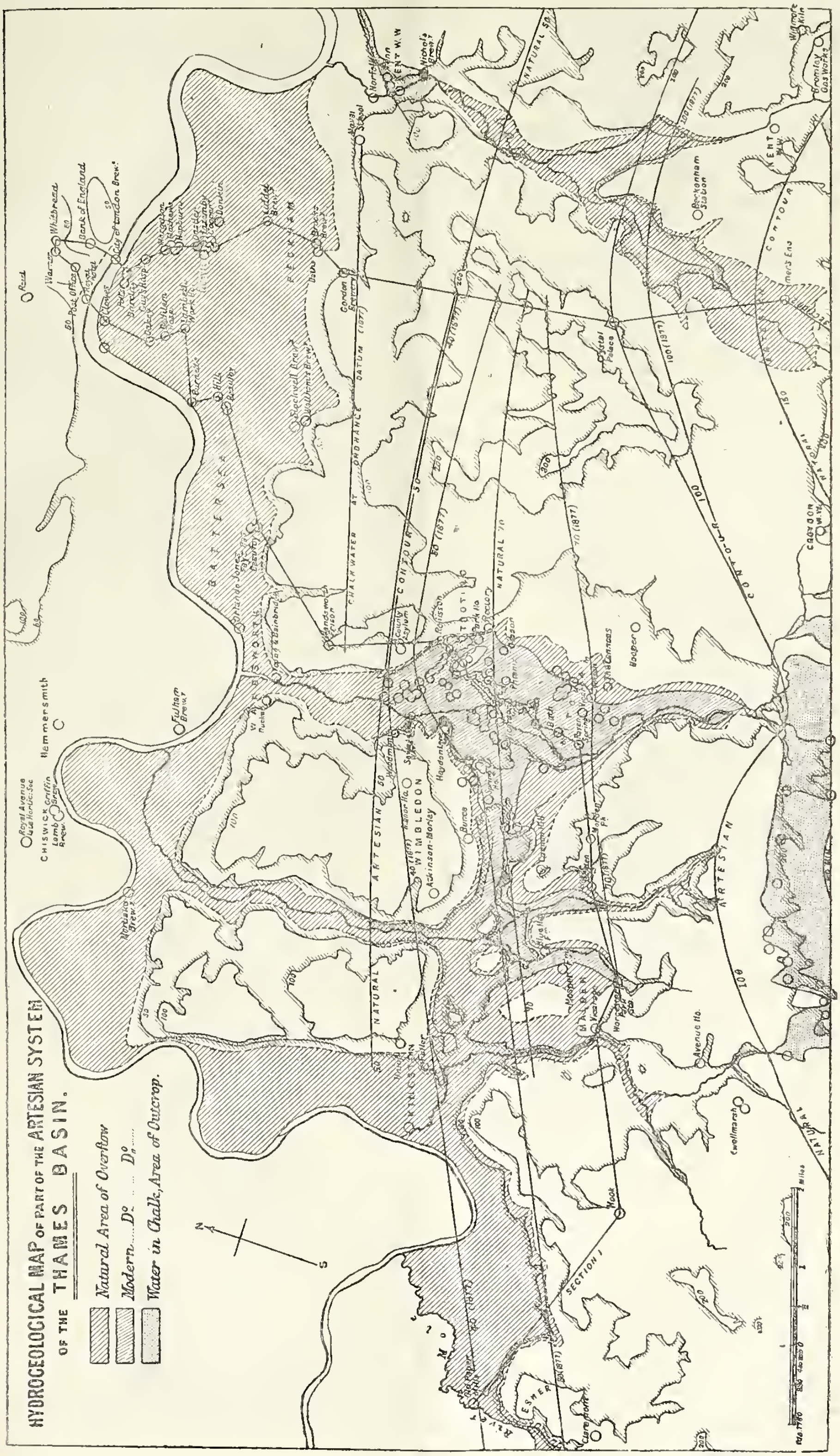
THE WANDLE BASIN.

a. The Overflowing Wells.

The Wandle valley presents a probably unique feature in the number of overflowing wells it contains. The oldest of these, the public well near Tooting Church, was bored in 1822. Owing to the success of this boring, another was bored by Mr. Cranmer at a house called "The Cannons," Mitcham, in September of the same year. Professor Prestwich, writing in the year 1850, estimates the number of borings at fifteen to twenty, whereas there are at present,—1876,—at least one hundred and ten on the area in question. Those that still overflow are contained within an area of about four square miles, lying in seven parishes, viz.:—

1. Wandsworth.
2. Streatham.
3. Tooting.
4. Mitcham.
5. Morden.
6. Merton.
7. Wimbledon.

Owing partly to the multiplication of vents, the discharge from the older borings has materially diminished, though some very strong ones remain Among the former are "The Cannons," now dry; "Nightingale's Factory" (now Driver's Cotton Print Works); and the one near Tooting Church. This last formerly produced a constant supply of



HYDROGEOLOGICAL MAP OF PART OF THE ARTESIAN SYSTEM OF THE THAMES BASIN.

130 gallons per minute, but at the present time produces only one-tenth of that quantity.

The height to which the water will now rise is less than formerly, and as an effect of this, the area over which the water will overflow is also diminished.

The boundaries of the present area of overflow drawn on the map, have been partly drawn on the ground, and partly computed from the rate of fall between Wallington and Mr. Sampson's Yard, Mitcham, and the latter place and Tooting Church.

The boundaries of the original area of overflow have been computed from the rate of fall of the ground, and of the water between Wallington and The Cannons, Mitcham, the height of the vent in the structure above the boring (now dry) at The Cannons being taken at the height of original flow.

The heights are as follows, approximately:—

	Height of ground.	Water rose originally.	Water rises now.
Wallington	90	..	..
Cannons..........	78	80	
Sampson's........	70	..	70
Tooting Church ..	58	65	60

Feet above Ordnance datum.

The fullest information as to the height to which the water now rises from these borings is given in the tables annexed.

I have no positive evidence as to the yield of the area, but from a personal inspection of all the springs, and a knowledge of the actual discharge of some of the strongest, I am inclined to average them at 10 gallons a minute, which, for 110 springs, would give rather more than a million and a-half gallons daily. I question whether the yield exceeds two millions of gallons daily on the area in question.

The strongest jets in the valley are those bored along the course of the Wandle, and are The Willows, Garrett Copper Mills (which originally rose 20 ft. above the ground, and is reported to have yielded 120 gallons a minute at the surface.) Martin's brickfield, Paxton's, Legge's, Grey's, and I may add the very strong one that has been allowed to lapse at the former Copper Mills at Merton, which originally rose 30 ft. above the ground, and is reported to have yielded 200 gallons a minute a three or four feet above the ground. It follows thatt these jets are the most permanent.

The actual head supplying the springs from the sands is limited to the height of the outcrop, whereas that supplying the chalk springs is derived from the water stored in the Surrey hills. From this it also follows that the chalk springs are more stable than the sand springs.

b. Wells not in Area of Overflow.

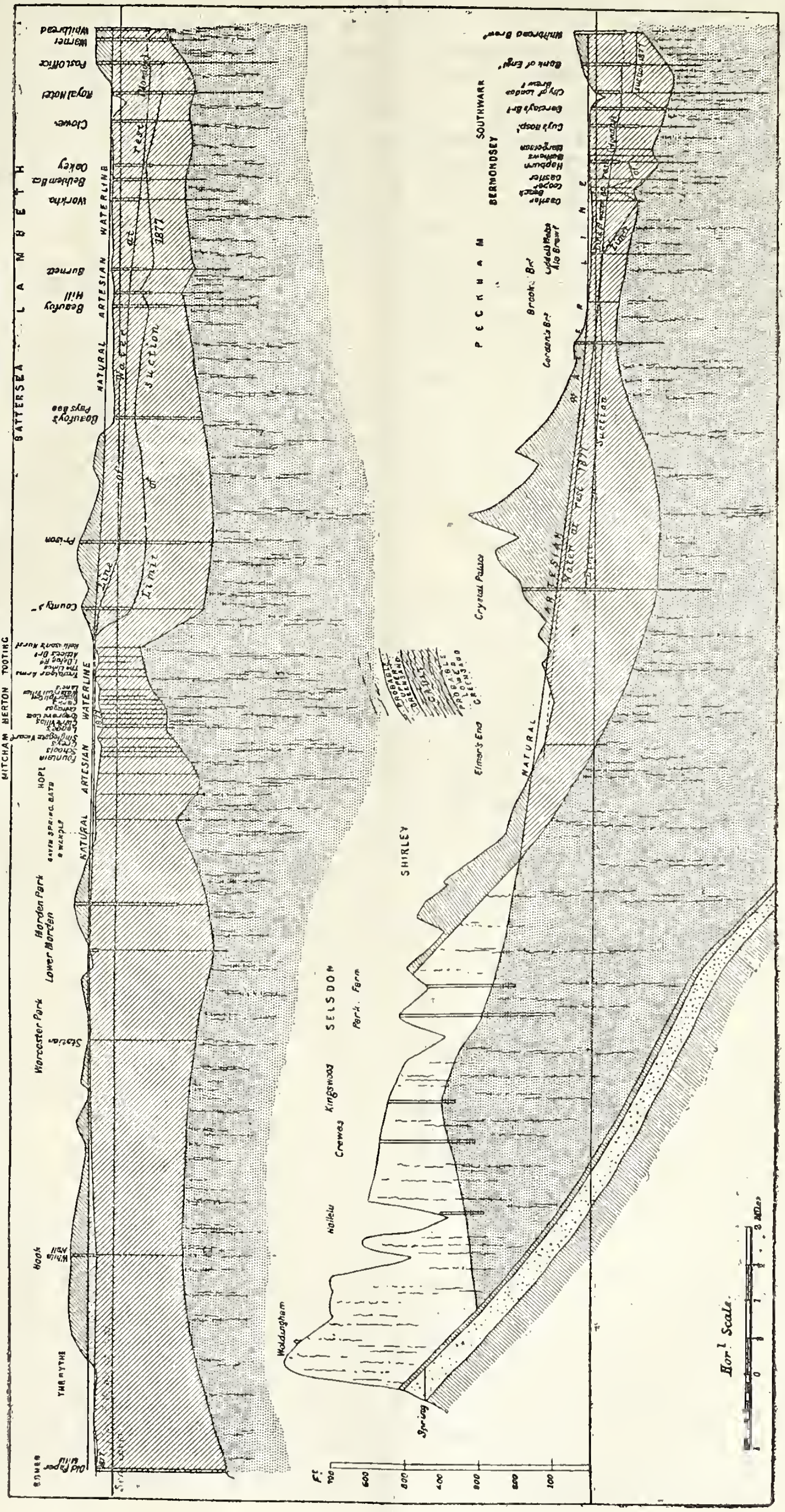
1. *In area of depression.*—The area of overflow as it at present exists, owing to the depression by pumping at Wandsworth and elsewhere, is isolated on the north from other parts of the natural area of overflow of the Thames basin. This area of depression is now very extensive, and probably includes all the natural area of overflow in the Thames basin north and east of the Wandle, as well as a considerable portion to the west and north-west. On January 2nd, 1877, the water in the well at Orlando Jones and Co's. Starch Works, which had not been drawn upon for some time previous to that date, stood 46 ft. below the surface, or about 30 ft. below Ordnance datum. The water from the chalk at this point would probably rise naturally about 30 ft. above Ordnance datum. The amount of depression is therefore about 60 ft. In the well at Young and Bainbridge's brewery, at the same date, during pumping, the water was at 70 ft. below the surface, or 52 below Ordnance datum. Less than a mile and a half to the south of this point the water from the Thanet sand is constantly flowing at 38 ft. above Ordnance datum. The height to which the water from the chalk would naturally rise at this point, Garratt, must also be about 50 ft. above Ordnance datum.

2. *Wells outside natural area of overflow.*—In the well at the House of Correction, when sunk in 1849, the water from the chalk rose to within 80 ft. of the surface, or upwards of 20 ft. Ordnance datum. The height of the artesian plane at this point is upwards of 40 ft. above Ordnance datum, which indicates a depression of at least 20 ft. at that date by metropolitan pumping. Since that time it has been gradually declining. After 30 hours rest, on Monday, January 26, 1852. it stood 12 ft. above Ordnance datum. On Saturday, March 3, 1877, it was, after pumping, 54 ft. below Ordnance datum; and on Monday, March 5th, after 36 hours rest it stood 8 ft. below Ordnance datum. There were, however, land springs running into the well at the time.

At the County Lunatic Asylum there are two wells. The older was sunk in 1840, and bored to a depth of 342 ft. The water from the chalk rose to 26 ft. from the surface, or about 68 ft. above Ordnance datum. In May, 1873, after a rest during repairs, it stood at 43 ft. from the surface, or about 51 ft. above Ordnance datum. The asylum is distant from the prison exactly one mile, and the difference in the height of the water at rest is now about 60 ft., the natural difference being some 28 ft. The present total depression of the water at rest is therefore at the asylum, 17 ft.; and at the prison, 48 ft. The newer well at the asylum takes no water from the chalk, but derives its whole supply from the Thanet sand. Though the suction extends to 128 ft. below Ordnance datum, yet at a distance of half-a-mile to the west and south there are several overflowing wells from the same bed of sand. At Garratt Farm, the water from the sand reaches 43 ft. above Ordnance datum; at St. Clement Danes' Almshouses, it until recently served a cistern at about 57 ft., and now serves a fountain at about 50 ft., and at Rollisson's nursery it reaches 64 ft. above Ordnance datum. The boring to the chalk at Messrs. Attlee's brewery, which is pumped from the surface, and would still overflow if allowed to do so, is surrounded by overflowing wells. Having regard to the excessive number of borings in this valley, the precise cause of their preservation is a matter of no small mystery. An explanation may, however, probably be found in the following facts.

All these borings traverse the London clay and underlying plastic clays, except, perhaps, five at Tooting, which, after passing through gravel, come at once into mottled clays, or Woolwich and Reading beds, a fact which is here recorded for the first time. From this we learn that an anti-

HYDROGEOLOGICAL SECTIONS ACROSS PART OF THE ARTESIAN SYSTEM OF THE THAMES BASIN.



clinal arch in the strata runs through New Wimbledon and Tooting in a north-easterly direction, to Peckham. It is partially dome-shaped, attaining its greatest elevation at Tooting Graveney.

Full advantage has been taken of this Tooting anticlinal, for at least 75 out of the 110, or two-thirds of the borings in the valley, lie clustered upon it.

As the area in question is on the south side of the London basin, the normal dip of the strata is towards the north. The strata, however, descend, not uniformly, but by a series of minor rolls, of which the anticlinal mentioned above is one. There are two synclinal troughs accompanying this anticlinal, having parallel axes and situated, one on the north and one on the south of it. The one on the north attains its greatest depression on the area immediately north of Garratt, and along the line of this trough the tertiary strata descend to a lower level than the bottom of the majority of the borings in the Wandle valley. Consequently, they intervene as a dam, which intercepts the horizontal movement of the water towards London

THE BEVERLEY BASIN.

a. Area of Overflow.

The Beverley basin contains at least five overflowing wells. The area of overflow is continuous with that of the Wandle basin. In Merton parish there is an overflowing well on the boundary ridge between the two basins. Two borings, at Mosper Farm and Blue House Farm, that formerly overflowed, do not reach the chalk, nor does the boring at Worcester-park Station that still overflows. The water in the bore pipe at Mosper Farm stood 3 ft. 8 in. below the surface, September, 1876, and the pipe was choked with sediment as high as 94 ft. 6 in. from the surface. In the lower part of this basin, at Mortlake, a well bored in 1834, at Mr. John Randell's, overflowed for a time at the rate of 5,000 gallons a day.

The well at Mortlake Brewery was originally bored in 1836 to a depth of 315 ft. The water at rest now stands at 42 ft. from the surface.

B. Wells not in Area of Overflow.

When the well at Morden-park was deepened a few years ago, a boring was carried down to the chalk, from which the water rose to 43 feet from the surface. The height of the ground is approximately 110 feet, which gives 67 feet as the height of the water line. The well on the green at Lower Morden, sunk and bored in 1863, is almost exactly upon the boundary of the natural area of overflow, but is just outside the existing limits of that area. The height of the ground is about 70 feet, and the water rose to the surface.

At Cannonhill there are two wells. The older, under the house wall, is sunk 130 feet, and on September 22nd, 1876, the water stood 6 feet below the ground. This well is probably not through the London clay. The newer well has a shaft of 25 feet, and is bored to the chalk. At the date named, there was no water in the shaft, though it is only a few yards distant from the older well. The height of the surface is about 95 feet, which would give the bottom of the shaft at 70 feet. There is no evidence to show that the water ever rose into the shaft. It probably stands about 20 feet below the bottom of the shaft at the present date.

The well at the Atkinson Morley Convalescent Hospital, on March 15th, 1877, gave 118 feet to water, after a sufficient rest to insure the natural level; which, taking the height of the ground at 160 feet, gives 42 feet for the water line. This height would probably be somewhat above the point at which the water from the chalk would stand, as there were land-springs running into the well at the time.

HOG'S-MILL RIVER BASIN.

a. Area of Overflow.

On the outskirts of Kingston there was formerly a boring, at Mr. Fuller's cottages, opposite the Cambridge Asylum, at a point where the ground-level is 53 ft., from which the discharge is reported to have been "20 gallons a minute at 10 ft. above the ground." This boring has long ceased to overflow. Until about five years ago, it was worked with a common hand pump, so that the water cannot have fallen many feet below the surface. The well is now disused.

The well at Hodgson's Brewery, Brook-street, Kingston, still overflows. When the boring was carried into the chalk, in 1866, the water rose 6 ft. above the ground, or about 31 ft. above Ordnance datum. So strong are the springs at the present time that the water is not depressed below the surface even when the pumps are in full work.

There is another well in Thames-street, which also overflows at 25 ft.

b. Outside Area of Overflow.

The well at the Union, bored about 1843, struck a sand-spring at 425 ft., from which the water rose nearly to the surface. On March 22nd, 1877, I found the shaft to end in soft mud, which doubtless has accumulated at its bottom, at 137 ft., and, three hours after the cessation of pumping, the water was 40 ft. from the surface, and rising fast. The water is pumped down at least 90 ft., and after rest is sometimes within 20 ft. of the surface, which is about 80 ft. above Ordnance datum. The water line is, therefore, about 60 ft. above Ordnance datum.

Deep wells in this valley are scarce on account of the great thickness of London clay. At the vicarage at Malden there is a deep well in which the water can be seen but not measured, owing to a staging at a depth of 34 feet. The water is probably within 60 feet of the surface, which is about 96 feet above Ordnance datum.

At Avenue-house there is a well 172 feet deep, which gave, on Dec. 20, 1876, 30 feet 8 inches to water. The height of the ground is about 96 feet, which gives the water line at 65 feet above Ordnance datum. This is too low for the chalk water at that point.

At White-hall, Hook, there is a well which has a shaft of 48 feet, and is bored to a total depth of 300 feet. The water never falls below the bottom of the shaft, and on March 22nd, 1877, stood 17 feet from the surface, the height of the ground is about 115 feet, which would give the water line at 98 feet. This is too high for the chalk water at that point, and if the boring were carried through to the chalk the water would fall at least 30 feet.

ABROOK BASIN.

I have not been able to discover any wells to the chalk in the Abrook Basin, doubtless on account of the great thickness of the London clay. There was formerly a well at Claremont sunk and bored for Prince Leopold, afterwards King of the Belgians. The well, however, proving a failure, was a source of great annoyance to the King, and was never used, and its existence is now unknown to those in charge of the place. The house is supplied from the Black Lake and from springs on Oxshott Heath. There are numerous shallow wells in the basin, sunk both in the outliers of Bagshot Sands and in the London clay.

MOLE BASIN.

The well at the old paper mills at Lowergreen, Esher, is 360 feet to the chalk, and has a shaft of more than 200 feet. On February 27th, 1877, the water stood 8 feet 5 inches below the ground, which is about 44 feet. This gives the water line at 36 feet above Ordnance datum. I have reason to suppose that the chalk water would naturally overflow from a boring at this point 6 feet above the ground.

In consequence of the variations in the depths to which the borings have to go under the conditions named, the temperature of the water is found to vary considerably, being, of course, warmest from the deepest borings.

This temperature does not vary between winter and summer.

I have abstracted the following from the tables appended, showing depth of the bore below O.D. in feet and the temperature in degrees Centigrade:—

	Feet.	Degrees.	
1. Mr. Little's	275	12·5	Sand.
2. Bath Tavern	237	12·3	Sand.
3. Fountain-cottage ..	214	13·0	Chalk.
4. Hope-cottages	212	12·3	Sand.
5. Mr. Latham's......	210	12·5	Chalk.
6. Grey's............	180	12·5	Chalk.
7. Nelson's Fields	174	12·1	Chalk.
8. Sir Jeffery Dunstan	[164]?	12·5	——?
9. Mr. Betts's........	83	12·0	Sand.
10. Brewers'-cottages ..	78	[10·5]?	Chalk.
11. The Britannia	77	12·0	Sand.
12. Shellard's	67	[10·5]?	Chalk.
13. Fountain, P. H.....	44	11·0	Sand.
14. Bell's Farm	35	11·0	Sand.

(The bottom of the bore is taken as the point from which the water ascends.) The depth of the boring at Sir Jeffery Dunstan is uncertain. The temperature of the water would seem to indicate that it must be greater than that given.

The thermometer with which the observations were made is graduated only to degrees, but though the decimals given cannot be taken as absolute, the table brings out in a very striking manner the facts, that under equal conditions of depth, the water in the chalk is warmer than that in the sand. I have observed that, in the Surrey hills, at equal altitudes above Ordnance datum, the water in the chalk hills is warmer than that in the lower green sands; also that the temperature of water in the chalk is more independent of altitude than that in the sands; facts which are strongly concurrent with those given above.

The uniformity of flow and temperature, which is observed to hold winter and summer, indicates the security from contamination that these springs enjoy. The absence of a shaft is a very great safeguard, though there are a few instances in which borings have been put down from the bottom of old shafts. Such cases are rare in an area of of overflow, but are common outside such limited areas. The liability to corruption in such cases enforces upon us the value of springs which rise naturally above the surface, and every effort ought to be made to preserve them. The stability and the incorruptibility of the springs are the special features of the artesian system.

The increasing exhaustion of the chalk long ago led to suggestions of a scientific character from the Rev. J. C. Clutterbuck and Prof. Prestwich, followed by practical results in the shape of borings to the lower green sand within the London basin, all of which up to the present time have proved failures as far as regards the object for which they were put down. They prove, however, among other facts of great scientific interest, that there is such a thing as going too deep for water. Water in large quantities is not to be met with at great depths. Comparatively little water finds its way down to the extreme depth of 1,000 ft. below sea level, and it is probably the fact that the major portion of the water in the water-bearing strata pervades that part of them that lies above the level of low water mark. That the lower green sand has now been proved to exist under London, is a fact of great scientific value, as it is thereby proved to exist under the whole range of country to the south, as far as its outcrop. The cores taken out of Messrs. Meux's boring exhibit the Hythe beds as they appear in Kent and East Surrey, in the character of a silicious limestone. The quantity of water found at that point from a public point of view is not a matter of great moment. The lower green sand is a bed or formation that lies below the chalk, and partakes of all its folds and convolutions, and it is therefore probable that the same causes that govern the presence of water in the chalk, will also operate in the lower green sand. At the locality in question the chalk is not remarkable for the exuberance of its fountains, and on that account alone, a large quantity could not be expected from the lower green sand.

Along the line of their outcrop in Kent and Surrey, the Hythe beds become more sandy towards the west. With these facts in view, an experimental boring for water to the lower green sand in the metropolitan area should be as far south as possible, as far west as possible, that is, as far south-west as possible, should be of the least possible depth, and lastly, should be at a point where the resources of the chalk water system are best developed.

There is only one point in the district under review that fulfils all these conditions, and that is a small oval spot a few hundred yards long, on which the plastic clay outcrops in the parish of Tooting Graveney. The stability of the existing chalk and other artesian fountains at this point is notorious, and it appears to me that the same cause that has protected them, viz., the very rapid fall of the strata towards London, also dams back the waters of the lower green sand beneath. The height of the ground is 50 feet above Ordnance datum, and the chalk is within 100 feet of the surface. The water from the lower green sand, if tapped, would probably rise to a height of 100 feet above the sea and 50 feet above the ground. The next best points would be at the River Wandle, at Wallington, at 90 feet above Ordnance datum, and at the site of the Kent Water Works, Deptford.

The past history and present position of the artesian system warants the following general conclusions:—In artesian districts, in areas of overflow, it is proper to bore the whole depth. Outside the area of overflow, to sink as far as the point to which the water will rise, and as much further as may be required (having regard to the yield of the springs), for the purpose of reservoir, and then to bore as far as the water-bearing stratum. Owing to the absence of proper data, it is frequently found necessary to deepen the shafts after its first construction.

The available reservoir in artesian districts is the column of water contained in the shafts, and the efforts of the springs to restore the depressed column. Thus if a portion of a shaft above a certain point contained 100,000 gallons, when the water has been lowered to that point by pumping, the quantity drawn from the shaft will exceed 100,000 gallons by the quantity discharged into the shaft through the bore during the period of pumping.

When the water-bearing stratum has once been thoroughly probed by a boring, and the water line has been lowered in the shaft to the limit of suction or the point of outdraught, the chances are so much against an increased quantity being supplied by fresh borings in the same water-bearing stratum within the diameter of the shaft, as not to warrant any further outlay of capital upon such additional borings.

The success of such additional borings depends upon the speculation—

A. That the existing boring is too small to deliver the whole quantity permeating the fissures beneath the shaft, and tending to discharge into the shaft; or,

B. That water-bearing fissures, not cut by the first bore, exist beneath the diameter of the shaft; both of which are highly improbable contingencies.

While, in artesian districts, the available reservoir depends upon the capacity of the part of the column depressed by pumping, and the strength of the springs to maintain that column; in the chalk hills, the available reservoir consists of the capacity of the shaft, and of the fissures contained in an inverted conical depression having an elliptical base, and of which the shaft is the axis, and the point of outdraught the apex.

In artesian districts, notwithstanding the certainty that the water, when struck, will rise to or near the surface, wells upwards of 200 ft. in depth are rare; while, on the chalk hills, notwithstanding the certainty that water struck in the shaft will remain at a great distance from the surface, wells up to 300 ft. in depth are common.

From observations on the height attained by the water both from borings in the areas of overflow, and in shafts outside those areas, the form and position of the so-called artesian plane may be deduced. This "plane" may be represented by contours which. taken with those of the surface of the ground, afford a means of defining the limits of the areas of overflow.

In the supply of water discharged upon the areas of overflow from artesian borings, we have an accomplished engineering fact, at a cost which is quite inconsiderable when compared with that of supplying an equal quantity of equally pure water from any other source. In the artesian system of the Thames basin, the strongest jets are those which, at equal distance from the outcrop of the chalk, flow out from the lowest levels, and which, therefore, necessarily lie along the course of the rivers proceeding from the chalk springs. As long as they are left to the operation of nature, and are maintained by proper pipes, artesian borings in areas of overflow furnish cool, pure, and everlasting fountains.

DISCUSSION.

Mr. Baldwin Latham said this was by no means the least important of the three papers which Mr. Lucas had read within the last few months, on the subterranean water supply. On some points, however, he, from his experience, entertained somewhat different views to Mr. Lucas. There was a large area between the Wandle and Ravensbourne, which appeared to be almost devoid of water, the wells sunk within it yielding hardly any. The well at the Crystal Palace had turned out a failure; and others sunk between Croydon and North Croydon, had been equally unsuccessful. In many places they had got some water from the upper tertiary beds; but on going deeper into the chalk it was lost. There appeared to be two parallel lines of fault—one on the Wandle, and the other on the Ravensbourne; and in all probability, the large quantity of water obtained at the West Kent Company's Works at Deptford, was due to the presence of these faults, and to the rivers flowing over the surface. The bed of the Wandle at Beddington ran upon the chalk, but a few yards north of the river the chalk was perfectly dry. At Beddington there was a well 210ft. deep, 110ft. in tertiary strata, and the remainder in the chalk, which had not yielded a drop of water. They got water in some of the upper strata, but the moment they touched the chalk, they lost the whole of the water, and never regained it. On his advice they filled it up to the level of the upper sands, when they got the water again. There was some reason why that large area of chalk was cut off from the large water supply flowing from south to north, and which manifested itself in these river basins. The probability was that there was some direct communication between the chalk and these valleys of the River Wandle, where there was so many wells, as for instance at Mitcham, Merton, &c. At Garrett there was an artesian well bored, and they got a continuous supply of water above the surface of the ground. In some cases, however, wells had been enlarged and deepened, and still the water did not rise above the ordinary level of the Wandle, although their construction might interfere with the supply of water in other wells in the neighbourhood. Taking the whole yield of water from this area, it was nothing compared to the wants of a great city like London. They had heard a great deal about this new well of Meux's, but they must recollect that they could not get more water from the lower sand than went into it, and its whole area was very limited, being not more than a few hundred square miles compared to thousands of the chalk. Where wells of this character had been carried out as in the Paris basin, the same thing occurred; the multiplication of wells caused the supply to fall off. A given area would only yield a certain quantity, depending on the amount of rainfall on the outcrop which percolated to the water-yielding beds. Experience had already shown that wells in London carried down to the green-sand were failures. There was an example at Camden-town, where a company which was pretty well off for water at one time, went a little deeper and lost it all, and had to hand over the whole works to the New River Company. The increase of temperature was also a great drawback to water coming from a great depth. Mr. Simons, the able meteorologist, had conclusively shown by experiment that there was an increase of 1° for every 50 or 55 feet of depth, so that if you went down 1,000 feet, you would get the temperature increased by about 20° Fahr., which would render it unfit for public supply. Another objection to the water from the green-sand was that several large towns, such as Reigate, were situated on the outcrop of this formation, and you therefore had no guarantee that the water would be pure from contamination, because it had never been shown that any amount of percolation would purify it from organic pollution.

Mr. Homersham could not agree with Mr. Latham's statement as to the rise of temperature, because they all knew that the normal temperature was about 52°, and at Messrs. Meux's, when the depth was 1,022 ft., and they were getting something like 1,000 gallons an hour, the temperature was shown to be 57°, and it was most carefully taken, because Messrs. Meux wished to use it for refrigerating purposes. He agreed with much that Mr. Latham had said about the water from the green-sand; he did not believe water going through a great depth of water-logged sand got purified, as it did in percolating slowly through chalk, when it was exposed to oxidation at every change of barometer. He referred to water from the chalk not covered with London clay, because it was then of a very different quality, containing 40 to 50 grains per gallon of soda salts, whereas in the other case it did not contain more than 18 to 22 grains. He did not agree with Mr. Lucas that there was a gradual depression in the chalk water in this district. At Croydon they had been pumping at an artesian well for 27 or 28 years, taking from 1 to 2½ million gallons per day, and the level of the water was now exactly the same as when they began. He also knew the well at Plumstead, which was sunk in 1852, when the requirements of the company for which it was made were about 600,000 gallons a day; it had been at work ever since, and the level of the water when they ceased pumping was the same as it was 25 years ago. Many years ago the Kent Company sunk some wells on the Ravensbourne, for the purpose of draining the well at Plumstead, in order to stop competition, from which they pumped 4 or 5 million gallons a day; but, finding it had no effect at all, they thought the best way was to supply themselves from this source, instead of from the Ravensbourne, and from that time they had been pumping from 5 or 6 millions of gallons a day; and yet, when they stopped pumping, the water rose to the same level as it was when the wells were sunk. They had since sunk wells at Bromley and St. Mary Cray, from which they could get almost any amount of water, and if they wished to double the supply they could easily do so. He wanted to know the grounds, therefore, on which Mr. Lucas based his conclusions. The fact was, there were plenty of men who could not do a thing, and it was so in sinking wells; and it did not follow that, because one man could not get water in a well, that there was none there. After boring through the London clay, you came to sand and gravel, and then to a very fine silt, which would come up the bore-pipe with the smallest velocity of water. Many of these boreings were lined at the least possible cost, tin pipes being used, or very thin iron ones, and after a short time through rust or decay, the pipe was destroyed, and the bore choked; and then it was supposed that the water was not there. He could mention many instances of that kind. In the Caterham district the whole of the chalk was now choked with water, which could not get away, and ran over the whole surface, notwithstanding the constant pumping at Plumstead and at many other places. It was true that under London district the level had lowered, because the number of wells had been increased by about 15 times within the last 20 years, but if they were to cease pumping the water would rise to its normal level. Besides, it was known to those experienced in well boring, that you could not get water from chalk freely under the London clay, although it would come freely enough where it was not so covered. For instance at Watford and St. Alban's, where the tertiaries just touched the chalk, situations were to be found where, if they wanted they could pump 10, 20, or 50 million gallons a day, but coming 8 or 10 miles nearer London, at Harrow or Hampstead, you could not get any large quantity; and what was got was not of so good a quality. The reason he believed to be this, the chalk being a marine formation, where it had been exposed to the rains of heaven for some million of years, the water filling the chalk had washed out the soda salts, which had not taken place where the chalk was covered with an impervious clay. Mr. Lucas said he did not think sinking wells to a great depth was the way to get more water, but at Plumstead they had found when they wanted to increase the supply, and sank a second well, that they did not get water until they reached a depth of upwards of 620 ft., when they got plenty. Again, at Canterbury some years ago, they found no water at 320 ft., but on going a little deeper they got 1½ million gallons, and exactly the same thing occurred in a second well only 9 ft. from the first. In many cases, therefore, going to a great depth did bring water, and this could easily be understood, because the chalk was a stratified formation, and the water lay in fissures in it, which might not be reached without going to a great depth. To the north of London the water lay 500 feet above the level of the sea, and gradually declined to Watford, where it was 169 feet above the sea-level, and the same thing might be shown in many other places.

Mr. Latham said his experience at Croydon entirely corroborated Mr. Lucas's view. When he went there, the engines were pumping a million gallons per day; but when he put up engines which lifted 2½ millions, they were left high and dry, the water was permanently lowered, and the engines had to be put down 20 feet, to bring up tho water.

Mr. Homersham said he had ascertained on Monday last the water stood on the same level as it always did.

Mr. Robert Sutcliff said the supply of water from an artesian well depended to a great degree on the way in which it was pumped. If you allowed the pressure of tho atmosphere to come upon the water in the well, it would be lowered to some extent by pumping, but if you drew the water out of the earth by attaching the pump immediately to the pipe, it would come more freely, and would not lower so quickly. In his experience he had sometimes found the quantity increase five times by employing this method. It was also useful sometimes to let the water go suddenly after you had pumped, when it would force its way into the fissures, and form channels to the point from which you were pumping. At a brewery at Newark, where he only got 700 gallons per hour, on fixing the pump directly on to the bore tube, the supply was increased to 5,000 gals.

Mr. Morris thought the reason there were no overflowing wells in the valley of the Ravensbourne was because there you had gravel lying over the chalk, and the water which came up through the chalk found a vent at the surface, whereas, at Teddington, there was an impervious stratum lying on the top, which prevented the water escaping into the streams.

The Chairman said this was not a new subject to him by any means, but it was new to find that the chalk in London had been pierced so extensively. Whether that which was found beneath the gault was the lower green-sand, he could not undertake to say, but he had a specimen which had come from that point which was unlike anything he had seen from the well at Meux's. He had also a piece of limestone rock, which he was told was immediately under the gault, and on testing it he found it contained 90 per cent. of carbonate of lime; and he had never seen anything in the lower green-sand like that which was found on passing the gault. However, he could not pretend to decide on that point, especially in the face of gentlemen who were learned in such matters, in shells, &c. He only professed to have studied the question of subterranean water. The well at Messrs. Meux's had attracted a deal of notice, and some people thought they were going to have an unlimited supply of water from the green-sand below the gault, but he saw no chance at all. Being in Paris many years ago, he visited the artesian well at Grenelle, which was first projected in 1832, when it was thought that Paris might be supplied with water by three artesian wells. 100,000 francs was voted for it, and after much trouble and disappointment the water rose to a great height, and brought with it gault, clay, and a great quantity of granulated silex, some of which he had with him, which was exactly similar to what he found within a mile of his own house. There were traces of iron in it; and it would lead one to suppose that the stratification in England and France were identical. At Grenelle the water rose some 36 metres above the level of the ground, in very large quantities. Glass vessels which were left in it for some time assumed a yellow tinge, showing it was impregnated with iron, and he also found that it was used for medicinal purposes. He asked the man who was in charge of the works if he found any diminution in the quantity when a second well was sunk at Passy, and he said that it had a slight effect upon it; so that the same result was produced, as Mr. Lucas had stated, in London. He was often asked to give advice, with regard to sinking wells in London, and on one occasion, being abroad, when a letter making such inquiry was forwarded to him, it struck him that it would be possible to discover some law by which the height to which these subterranean waters would rise would be predicted. He therefore got the best map he could of Paris, drew out a diagram, and found that the water at Grenelle ought to rise to thirty-six metres above the ground, which, on referring to a little book giving the particulars of the works, he found to be exactly correct. The same applied to a well at Elbœuf. He took a line from Lusigny, where green-sand water first appeared, to Havre, where it had its outfall, and found he could foretell exactly the height to which the water would rise all along that line. M. Arago had also said that if the water rose to a certain height at Elbœuf it would rise above the ground at Paris, and someone else predicted that it would be found at Lusigny, but he believed that he himself had the credit of having first shown how the question could be determined. He then applied the same principle to the chalk water under the London basin. Taking the mean tide level of the water in the Thames about Deptford, and drawing a line to a certain spot near the River Colne, that would give you to a foot the height to which the water would rise. Mr. Homersham had called in question the depression of the water, but there could be no doubt of the fact. The New River Company sunk a well in Tottenham-court-road, to test the possibility of getting a large supply from the chalk, and during eight years, being an intimate friend of the engineer, he had daily measurements, except when they were pumping, of the height of the water. He found that, during those eight years, it sank from 110 ft. to 123 ft. He had not troubled about the matter lately, but he was quite certain that the wells had sunk since he measured them. It was a gradual depression, though not constant, because a heavy rainfall would counteract it, and he had proved, by a long series of observations, that when there was a large quantity of percolation, as shown by Dalton's gauge, the wells rose. Some time ago, he read a paper at the Institute of Civil Engineers, when Mr. Fredk. Braithwaite showed that, in Messrs. Combe's well, there had been a tremendous depression. He could well understand that it did not appear at Plumstead, because that was about the natural outfall of the whole water from the chalk. It had been found, also, that the water in the well at the Hampstead-road rose and fell, according as they were pumping or not from the well in Liquorpond-street. The water, therefore, rose with a rainfall, but there was a general depression, owing to the demand being greater than the supply.

Mr. Fitzgerald asked if the water in artesian wells in England was generally fit for drinking purposes?

The Chairman said it was generally—not always.

Mr. Fitzgerald said he had been informed there were many such wells in America, but the water was apt to be alkaline.

The Chairman said that was often the case; but sometimes sufficient care was not taken. In the vale of Aylesbury, near the outcrop of the Oxford clay, there was a well, where the water was pure at first, but after a short time through standing in the shaft sunk in the clay it became unfit for use. A second boring was then made, and the tube carried up to the surface, and the water remained perfectly pure. He concluded by moving a vote of thanks to Mr. Lucas.

The motion having been carried unanimously,

Mr. Lucas, in reply, said it was quite true that there was an area in which the chalk was almost waterless, as Mr. Latham had said, between the Wandle and the Ravensbourne, but that did not affect the question of the height to which the water would rise. The quantity might be small, because that depended on the capacity of the fissures. From some cause, which he could not attempt to explain, there was a great paucity of these fissures in that area, whilst in others they were very numerous, probably indicating a line of weakness in the tertiary strata above. He did not believe there was any chemical difference in the chalk water found under the tertiary strata, or that the chalk water proper was affected by being under the London clay. With regard to the quantity of water, he felt sure that many people who had pumps and wells of their own would agree with him that the power of the pumping machinery in London at the present time was out of all proportion to the quantity of water which could be raised by it. Not very long ago he read a paper on the chalk water at the Institution of Civil Engineers, in which system he stated that the pumps must be lowered to increase the quantity of water, and though his position was severely contested, he found that since the reading of that paper there were very few wells on the south of the Thames which had not lowered their pumps. At Messrs. Reid's in Liquorpond-street, they had made a series of observations which would be found in the tables, and notwithstanding the enormous storage capacity in that well, they could pump it to the bottom in about three hours. He agreed with Mr. Latham that the lower green sand could never be looked to as the supply for London, the quantity being much less than could be obtained from the chalk. In the lower green sand at Messrs. Meux's well he certainly recognised the same beds as occurred in Kent.

Mr. Baldwin Latham moved a vote of thanks to the Chairman, which concluded the proceedings.

CHALK WELLS IN THE THAMES BASIN EAST OF THE RAVENSBOURNE.

Measured by W. Morris, Esq., C.E., Engineer to the Kent Water Company.

	Ground above O.D.	Depth of Well.	To Chalk.	Top of Chalk above O.D.	Date.	To Water.	Water-line above O.D.	Remarks.
East Wickham—	Ft.	Ft.	Ft.	Ft.	1876	Ft.	Ft.	
Cemetery-cottages......	107·0	...	46·75	60·25	Jy. 24 1877 Mar31	91·8 93	15·33 14	
Russell-cottage	47·57	...	17	30·57	Mar. 30	35	8·57	
Suffolk-place	49·7	...	24	25·7	Mar. 30	45	4 7	
Crayford—					1876			
Kent Waterworks (1)...	28·75	28	In chalk.		July 23	12	16·75	
Crayford—	Ft.	Ft.	Ft.	Ft.	1876	Ft.	Ft.	
Kent Waterworks (2)...	30·75	34	In chalk.		July 23	14	16·75	With a bore 150 ft.—24 in. for 10 ft., 18 in. for 40 ft., below which 15 in.
Belvedere—								
Kent Waterworks	82·68	90·5	...	...	July 23	78·5	34·18	
Plumstead—								
Kent Waterworks	82·51	139·75	133·75	6	July 23	51·11	Below 1·4	3 p.m. after pumping.
Charlton—								
Kent Waterworks	...	...	...	...	...	...	...	Disused.

WELLS IN THE THAMES BASIN EAST OF THE RAVENSBOURNE

Communicated by the Surveyor-General of the Ordnance.

WOOLWICH.

	Height of Ground above O.D. (approx.)	Diameters.		Depths.					Bottom of Shaft below O.D.	Height Water rose when sunk.			Depth of Pumps & Suction.		Height of Water-line.						Yield.						Cost.	Sunk by
		Shaft.	Bore.	Shaft.	Bore.	To Chalk.	In Chalk.	Total.		Date.	Below Ground.	Above O.D.	Below Ground.	Below O.D.	Date.	Before Pumping		After Pumping		Difference.	No. of Hours Pumping.	Gallons per Hour.	Total Gallons.	Capacity of part of Shaft exhausted.	Difference = Springs	Gallons per Hour at Suction.		
																Below Ground.	Above O.D.	Below Ground.	Above O.D.									
Royal Arsenal—	Ft.	Ft.	In.	Ft.	Ft.	Ft.	Ft.	Ft.	Ft.		Ft.	Ft.	Ft.	Ft.	1861	Ft.	Ft.	Ft.	Ft.	Ft.				Gals.	Gals.		£ s. d.	
1. S.W. corner of Royal Laboratory-yard........	30	...	12	51⅛	312⅔	54½	...	364	...	1861	...	...	never used.		...	...	...	...	...	...	...	...	...	...	...	...	999 2 9	Docwra
2. Under engine-room of Genl. Factory, Royal Laboratory Departmnt.	29	...	5	...	160	...	...	160	...	1855	...	...	...	...	?	?	...	17	12	...	...	7020	...	...	...	...	...	Hall
3. Royal Laboratory Department, near Cartridge Factory	22	...	10	...	550	5⅔	...	550?	...	1856	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	Thos. Clark
4. Under engine-room S. end of scrap forge	22	...	?	..	165	...	...	165	...	1855	...	...	...	...	?		...	25½	Below.	...	...	...	...	...	...	...	431 11 0	Thos. Clark
5. Saw-mills, Royal Carriage Department	16	6½	14?	46¾	160¾	...	...	207	...	1855	...	...	...	...	April 9	..	...	22?	6	...	...	...	...	...	...	...	943 11 0	Thos. Clark
H.M. Dockyard	20	12 for 30 6 for 40	18	70	...	20	...	698	...	1848	...	...	48¼	283	1865 July 18*	35	...	48¼	2-¼	13¼	1¾	†	...	2,341	...	30,540 nearly	...	Thos. Clark

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* Commenced pumping, July 18, 1865, at 11.15 a.m., 35 ft. below ground. At 11.30, 42 ft. At 11.45, 46 ft. 9 in.; at and below this point, 509 gallons per minute were raised. At 12, 47 ft. 9 in. At 12.30, 48 ft.; at this point, spring nearly equal to raising power of pumps, 509 gallons per minute. At 1, 48 ft. 3 in.; at this point pumps drew air. [The point at which the springs would actually yield 509 gallons per minute was therefore below the limit of suction.]—J. L.

ark, in proceedings of Institute of Civil Engineers:—While pumping, at 70 ft. below ground, the springs gave 60,000 gallons per hour.

ARTESIAN WELLS IN THE RAVENSBOURNE VALLEY.

A.—*In Area of Overflow.*—Brewery, Elmer's-end.—Water from sand flowed 4 ft. above ground; on reaching chalk, the water fell to 3 ft. below ground (Eastell).

BROMLEY.—*B.—Not in Area of Overflow.*

	Height of Ground above O.D. (approx.)	Diameters.		Depths.					Below O.D.		Height Water rose when sunk.			Depth of Pumps and Suction.				Height of Water-line.							Difference.	Yield.						Sunk by
		Shaft.	Bore.	Shaft.	Bore.	To Chalk.	In Chalk.	Total.	Bottom of Shaft.	Bottom of Bore.	Date.	Below Ground.	Above O.D.	Below Ground	Suction below Ground.	Above O.D.	Below O.D.	Date.	Before Pumping. Below Ground.	Before Pumping. Above O.D.	Before Pumping. Below O.D.	After Pumping. Below Ground.	After Pumping. Above O.D.	After Pumping. Below O.D.		No. of Hours Pumping.	Gallons per Hour.	Total Gallons	Capacity of part of Shaft exhausted.	Difference = Springs.	Gallons per hour at Suction.	
	Ft.	Ft. In.	In.	Ft.	Ft.	Ft.	Ft.	Ft.	Ft.	Ft.		Ft.	Ft.	Ft.	Ft.	Ft.	Ft.		Ft.	Ft.	Ft.	Ft.	Ft.	Ft.	Ft.				Gals.	Gals.		
Widmore Kiln	190	6 0	9	54	98	120	32	152	...	...	1869	...	...	54	82	108	...	1877	60	130	...	75	115	...	15	$\frac{1}{12}$	3600	†	...	...	...	Baker.
Bromley Gas Works (from the Engineer)	172	6 0	10,4	40	75	...	...	115	...	...	1863	42	130	37	61	111	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	Monkton.
Kent Water Works, Shortlands (1)	140	6 5	18	100	100	70	...	200	...	...	1865*	...	...	...	...	...		April	8	...	...	18	...	J. L.	10	$\frac{1}{6}$	6000	...	...	...	...	Baker.
do. (2)	140	5 4	18	100	100	...	...	200	...	...	1873	...	...	...	..	...											6300	...	...	...	...	
PENGE.																																
Crystal Palace	190	8 6	7	247	353	361	...	600	...	...	1852	92	100	136	172	18	..	1875. Feb. 15	100	...	...	149$\frac{1}{6}$	...	...	49$\frac{1}{6}$	3	...	34,540	partly headings.	...	2,483	Baker.
NEW CROSS.																																
Royal Naval School.	70	5 0	7	75	...	125	...	185	...	...	1844	...	...	58	87½	...	17½	1861 Feb 12 1877 Ap. 5	... 72	... J. L.	... 2	74½	...	4½	...	...	...	...	...	...	...	Braithwaite.
LEWISHAM.																																
Anchor Brewery Messrs. Nicholl ..	29	0 0	9	0	160	0	160	160			...	..	...	8	35	...	7	...		...	...	...	...	...	..	...	...	...	...	...	...	Speller.
DEPTFORD.																																
Kent W. W. Garden Well	21	10	...	90	...	in c	halk	90	69	...	‡	...	...	...	...	...	...	1876 Jly. 27	25	...	4	85	...	64	60	14	...	2,580,000	29,452	2,550,540	..	
do. New Bath	16·37	8	...	99	...	...	...	99	83	...	..	...	...	...	...	...	...	..	...	...	..	71	...	54½	...	15	...	1,290,000	...	...	...	
do. Twins ...	18·26	8	...	107	...	...	...	107	89	...	..	...	...	...	...	...	...	27	30	...	12	85½	...	67½	55	16½	...	2,673,000	19,280	2,653,720	...	
Penn's Engineering Works	32	7	10	28	150	...	...	178	...	..	1857	27	5	27	55	...	23	1877	35	...	3	45	...	13	10	...	7920	...	...	...	...	
Deptford Brewery ..	20	0	12	0	120	...	...	120	...	100	1847	6	14	on surf.	28	...	8	1877 Ap. 11	J. L.	...	...	22½	...	2½	...	...	...	...	...	...	...	Baker.

Beckenham-place.—Shaft, with a boring to the chalk. No information. | Beckenham Junction.—Well, with boring to the chalk; disused. No information.

ARTESIAN WELLS IN THE METROPOLITAN AREA SOUTH OF THE THAMES.

PECKHAM.

	Height of Ground above O.D. (approx.)	Diameters. Shaft.	Diameters. Bore.	Depths. Shaft.	Depths. Bore.	To Chalk.	In Chalk.	Total.	Bottom of Shaft.	Bottom of Bore.	Date.	Below Ground.	Above O.D.	Below Ground	Suction below Ground.	Above O.D.	Below O.D.	Date.	Before Pumping. Below Ground.	Before Pumping. Above O.D.	Before Pumping. Below O.D.	After Pumping. Below Ground.	After Pumping. Above O.D.	After Pumping. Below O.D.	Difference.	No. of Hours Pumping.	Gallons per Hour.	Total Gallons	Capacity of part of Shaft exhausted.	Difference = Springs.	Gallons per hour at Suction.	Sunk by
Gordon's Brewery ...	50	5	18	122	110	123	112½	235½	...	...	1876	49 4	...	42	...	...	...	1876 1877 Mar. 9	49⅓ 48⅓	...	...	...	...	...	11½	9	7700	69,372	117	69,255	Temp. 51	Docwra.
Brooks's Brewery ..	17	...	9	8	246	84	...	254	...	...	1876	23	...	on surf.	28	...	11	1877 Apr. 1	J.L. 23$\frac{1}{6}$	...	6 2	...	...	...	1	...	2500	...	...	...	...	Spellers.
Welsh Ale Brewery (Messrs. Liddell)	8	...	...	...	...	...	...	?275	...	...	...	...	...	9	38	...	30	1877 Apr.	9	...	1	...	...	...	...	...	...	...	...	...	...	S. F. Baker and Son.

* Said to have overflowed. † On cessation of pumping rises 15 ft. in one minute—from 75 to 60 ft. ‡ To level of Ravensbourne. ‖ From Council Minutes (? before or after pumping.)

BERMONDSEY.

	Height of Ground above O.D. (approx.)	Diameter.		Depths.					Height to which Water rose when sunk.			Depth to Pumps and Suction.			Height of Water-line.						No. of Hours Pumping.	Pumping at rate of Gallon per Hour.	No. of Gallons Pumped.	Capacity of part of Shaft exhausted.	Difference = Springs.	Springs at rate of Gallons per Hour.	Yield at Suction, Gallons per hour.	Sunk by
		Shaft.	Bore.	Shaft.	Bore.	To Chalk.	In Chalk.	Total.	Date.	Below Ground.	Below O.D.	Below Ground.	Suction below Ground.	Suction below O.D.	Date.	Before Pumping.		After Pumping.		Difference.								
																Below Ground.	Below O.D.	Below Ground.	Below O.D.									
	Ft.	Ft. in.	In.	Ft. in.	Ft. in.	Ft. in.	Ft. in.	Ft.		Ft.	Ft.	Ft. in.	Ft. in.	Ft.		Ft. in.	Ft. in	Ft. in.	Ft. in.	Ft				Gals.	Gals.			
Oastler, Palmer & Co., Willow-walk*	9	0	10	0	140	126	14	140	1862	...	...	100	130	121	1877 Feb.	40	31	...	...	...	...	5,700	...	...	...	...	...	S. F. Baker and Son.
Donkin and Co., Blue Anchor-road	8	...	10½	9 6	223 6	91 6	140 6	233	1858	...	...	9 6	38	30	1864 Feb. 5	16 3	8 3 ...	38 9 ...	30 9 ...	22 6 ...	13¾ ...	1,800 ...	23,850 ...	... ...	... ...	... ...	... ...	„ „
Beach's tan-yard, Willow-walk*	10	0	12	0	112	?	0	112	1851	3 to 4	...	60	90	80	...	...	...	...	...	...	...	...	...	...	...	...	...	„
Cooper's, Crimscott-street*	10	...	12	...	...	120 ?	0 ?	140?	1863	30	20	18	46	36	†1873	39	29	...	...	...	...	...	...	...	...	...	...	Norton's Co.
E. Lazenby, Do.	11	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	..	...	...	...	...	...	...	...	...	...	...	
Hewit's, late Learmonth and Roberts A	10	5	18 to 10	45	...	127	...	195	1839 ?	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
B	10	5	10 to 6	60	45	102	30 ?	105	?	...	...	55	83	73	...	...	...	...	...	...	...	...	...	...	...	...	...	„
Oastler, Palmer & Co., Grange-road	12	...	10	...	232	...	...	232	1859	...	...	90	120	108	1877 Feb.	50	38	?	?	...	...	6,000	...	...	...	...	...	„ ‖
Cordrey's, Long lane	13	3	...	100	...	149	...	...	1865	...	...	20	48	35	...	...	...	...	...	...	1 min.	6,000	...	...	...	...	...	
Hepburn and Co., Long-lane	12	6 6	12	80 8	..	184	104 6	288½	Sunk 1859 Bored 1860	...	...	76	105	93	1877 Ap. 21 Ap. 23 Mon.	64* 58 2	52 56 2	78 4 78 4	66 4 66 4	14 3 20 2	32 43	6,900 6,900	3,680 4,945	2,946 4,170	734 775	1,380 1,080§	5100	S. F. Baker and Son.
Mathews, old*	12	..	...	...	...	160 ?	...	...	1820	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	„
Mathews, new*	12	...	14, 8	...	230	170	60	230	1876	56	44	100	127	115	...	...	..	...	...	...	...	...	...	...	...	...	...	„
Margetson*	12	...	15	...	...	170	9	179	1853	38	26	..	...	...	1871	74	62	...	...	...	...	...	...	...	...	...	...	„
SOUTHWARK.																												
Guy's Hospital	14	...	...	133	...	197	100	...	1859	63	49	...	...	...	1877 Ap. 4	J. L. 79 8	65 8	During deepening of bore.										Docwra.
Barclay Perkins, A.	12	Dis	used.	...	...	...	...	...	...	...	...	...	...	...	...	...	...											
Do. do. B.	12	6	18, 10	211	227 6	202 6	236	438½	1871	...	...	165	193	181	††	...	...	113	101									
Messrs. Pott's Vinegar Works	12	...	...	114**	...	...	...	...	1827	30	18	73	101	‖‖89	1852 June 1877 Ap. 6	73 J. L. 91	61 79‡‡											

* Pumps fastened on to bore-pipes.
† During repairs.
‡ Pumped out to suckers three times a day, to fill 18,000 gallons tank. Pumped out in one hour.
‖ Deepened 106 feet, February, 1877.

§ N.B.—Water-line, 78 ft. 4 in.; springs yield 4,380 gallons per hour.
** With a boring.
†† 1877, April 9, 4 p.m., during pumping (J. L.).
‡‡ Well not used.
‖‖ N.B.—In 1844 pumps lowered 30 ft.

LAMBETH.

	Height of Ground above O.D. (approx.)	Diameters.		Depths.					Height to which water rose when first sunk.					Depth to pumps and suction.			Height of Water-line.						No. of hours pumping.	Pumping at rate of gallons per hour.	Number of gallons pumped.	Difference = Springs.	Sunk by
																		Before Pumping.		After Pumping.							
		Shaft.	Bore.	Shaft.	Bore.	To Chalk.	In Chalk.	Total.	Date.	Above Ground.	Below Ground.	Above O.D.	Below O.D.	Below Ground.	Suction below Ground.	Suction below O.D.	Date.	Below Ground.	Below O.D.	Below Ground.	Below O.D.	Difference.					
	Ft.	Ft. In.	In.	Ft.	Ft.	Ft.	Ft.	Ft.		Ft.	Ft.		Ft.	Ft.	Ft.	Ft.	1877	Ft.	Ft.	Ft. In.	Ft.	Ft.					
Beaufoy's, Old	15	...	...	...	...	...	...	...	...	...	...	...	...	68?	98?	...	April 9	(J.L.) 42	27	...	...	.	..	...	...	...	
Beaufoy's, New	15	...	...	...	...	201	174	375	...	...	...	...	...	...	...	...	...	..	...	...	...	...	...	...	...	...	
Hill & Co., Crown Works	13	5 0	12,8	107	194½	188	113½	301½	1870	...	...	...	...	44	72	59	...	...	...	...	...	...	...	...	...	...	S. F. Baker & Sons.
Burnett's, Vauxhall	14	6 0	12	98	227	224	101	325	1850	...	50	..	36	85	115	101	April 7	...	...	(J.L.) 80	66	...	...		...	...	Roberts.
Workhouse	12	5 0	...	...	...	...	...	300	1875?	...	...	...	...	64	92	80	Apr. 16*	(J.L.) 68	56	[74]	[62]	[6]	...	3800	...	...	Baker.
Oakey & Co.	12	6 0	12,9	105	217	212	108	320	1873	...	63	...	51	60	88	76	...	...	...	...	...	...	...	...	...	...	Baker.
Lion Brewery	12	6 0	a 6 b 12	156	252	245	163	a308 b408	1837	...	40	...	23	130?	161	149	...	...	...	...	...	...	...	..	...	...	Baker.†
Clowes's, Duke-street	15	5 6	...	119	...	210	...	...	...	...	...	...	...	95	...	123	1876 June 8 June 18 July 19 Sept. 6 Nov. 13 Dec. 19	93 99 95 101 96 89	1876 May 20 78 84 80 July 28 86 81 Dec. 15 74	... 107 ... ... 110 108	... 92 ... ... 95 93	...	...	...	...	...	Baker.
ST. GEORGE'S.																											
Bethlehem Hospital	12	6 0	...	95	160	200	...	255	...	...	15‡	...	...	70	110	98	1864 Aug. 13 1877 April 6	50 64	38 52	summer 1876§ 84	... 72	...	...	...	...	...	
BATTERSEA PARISH.																											
Orlando Jones and Co., Starch Works	15 0	...	...	143	208	249	102	351	...	...	...	...	...	...	...	...	1877 Jan. 2	(J.L.) 46	31 0‖	...	...	...	...	...	...	...	Baker.
Beaufoy's, Pays Bas A., Old Well	8 0	...	...	...	...	...	...	240		Overflowed.				29	58	50	1870 Mar. 16 1872 May	27 29	19 0 21 0								
Beaufoy's, Pays Bas B., New Well	7 6	...	...		...	...	...	...	...	...	...	...	...	...	...	...	1873 Mar. 12	28½	20 6								
TOOTING PARISH.																											
Attlee's Brewery	52 0	...	...	...	...	116	...	117	1874	8	..	60	...	on surface.	28**	...	...	...	...	...	...	...	...	..	...	...	Eastell.
STOCKWELL-GREEN.																											
Hammerton's Brewery ‡‡	31 0	7 0	12,4	120	230	211	139	350	..	...	...	...	...	38	66	35	[1869	...	...	49 8	18 8	...	15	2880	43200	43200	S. F. Baker & Sons.
Waltham's Brewery	36 0	4 0	9	§§94	...	210	100	310	1859	...	44	...	8	...	..		1866	59	23 0	...	..	...	...	††	..**	...	

* Commenced pumping 2 50 p.m.
† Deepened 1868.
‡ ? higher.
§ Pumps on surface 30 years ago. New pumps fixed at 50 ft. 1864; lowered 20 ft. 1875. Suction direct from bore-pipe.
‖ Silted up to 115 ft from surface.
** Water would overflow. Pumps fastened on to bore-pipe, which is provided with a tap to let water run off when pumps are at rest.
†† Yield of springs at 18 ft. 8 in. below O.D.
‡‡ Water from chalk confined in bore-pipe. Top of bore-pipe 40 ft. 10 in., below ground. Water from Thanet sand in shaft.
§§ Bore-pipe from chalk 18 ft. above bottom of shaft.

ARTESIAN WELLS IN THE WANDLE BASIN.

A.—In Area of Overflow.

WANDSWORTH PARISH.

	To Chalk.	In Chalk.	Total.	Temperature, Centig.	Date.	Height of Ground above O.D. (approx.)	Water rose above Ground.	Water rose above O.D.	Serves at present. Cistern.	Serves at present. Fountain.	Serves at present. Stand-pipe.	Water rises above O.D.	Depths below O.D. of Top of Chalk.	Depths below O.D. of Bottom of Bore.	Diameter of Bore.	Bored by	Date.	Remarks.
GARRATT—	Ft.	Ft.	Ft.		1876	Ft.			Feet above ground.			Ft.		Ft.	In.			
Mr. Fenton's	...	...	360	...	Mar. 20	30	...	...	8	...	...	38	...	...	...	...	...	To sand.
Garratt Farm	360 ?	5 ?	365 ?	...	,,	36	7	43	7	...	...	43	...	324	6, 5, 4	Eastell	...	To muddy sand, 375 ft. (Eastell.)
Mr. Little's	...	...	300	12·5	,,	25	16	41	16	...	...	41	...	275	6, 5, 4	Eastell	1871	
Elton's Dye-works	...	...	258½	...	,,	36			...	...	...	...	...	...	...	Kemsley	...	Bored hy Denning. (Eastell.)
Althorp-lodge	...	...	240	...	...	34	20	54	...	...	...	...	...	...	6, 4½	Mallard	...	To sand.
SUMMERS-TOWN—																		
Sir Jeffery Dunstan	...	...	195 ?	12·5 12·5 12·5	,, Aug. 22 Dec. 20	31	10	41	...	...	1⅔	...	...	164	9, 4½	Mallard	...	195 ft. (?). To grey sand.
Sadler's-cottages	...	...	150			32	20	52	12	41	...	44	...	...	9, 6	Eastell	1866	To grey sand. Water rose 20 ft. above ground.

STREATHAM PARISH.

	To Chalk.	In Chalk.	Total.	Temperature, Centig.	Date.	Height of Ground above O.D. (approx.)	Water rose above Ground.	Water rose above O.D.	Serves at present. Cistern.	Serves at present. Fountain.	Serves at present. Stand-pipe.	Water rises above O.D.	Depths below O.D. of Top of Chalk.	Depths below O.D. of Bottom of Bore.	Diameter of Bore.	Bored by	Date.	Remarks.
St. Clement Danes Almshouses	...	...	155	...	1876 Mar. 20	42	...	...	...	8	...	50	...	...	...	...	...	Into the grey sand.
Mr. Robinson's	...	...	150	...	Mar. 20	35	...	...	5	...	...	40	...	...	4, 3	Eastell	...	Into the grey sand.
Blackshaw-lane	...	...	150	...	Mar. 20	32	...	..	12	...	...	50	...	...	...	Eastell	...	Into the grey sand.
Mr. Martin's	...	...	...	...	...	...	...	...	...	...	3	...	...	..	...	Eastell	...	
Mr. Brigden's	...	...	...	11·6	Dec. 20	...	...	...	...	...	...	..	...	...	...	...	...	Distributed among several cottages.
Rollison's Nursery	...	...	128	...	Dec. 20	58	...	...	...	6	...	64	...	...	...	...	...	To sand.

TOOTING PARISH.

	To Chalk.	In Chalk.	Total.	Temperature, Centig.	Date.	Height of Ground above O.D. (approx.)	Water rose above Ground.	Water rose above O.D.	Serves at present. Cistern.	Serves at present. Fountain.	Serves at present. Stand-pipe.	Water rises above O.D.	Depths below O.D. of Top of Chalk.	Depths below O.D. of Bottom of Bore.	Diameter of Bore.	Bored by	Date.	Remarks.
Bell's Farm	...	...	80	11	1876 March	45	...	...	...	...	...	...	...	35	...	...	...	To grey sand.
Parker's Nursery	...	...	126	...	...	45	...	...	...	...	...	45	...	44	...	Eastell	1864	Into tbe chalk.
Fountain P.H.	...	...	90	11	...	46	...	...	...	4	...	50	...	...	...	...	...	20 ft. into sand. (Eastell.)
Fountain-road	100	15	115	...	...	40	...	...	...	...	...	45	60	...	...	Eastell	1864	
,,	...	10	131	...	...	38	...	...	...	...	...	...	...	...	...	Eastell	...	
Lambeth Cemetery, A	135	10	145	...	...	40	...	...	...	...	8	48	95	...	...	Eastell	...	
,, ,, B	...	...	150	...	...	40	...	...	...	...	...	...	...	...	...	...	...	To chalk.
Martin's Brickfield	...	...	...	12	...	40	...	...	...	...	...	...	...	...	...	Eastell	...	
Lane's-cottages	142	12	154	...	...	48	...	...	...	3½	...	51½	94	...	...	...		
Wallace's-cottages	138	15	153	...	...	56	...	...	...	...	...	...	82	...	...	Eastell	1870	
Betts's-cottage	...	...	95	...	...	55	...	...	...	..	...	...	...	...	...	...	...	To sand.
The Limes	130	10	140	...	...	54	...	...	...	...	...	...	76	...	...	Eastell	1870	
"Trafalgar Arms"	...	...	130	...	...	60	...	...	...	...	...	..	...	...	...	...	...	Did not rise to surface. Not in use. To sand.
Grove-house	...	...	...	...	March	60	...	...	...	...	...	...	...	...	...	Eastell	1864	
Eldon-house (new)	144	12	156	...	,,	60	...	...	...	3	...	...	84	...	...	...	...	
,, (old)	...	...	...	...	,,	62	...	...	...	...	...	...	...	...	...	...	...	To sand (?). Just reaches surface.
The "Britannia"	...	...	136	12	,,	59	...	...	...	...	...	...	...	77	...	Mallard	...	To sand.
Old, near do.	...	...	..	...	,,	...	...	...	...	...	...	...	...	...	...	Mallard	...	Closed.
Defoe-road, No. 1	...	...	80	...	,,	52	...	...	...	10	...	...	...	...	...	...	...	To sand.
,, Shellard's	100	16	116	10·5	,,	49	14	63	...	...	...	...	51	67	...	Eastell	1875	London clay ahsent.

TOOTING PARISH—*continued.*

	To Chalk.	In Chalk.	Total.	Temperature, Centig.	Date.	Height of Ground above O.D. (approx.)	Water rose above Ground.	Water rose above O.D.	Serves at present. Cistern.	Serves at present. Fountain.	Serves at present. Stand-pipe.	Water rises above O.D.	Depths below O.D. of Top of Chalk.	Depths below O.D. of Bottom of Bore.	Diameter of Bore.	Bored by	Date.	Remarks.
	Ft.	Ft.	Fr.		1876	Ft.	Ft.	Ft.	Feet above ground.			Ft.	Ft.	Ft.	In.			
Brewer's-cottages	...	...	126	10·5	,,	48	...	...	...	..	...	...	...	78	...	...	...	To chalk.
Attlee's Brewery	116	...	117	...	,,	52	8	...	...	...	...	...	...	...	...	Eastell	1874	Into chalk.
Stevenson's	124	4	128	...	,,	58	...	...	...	8	...	66	67	...	...	...	...	To sand. 125 ft. of piping.
Williamson's	..	...	113	...	,,	54	...	...	...	...	...	...	...	...	...	...	...	To sand.
Betts's	126	10	136	12	,,	53	...	...	...	...	...	...	73	83	...	...	...	
Dr. Batt's	...	...	...	...	,,	...	...	...	...	...	...	...	...	...	...	Mallard	...	To sand.
,,	...	...	...	...	,,	..	...	...	...	...	...	..	...	...	...	Mallard	...	To chalk.
Holmbury	...	...	...	11·5	,,	56	...	...	...	...	...	...	...	...	...	...	...	Sand.
Park-house	149	1	150	...	,,	56	...	...	...	6	...	...	93	...	...	...	...	
Near Tooting Church	...	...	130	12	,,	58	...	...	...	...	...	...	...	...	...	...	1822	Sand.
Tooting Rectory	...	...	170	...	,,	...	...	..	...	...	...	...	...	...	...	..	...	14 ft. in grey sand. Sunk 20 ft., bored 150 ft.
Mr. Gibson's	210	20	230	...	,,	58	...	...	...	4	...	...	152	...	...	Eastell	...	

MITCHAM PARISH.

	To Chalk.	In Chalk.	Total.	Temperature, Centig.	Date.	Height of Ground above O.D. (approx.)	Water rose above Ground.	Water rose above O.D.	Serves at present. Cistern.	Serves at present. Fountain.	Serves at present. Stand-pipe.	Water rises above O.D.	Depths below O.D. of Top of Chalk.	Depths below O.D. of Bottom of Bore.	Diameter of Bore.	Bored by	Date.	Remarks.
Waterfall-house	187	...	...	..	,,	48	...	...	...	...	...	...	...	...	...	...	...	
Longley-road	...	7	...	...	,,	abt. 55	7	62	...	...	...	...	132	139	...	Eastell	1876	
Waterfall-villas	157	...	...	...	,,	47	...	...	...	...	...	...	...	...	...	...	...	
Waterfall-cottages	..	18	175	...	,,	47	...	...	...	...	7	51	110	...	...	...	...	
Mr. Batchelor's	...	...	219	...	,,	50	...	...	...	...	...	...	...	...	...	Eastell	1870	In chalk.
Collierswood	210	...	...	...	,,	...	...	...	...	3½	...	...	...	...	..	...	...	
Phœnix-villa	168	15	225	...	,,	55	...	...	7	...	...	62	155	...	...	Eastell	1875	
Clarke's, Acton-terrace	...	12	180	...	,,	47	...	...	...	...	8	55	121	...	...	..	...	
Cottages near "Red Lion"	180	...	...	...	,,	45	...	...	...	...	5	50	...	...	...	Eastell	...	
Byegrove-house	...	10	190	...	,,	44	...	...	...	8	...	52	136	...	...	Mallard	...	
Byegrove-cottage	174	...	...	12·5	,,	40	..	...	...	...	7	47	...	...	...	Eastell	...	Very strong.
Clare-villas	...	6	180	...	,,	40	...	...	...	...	7	47	134	...	...	Eastell	...	
Legge's	...	...	..	12	,,	40	...	...	...	...	7	47	...	...	...	...	...	Very strong.
New Vicarage	...	...	...	12·4	,,	50	...	...	...	...	2	52	...	...	...	Neal	...	
Grey's	220	...	220	12·5	,,	40	...	...	...	5	...	...	...	180	...	...	...	In chalk.
New Singlegate Schools	...	14	234	...	,,	41	...	...	...	...	10	...	179	...	...	Eastell	1874	
Fountain-cottage	250	...	260	13	,,	46	...	...	...	5	...	...	...	214	...	...	...	In chalk.
Latham's	...	10	260	12·5	,,	50	...	...	...	4½	...	51½	200	210	4, 3	Eastell	1874	
Hope-cottages	225	...	260	12·3	,,	48	...	...	...	...	3	...	...	212	...	Mallard	...	In sand.
Lewis's-cottages	...	25	250	...	,,	63	...	...	...	...	...	...	162	...	...	Eastell	1865	
St. Saviour's Schools	...	...	210	...	,,	70	...	...	...	...	...	...	...	...	...	Eastell	...	Sunk 50 ft., bored 160 ft. Water rose to surface.
Sibthorp-road	225 ?	...	200	...	,,	70	...	...	...	...	...	...	...	...	...	...	...	
Gas-works	184	25 ?	250 ?	...	,,	63	...	...	...	...	...	...	162 ?	...	...	...	...	
Mitcham-house	190	16	200	...	,,	68	2½	...	...	...	...	...	116	...	...	...	...	
Cotton Print-works	...	21	211	...	,,	64	...	...	...	...	4	...	126	...	...	...	...	Nightingale's Factory, much less.
"Bath" Tavern	310	...	293	12·3	,,	56	...	...	...	...	...	...	...	...	...	...	...	
Mr. Hatfield's	220	5	315	...	,,	54	...	...	...	5	...	...	256	...	...	...	..	
Raven Spring	170	40	260	...	,,	56	...	...	...	...	...	...	164	...	...	Eastell	1875	
Surrey Brewery	170	55	225	...	,,	68	..	...	...		...	...	102	...	...	...	...	
Baron-house	170	...	170	...	,,	70	6	...	...	3	...	73	100	...	...	...	.	Used to flow 6 ft. above ground.
Mitcham-hall	180	130	300	...	,,	70	...	...	...	...	...	...	100	...	...	Eastell	1874	
Sampson's-yard	...	10	190	...	,,	70	...	...	...	...	...	...	110	...	...	Eastell	1871	Flows at surface into tank; weak; does not flow in summer.
Mitcham Vicarage	...	...	...	11·3	,,	64	...	...	...	...	...	...	...	...	...	..	...	Flows at surface into pond.
The Cannons	...	...	...	...	,,	75	...	...	...	...	...	...	...	...	...	...	1822	Has been dry for twenty years.

MORDEN PARISH.

	To Chalk.	In Chalk.	Total.	Temperature, Centig.	Date.	Height of Ground above O.D. (approx.)	Water rose above Ground.	Water rose above O.D.	Serves at present. Cistern.	Serves at present. Fountain.	Serves at present. Stand-pipe.	Water rises above O.D.	Depths below O.D. of Top of Chalk.	Depths below O.D. of Bottom of Bore.	Diameter of Bore.	Bored by	Date.	Remarks.
	Ft.	Et.	Ft.			Ft.	Ft.	Ft.	Feet a	bove g	round.	Ft.	Ft.	Ft.	Ft.			
Morden-hall	...	...	320	...	1876 March	52	...	...	...	4	...	...	...	...	...	Mallard	...	
MERTON PARISH.																		
Nelson's-fields	217 ?	8 ?	225	12·1	1876 March	51	...	...	...	3	...	...	166	174	...	Cleaned by Eastell	1874	
High-street	...	...	...	12·0	1877 Mar. 22	48	...	...	...	...	...	...	...	...	...	...	...	
Baker's shop	...	...	...	...	Mar. 22	48	...	...	5	...	...	...	...	...	...	...	...	Just reaches surface.
Spring-house	...	...	...	...	Mar. 22	52	...	...	...	...	...	...	...	...	...	...	...	
Merton Flock Mills, formerly Copper Mills...	...	...	...	...	...	43	30	73	...	...	...	...	...	...	...	..	...	This boring no longer exists.
WIMBLEDON PARISH.																		
Hartfield-road	193¾	75	268¼	...	1876 March	55 ?	4	...	...	...	...	...	...	...	...	Eastell	...	Just reaches surface.
Old Brickfield	...	...	...	...	,,	55 ?	...	...	...	...	...	...	...	...	...	...	...	
Ashbourne-terrace	...	...	...	...	...	abt. 65	...	...	...	...	...	...	...	...	...	Field	...	Pump. Does not overflow.
Holme Elms	...	...	...	...	...	..	...	...	...	...	...	...	...	...	...	...	...	Covered.
"Duke of Edinburgh"	..	...	...	...	,,	52	...	...	...	5½	...	58	...	...	...	...	...	
Montague-lodge	...	...	...	...	,,	48	...	...	...	3½	...	51	...	...	...	...	...	
Fern-bank	...	...	...	...	,,	53	...	...	...	1	...	54	...	...	...	...	...	
Lamprew's	...	...	...	...	,,	55	...	...	...	...	...	...	...	...	...	...	...	Has not flowed for three years.
Rose-cottage	...	...	..	...	,,	50	...	...	...	2	...	52	...	...	...	...	...	
Hamilton-terrace	...	16	200	...	,,	47	...	...	6	...	...	53	...	...	...	Eastell	...	
Woodbine-terrace	...	15	192	...	,,	46	...	...	...	...	...	...	...	...	...	Eastell	...	
British Land Company (formerly Creed's) ...	170	10	180	...	,,	46	...	...	6	...	...	52	124	...	...	Eastell	...	
No. 2, Hubert-road	...	...	...	...	,,	...	9	...	...	...	1	...	...	...	...	Field	...	
St. George's-terrace	170	10	180	...	,,	42	...	...	...	...	...	...	128	...	...	Eastell	...	
Bank-buildings	...	...	...	...	,,	...	...	...	...	...	7	...	...	...	...	...	...	Distributed.
Wandle-bank-house	...	...	...	...	,,	40	...	...	...	...	...	...	...	...	..	...	...	Shaft 8 ft. diameter; 70 ft. to 80 ft. deep; sunk in 1780. Bored deeper subsequently.
Mill-cottage	...	...	...	12·7	,,	...	...	...	...	6	...	...	...	...	...	Eastell	...	
Wandle-bank-villa	...	...	...	12·2 12·5	,, Aug. 22	40	...	...	...	...	10	...	...	...	...	...	...	
Cooke's, South-road	177	15	192	...	,,	45	...	...	...	..	...	...	...	...	...	Eastell	...	
Moore's, South-road	...	...	...	...	,,	44	...	...	...	...	...	...	...	...	...	Field	...	
Field's, North-road	...	...	...	...	,,	44	...	...	...	...	...	...	...	...	...	Field	...	
Parker's, North-road	...	...	...	...	,,	44	...	...	...	...	...	...	...	...	...	...	...	
Hayden's-lane Station	160	20	180	...	,,	54	...	...	...	...	...	...	106	...	...	Eastell	...	
Garrett Copper Works	...	...	143	...	...	35	20	55	...	...	...	...	...	108	...	...	...	Distributed. Very strong. To top of Thanet sand.
The Willows	...	...	256	...	,,	38	...	...	...	...	...	...	...	...	..	Eastell	...	Distributed. In chalk.
Wimbledon Sewage Works	277	121	398	...	March	52·25	...	51·75	...	...	...	...	225	...	...	Tilley	1876	Water rose to 51·75 ft. above O.D., delivering twelve gallons per minute.
The "Woodman"	...	...	355	...	...	55	...	...	...	...	...	...	...	300	...	Eastell	...	Does not rise to surface. Sand.

WANDLE BASIN.

B.—Not in Area of Overflow.

WANDSWORTH PARISH.

	To Chalk.	In Chalk.	Total.	Approximate Height of Ground.	Date.	To Water.	Water-line below O.D.	Depths of		Remarks.
								Shaft.	Bore.	
	Ft.	Ft.	Ft.	Ft. in.	1877	Ft. in.	Ft.	Ft. In.	Ft.	Memorandum from Mr. Rucker.
Hermann Rucker, Esq., West-hill	...	...	...	48 0	Jan. 2	67 0	19	157 0	...	A section made about twelve years ago represents the water-line at 26 ft. below the surface.
Young & Bainbridge's Brewery	...	60	344	18 0	Jan. 2	70 0	52	170 0	...	
House of Correction	...	...	...	100 7	Feb. 28	...	...	...	...	No water from chalk. To suckers, 218 ft.
County Lunatic Asylum, A	...	...	...	90 0	Feb. 28	143 while pumping	53	222 0	...	When sunk in 1840, water rose to 26 ft. from surface. In May, 1873, it stood at 43 ft. To suckers, 135 ft.
" " " B	...	342	342	94 0	Feb. 28	98·4 after pumping	4	...	...	

MITCHAM PARISH.

	To Chalk.	In Chalk.	Total.	Approximate Height of Ground.	Date.	To Water.	Water-line below O.D.	Shaft.	Bore.	Remarks.
Hooper's India-rubber Works	...	...	400	...	...	...	...	...	...	

MERTON PARISH.

	To Chalk.	In Chalk.	Total.	Approximate Height of Ground.	Date.	To Water.	Water-line below O.D.	Shaft.	Bore.	Remarks.
Morden-hall Farm	...	...	320	56 0	...	...	...	...	...	Does not overflow. Pumped from.

ARTESIAN WELLS IN THE BEVERLEY BASIN.

A.—In Area of Overflow.

MERTON PARISH.

	To Chalk.	In Chalk.	Total.	Temperature, Centig.	Date.	Height of Ground above O.D. (approx.)	Water rose above		Serves at present.			Water rises above O.D.	Depths below O.D. of		Diameter of Bore.	Bored by	Date.	Remarks.
							Ground.	O.D.	Cisterns	Fountains.	Stand-pipes.		Top of Chalk.	Bottom of Bore.				
	Ft.	Ft.	Ft.		1876	Ft.	Ft.	Ft.	Feet above ground.			Ft.	Ft.	Ft.	In.			
Manor Farm	...	...	...	...	...	52	...	...	...	...	...	..	...	...	...	...	...	
Broadwater Farm	...	...	...	11·5	...	48	...	...	..	...	...	50	...	...	...	Mallard	...	
Wooden cottages in Cannon-hill-lane	...	...	300	...	...	52	...	...	..	...	...	...	...	...	...	Thoms	...	Rises to surface. Dug 20 ft.
Blue-house Farm	...	...	295	...	...	...	...	...	...	...	...	...	...	...	...	...	...	Plastic clay at bottom. Does not now overflow. Cleared S. F. Baker & Sons.

MALDEN PARISH.

	To Chalk.	In Chalk.	Total.	Temperature, Centig.	Date.	Height of Ground above O.D. (approx.)	Water rose above Ground.	Water rose above O.D.	Serves at present. Cisterns	Serves at present. Fountains.	Serves at present. Stand-pipes.	Water rose above O.D.	Depths below O.D. of Top of Chalk.	Depths below O.D. of Bottom of Bore.	Diameter of Bore.	Bored by	Date.	Remarks.
	Ft.	Ft.	Ft.			Ft.	Ft.	Ft.				Ft.	Ft.	Ft.	In.			
Mosper Farm	...	...	310	...	1876 Sep.	...	...	...	...	...	...	*	...	...	...	S. F. Baker & Sons	...	*Stood 3 ft. 8 in. below ground. Bed of sand at 304 ft. 6 ft thick, from which water.
Worcester-park Station	...	...	284	...	...	70	...	...	...	...	...	...	...	...	–		..	Bed of sand at 281 ft. 2 ft. thick, from which water.

MORTLAKE PARISH.

	To Chalk.	In Chalk.	Total.	Temperature, Centig.	Date.	Height of Ground above O.D. (approx.)	Water rose above Ground.	Water rose above O.D.	Serves at present. Cisterns	Serves at present. Fountains.	Serves at present. Stand-pipes.	Water rose above O.D.	Depths below O.D. of Top of Chalk.	Depths below O.D. of Bottom of Bore.	Diameter of Bore.	Bored by	Date.	Remarks.
Mortlake Brewery	267	...	332	...	1871 April 16 Monday	...	...	...	...	To Water 42	...	...	...	...	9, 6, 4¾	...	1863	Bored by Self, of Kingston; deepened by Worsencroft, 1858.
Mr. John Randell's	315	50	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1836	Overflowed for a time at the rate of 5,000 gallons a day.

ARTESIAN WELLS IN THE BEVERLEY BASIN.

B.—Not in Area of Overflow.

WIMBLEDON PARISH.

	To Chalk.	In Chalk.	Total.	Approximate Height of Ground.	Date.	To Water.	Water-line above O.D.	Depths of Shaft.	Depths of Bore.	Remarks.
	Ft.	Ft.	Ft.	Ft. In.		Ft. In.	Ft.	Ft. In.	Ft.	
Manor-house	...	...	563	170 0	1798 1804	114 0 155 0	56 15	563 0	...	Sunk to Woolwich beds. This well is filled up.
Bunce's Farm	...	...	...	...	..	...	...	...	...	To grey (Thanet) sand, 301 ft.
Atkinson Morley's Convalescent Home	...	...	...	160 0	1877 Mar. 15	118	42	200 0	367	Land springs running into well.

MERTON PARISH.

	To Chalk.	In Chalk.	Total.	Approximate Height of Ground.	Date.	To Water.	Water-line above O.D.	Depths of Shaft.	Depths of Bore.	Remarks.
Cannon-hill, A	...	...	130	92 0	1876 Sept. 22	6 3	86	...	...	
„ „ B	...	...	...	95 0	Sept. 22	...	...	25 (dry)	...	With a bore to the chalk.

MORDEN PARISH.

	To Chalk.	In Chalk.	Total.	Approximate Height of Ground.	Date.	To Water.	Water-line above O.D.	Depths of Shaft.	Depths of Bore.	Remarks.
Morden-park	...	...	365	110 0	...	...	67	280 0	85	Water rose to 43 ft. below surface.
Lower Morden, P.W.	340	45	385	70 0	1863	...	70	...	...	Water rose to surface. Pump. Does not overflow.

ARTESIAN WELLS IN THE HOG'S MILL RIVER BASIN.

A.—In Area of Overflow.

KINGSTON PARISH.

	To Chalk.	In Chalk.	Total.	Temperature, Centig.	Date.	Height of Ground above O.D. (approx.)	Water rose above		Serves at present.			Water rises above O.D.	Depths below O.D. of		Diameter of Bore.	Bored by	Date.	Remarks.
							Ground.	O.D.	Cisterns	Fountains.	Stand-pipes.		Top of Chalk.	Bottom of Bore.				
	Ft.	Ft.	Ft.			Ft.	Ft.	Ft.				Ft.	Ft.	Ft.	In.			
Hodgson's Brewery, Brook-street	371	99	470	...	...	25	6	31	...	...	...	...	...	...	...	Tilley	1866?	Shaft 90 ft.
Thames-street	...	...	365	...	...	25	...	...	...	...	...	...	...	...	...	...	...	To surface.
Mr. Fuller's, near Cambridge Asylum	...	...	355	...	...	53	10	63	...	...	...	...	...	...	...	...	...	Disused. Has not overflowed for years. Until four or five years ago was worked by hand-pump.

B.—Not in Area of Overflow.

EPSOM PARISH.

Waterworks.	Ground above O.D. (approx.)	Shaft.	Bore.	To Chalk.	In Chalk.	Total.	Remarks.
	Ft.	Ft.	Ft.	Ft.	Ft.	Ft.	
Garden well	149	46	140	62	124	186	At a depth of 43 feet there is a pipe communicating with all three wells.
Middle well	149	48	80	...	64	128	Suction at 43 feet below surface. Supply at that depth insufficient.
Engine well	149	50	30	...	14	80	A bore near the site of these wells used to overflow when the Bourne was flowing.

EWELL PARISH.

	To Chalk.	In Chalk.	Total.	Approximate Height of Ground.	Date.	To Water.	Water-line above O.D.	Depths of		Remarks.
								Shaft.	Bore.	
	Ft.	Ft.	Ft.	Ft. In.		Ft. In.	Ft.	Ft. In.	Ft.	
Ewell-marsh, A	...	...	...	112 0	...	3 6	108	31 0	...	Tertiary wells.
,, B	...	...	...	...	...	1 10	..	56 4	...	
Avenue-house	...	...	...	96 0	...	30 8	65	172 6	...	

MALDEN PARISH.

	To Chalk.	In Chalk.	Total.	Approximate Height of Ground.	Date.	To Water.	Water-line above O.D.	Shaft.	Bore.	Remarks.
Vicarage	...	...	...	96 0	...	...	...	...	...	To stage, 34 ft.

KINGSTON PARISH.

	To Chalk.	In Chalk.	Total.	Approximate Height of Ground.	Date.	To Water.	Water-line above O.D.	Shaft.	Bore.	Remarks.
Union Workhouse	...	...	...	80 0	1877 Mar. 22	40 ft. three hours after pumping	...	140? 0	425	

ABROOK BASIN.

HOOK PARISH.

	To Chalk.	In Chalk.	Total.	Approximate Height of Ground.	Date.	To Water.	Water-line above O.D.	Shaft.	Bore.	Remarks.
White-hall	...	...	300	115 0	1877 March 22	17 0	98	48 0	...	Tertiary well.

ESHER PARISH.

	To Chalk.	In Chalk.	Total.	Approximate Height of Ground.	Date.	To Water.	Water-line above O.D.	Shaft.	Bore.	Remarks.
Claremont	560	...	...	...	...	...	...	...	...	Proved a great failure. Long disused. Site forgotten.

MOLE BASIN.

ESHER PARISH.

	To Chalk.	In Chalk.	Total.	Approximate Height of Ground.	Date.	To Water.	Water line above O.D.	Depths of		Remarks.
								Shaft.	Bore.	
	Ft.	Ft.	Ft.	Ft. In.		Ft. In.	Ft.	Ft. In.	Ft.	
Lower Green Paper-mills......................	360 ?	...	...	44 0	1877 Feb. 27	8 5	32	More than 200	...	Old water-mark at 2ft. below ground.

METROPOLITAN WELLS NORTH OF THE THAMES.

	Ground above O.D. (approx.)	Dia-meters.		Depths.					Height to which water rose when sunk.					Depth to Pump and suction.			Height of water-line and yield.												Sunk by
																	Before pumping.			After Pumping.									
		Shaft.	Bore.	Shaft.	Bore.	To chalk.	In chalk.	Total.	Date.	Above ground.	Below ground.	Above O.D.	Below O.D.	Below ground.	Suction below gnd.	Suction below O.D.	Date.	Below ground.	Below O.D.	Below ground.	Below O.D.	Difference.	Number of hours pumping.	Gallons per hour.	Total gallons.	Capacity of part of shaft exhausted.	Difference of springs.	Gallons per hour at suction.	
		Ft.	In.	Ft. In.	Ft. In.	Ft.	Ft. In.	Ft. In.		Ft.	Ft.	Ft.	Ft.	Ft.	Ft.	Ft. In.		Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft.							
St. Andrew's, Holborn— Reid's Brewery (A)	70	...	...	222 5	40	136	126 5	262 5	1842	...	121?	...	51	...	...	...	1877 Ap. 21 12.45 pm April 23 12.45 pm 2 p.m. 3.15p.m.	... 200	... 130 0	221 ... 210 0 221 0	151 ... 140 0 151 0	 21	... ... 2½	... ...	36,000	... ...	... ...	... ...	Braithwaite
Reid's Brewery (B)	70	...	...	222 5	...	136½	85 11	222 5	1844	...	120?	...	50	195	221	151	April24* April25†	... ...	... ...	... ...	... ...	... ...	... ...	.. ...	... ...	... ...	... ...	... ...	Boulton and Watt.
Blackfriars— Keyser's Royal Hotel ...	14?	6 5	12	230	165	230	165	395	1865	...	94	...	80	108	138	124	1876 Aug. 29	98 6	84 6	126 6	112 6	28	...	...	...	...	...	...	Baker.
St. Martin's-le-Grand— General Post-office‡	58	9,6,5	18	185	...	243	...	614	1876	...	..	...	...	not	yet	applied	Nov 14 Nov 24 1877 Ap. 16	145 142 J.L. 140	87 84	155 0	97 0	10	336	2291	770000	1,227	768773	... ...	Burton.
Aldersgate-street— Warner's Bell Foundry Jewin-crescent.........	55	5	12	123	188 6	192 6	119	311 6	..	...	...	...	...	108½	134	79	...	..	...	...	...	...	...	...	...	...	...	...	T. Clark.
Chiswell-street— Whitbread's Brewery (A)	60	8½ 7,6,5	12	138 6	...	186	4	190	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Whitbread's Brewery (B)	60	7 for 125 6	12	183	17	183	17	199 6	1831	...	...	...	...	142	170	110	1866 Nov. 5‖	132 4	...	...	...	...	...	...	...	...	...	...	Baker.
Lothbury— Bank of England	39½	5	12	137	...	234	...	334	1852	...	88	...	48½	126	154	114 6	1856 1866 1876	95 100 115	55 6§ 60 6 75 6	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	Cubitt.
Upper Thames-street— City of London Brewery	12?	6	18 4½	80	...	219	262	481	...	...	..	..	...	90	108½	96 6	...	100¶	...	...	...	...	...	...	...	...	...	...	

* Started pumps at 6 a.m., and found 300 barrels only.
† Started pumps at 6 a.m., and found 500 barrels only.
‡ See "Minute B, Appendix."

‖ Monday Morning, after 18 hours' rest.
§ Measured on the last Monday morning in each of above years.
¶ Water never rises above pumps.

THAMES BASIN—AREA OF DEPRESSION BY PUMPING NORTH OF THE THAMES.

CHISWICK.

	Height of ground above O.D.*	Diameters.		Depths.					Height to which water rose when sunk.					Depth to Pumps and Suction.			Height of Water-line and yield.												Sunk by
																	Before Pumping.			After Pumping.									
		Shaft.	Bore.	Shaft.	Bore.	To chalk.	In chalk.	Total.	Date.	Above ground.	Below ground.	Above O.D.	Below O.D.	Below ground.	Suction below gnd	Suction below O.D.	Date.	Below ground.	Below O.D.	Below ground.	Below O.D.	Difference.	Number of hours pumping.	Gallons per hour.	Total gallons.	Capacity of part of shaft exhausted.	Difference ‖ springs.	Gallons per hour at Suction.	
	Ft.	Ft.	Ft.	Ft.	Ft.	Ft. In.	Ft. In.	Ft.		F I	Ft.	Ft.	F. I.	Ft.	Ft.	Ft.	1877	Ft. In.	Ft. In	Ft.	Ft In.	Ft.							
Royal Avenue, formerly in the Horticultural Gardens	20	...	...	30	...	261 6	67 6	329	1823	15 0	...	35	...	...	...	...	...	‡	...	...	...	...	...	...	...	...	...	...	
Lamb Brewery (A)	23	...	...	...	...	...	...	...	1853	...	...	...	...	110	118	95	...	‖	...	...	...	...	...	...	...	...	...	...	
Lamb Brewery (B)............	23¾	...	...	...	..	...	...	...	1860	...	...	...	...	...	...	...	April 18	J. L. 59 8	36 4	...	...	...	...	...	...	...	...	...	
Lamb Brewery (C)............	23·8	5	12 9	201	...	290	...	413	1873	...	47†	...	23 4	107	125	101 4	Jan. 24	57 0	33 4	125	101 4	68	4⅓	...	...	8296	...	...	H.W.Sich, C.E., and S. F. Baker and Sons.
																	April 18	J. L. 68 9	45 1	...	...	...	...	...	...	...	...	...	
																	April 28	66 6	42 10	121 6	97 10	55	5¼	1371	7200	6727	473	...	
Griffin Brewery	24	5	8 6	204	...	293	...	404	1856	...	40	...	...	106	131	107	1856	41	...	...	...	...	...	...	...	...	...	...	
																	1875	63	...	...	...	...	...	...	...	...	...	431	
																	1876 Dec. 21	56 3§	...	...	...	...	...	...	...	...	...	...	

HAMMERSMITH.

Bridge-street	17	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	Worsencroft

FULHAM.

Palace¶	15	...	...	27	...	250	...	370	1823	7 6	...	22½	...	24	52	37	1877 April	[50]	...	...	...	...	...	...	...	...	...	...	

* Approximate.
† From sand. When chalk was touched, water sank.
‡ Well closed before 1850. Shallow well with suction pump on site of same, which is now in private grounds.

‖ This well folded in at 45 feet from the surface in 1859, and is now choked.
§ After 10 days' rest.
¶ Had ceased to overflow before 1836. Deepened 1862. Now disused.

MINUTE A.

Experiments at the Crystal Palace Well by the Clerk of the Works.

Depth to Water from Surface in Feet and Inches.

	Before Pumping.	After Pumping.	Difference.	No. of Hours.		Gallons Pumped.
1875.						
Feb. 15	100	149·2	49·2	3		34,540
„ 16	109·6	132·8	23·2	1	3	36,569
„ „	..	147·11	38·5	2		
„ „	..	150	40	3		
„ 17	109	131·3	22·3	1	5¾	64,306
„ „	..	145·10	36·10	2		
„ „	..	148·4	39·4	3		
„ „	..	150·4	41	4		
„ „	..	154·3	45·3	5		
„ „	..	162	53	5¾		
„ 18	118·9	143·3	24·6	1	3¾	52,750
„ „	..	148·7	29·10	2		
„ „	..	151·4	32·7	3		
„ „	..	164·0	45·3	3¾		

1875.

Sep. 23 Water in each case having been lowered to suction, had risen:—

„ „	1st	2ft. at end of		16 minutes.	
„ „	2nd	„	„	18½	„
„ „	3rd	„	„	19½	„
„ „	4th	„	„	22	„
„ „	5th	„	„	24½	„
Sep. 24	1st	„	„	16½	„
„ „	2nd	„	„	18	„
„ „	3rd	„	„	19	„
„ „	4th	„	„	22½	„
„ „	5th	„	„	24	„
Sep. 28	1st	„	„	15½	„
„ „	2nd	„	„	17	„
„ „	3rd	„	„	18½	„
„ „	4th	„	„	22	„
„ „	5th	„	„	25	„
Sep. 29	1st	„	„	15	„
„ „	2nd	„	„	16½	„
„ „	3rd	„	„	18½	„
„ „	4th	„	„	21½	„
„ „	5th	„	„	24	„

N.B.—Limit of suction, 172 feet from surface.

There are three headings of 8 ft. 6 in. diameter, one being 30 ft. long and the others 12 or 14 ft. [The bottom of the headings are at 152 ft. from the ground; the top at 143 ft. 6 in. (about). The capacity of the headings must be greater than that given above (J.L.).] There is a fourth heading which is bricked up.

From Major S. Flood Page.

MINUTE B.

Experiments at General Post-office Well.

When testing was commenced on November 14th, 1876, there were 53 ft. of water in shaft [5 ft. cylinders]. Took out 55,000 gallons daily for 14 days continuous pumping. At the end of the first week the water stood 14 ft. lower; at the end of the second week, 10 ft.; all in 5 ft. cylinders. [The fluctuations during the experiments were doubtless regulated by neighbouring pumps.]

MINUTE C.

Experiments at Lamb Brewery, Chiswick.

			ft.	in.	
	N.B.—At the end of October	the water stood at	64	0	below ground
	December 6	„	60	3	„
	„ 7	„	60	1	„
	„ 8	„	60	3	„
	„ 9	„	60	9	„
	„ 11 (Monday)		59	6	„
No pumping at the Griffin Well during this time.	„ 12	„	59	0	„
	„ 13	„	58	8	„
	„ 14	„	57	9	„
	„ 15	„	56	10	„
	„ 17	„	55	6	„
	„ 18	„	54	6	„
	„ 19	„	53	11	„
	„ 20	„	53	5	„
	„ 21	„	53	0	„
Pumping at Griffin Well.	„ 26	„	51	6	„
	„ 27	„	50	10	„
	„ 29	„	57	5	„
	„ 30	„	59	1	„
	„ 31	„	59	7	„
	January 1, 1877	„	57	1	„
	„ 2	„	58	9	„

Began pumping at Lamb Brewery. On January 4th, lowered water to 125 (*i.e.*, to suction). On January 5th, the water had risen to 83·9 in 24 hours, which is equal to 5,048 gallons in 24 hours.

The usual height of the water in Lamb Well is about 60 ft. from surface when pumping is not going on. Pumping at the Griffin then lowers it about 3 ft., but when exceptionally high, as last December, the effect is much greater, as will be seen. No amount of pumping at Griffin lowers the water in Lamb Brewery Well below 65 ft. from surface.

From H. W. Sich, C.E.

MINUTE D.

House of Correction, Wandsworth,
5th March, 1877.

Year.	Month.	Day.	Time.	Hours of Working the Pumps.	Hours of Rest.	Depth of Water from surface.	Rise of Water.
						FT. IN	FT. IN.
1857	March 2	Monday	6.15 a.m.	...	36¾	104 0	...
1860	„ 24	Saturday	5 p m.	8½	...	156 6	...
„	„ 26	Monday	6 15 a.m.	...	36¾	104 6	52 0
1861	„ 4	Monday	6.15 „	...	36¾	99 9	...
„	„ 11	Monday	6.15 „	...	36¾	103 0	...
1862	„ 10	Monday	6.15 „	...	36¾	109 6	...
„	„ 17	Monday	6.15 „		36¾	109 9	...
1871	„ 25	Saturday	4.15 p.m.	7	...	180 0	...
„	„ 27	Monday	6.15 a.m.	...	38	130 0	50 0
1873	„ 3	Monday	6.15 „	...	36¾	110 6	...
„	„ 29	Saturday	5.30 p.m.	8½	...	176 6	...
„	„ 31	Monday	6.15 a.m.	..	36¾	111 0	65 6
1877	„ 3	Saturday	5.30 p.m.	8½	..	154 0	...
„	„ 5	Monday	6.15 a.m.		36¾	108 0	46 0

From the Governor.

W. SPENDER,
Engineer.

The opening of the South African International Exhibition took place at Cape Town, on April 5th, under the presidency of the new Governor of Cape Colony, Sir Bartle Frere.

GENERAL NOTES.

Examinations for Bankers' Clerks.—The extension of examinations to the higher class of commercial appointments, as clerkships in banks and in railway and other public companies, has often been advocated. A beginning has been made in this direction by the directors of the London and County Bank, who have issued a detailed scheme of examination for applicants for situations in that establishment. The subjects of examination comprise:—1. Orthography, including spelling and punctuation, as tested by dictation. 2. English composition, as tested by a letter or essay on a given subject; and 3. Arithmetic, including vulgar and decimal fractions. These subjects will be "obligatory," and candidates will be expected to take up, in addition to these, two or more of the following subjects:—Algebra to quadratic equations; Euclid, Books I. and II.; French, German, and Latin. The minimum of marks for passing will be 175, of which 115 must be gained on the three obligatory subjects; and every candidate obtaining 275 marks will be entitled to a certificate of "extra merit;" candidates will be exempted from examination in the "obligatory" subjects who produce certificates of having passed the College of Preceptors second class, or the Oxford or Cambridge "junior" examinations, each of which will entitle him to count 225 marks to his credit. Every candidate on passing a specified period of "probation" in the bank will, if reported by the manager to be an "efficient and satisfactory junior clerk," be received on the permanent staff, with an addition of £5 to his salary more than he would otherwise have received; and he will receive an addition of £10 if he has passed either of the following examinations:—1. University of London Matriculation. 2. Oxford and Cambridge Schools Examination Board. 3. Oxford Senior Local. 4. Cambridge Senior Local. 5. College of Preceptors First Class. It is believed that there will be between fifty and sixty situations open in the Bank and its various branches throughout the country every year.—*Educational Times.*

NOTICES.

PROCEEDINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings, at 8 o'clock. The following arrangements have been made:—

May 16.—"The Practical Use of the Food Collection of the Science and Art Department," by W. Stephen Mitchell, Esq., M.A.

May 23.—"The Measurement and Settlement of Musical Pitch," by A. J. Ellis, Esq., F.R.S., F.S.A.

CANTOR LECTURES.

[Members are specially requested to take notice that the hour for this course of lectures is **FOUR** p.m., not eight p.m.]

Monday afternoons, at four o'clock. Third Course on "The Connection of Greek and Roman Art with the Teaching of the Classics," by Sidney Colvin, Esq., M.A., Slade Professor of Fine Art at the University of Cambridge.

LECTURE V.—MAY 14.

Future of the Study.—Importance of its systematic recognition in England. Unlimited results possible from future excavations. The French and German schools at Rome and Athens—an example to be imitated. National museums; provincial and university museums. Facilities offered by casts and reproductions.

Each member can admit one friend to these lectures. No special tickets are now required for the purpose; the tickets issued to members at the commencement of the session are available for the Cantor Lectures, as well as for the Ordinary and Sectional Meetings.

MEETINGS FOR THE ENSUING WEEK.

Mon.... **SOCIETY OF ARTS**, John-street, Adelphi, W.C., 4 p.m. (Cantor Lectures.) Prof. Sidney Colvin, "The Connection of Greek and Roman Art with the Teaching of the Classics." (Lecture V.)
Institute of Surveyors, 12, Great George-street, S.W., 8 p.m. Adjourned Discussion on Mr. Shaw's Paper, "The Rivers Pollution Prevention Act, 1876."
Royal Geographical, University of London, Burlington-house-gardens, 8½ p.m.

Tues. ..Royal Institution, Albemarle-street, W., 3 p.m. Prof. Gladstone, "Chemistry of the Heavenly Bodies" (Lecture V.)
Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Sir W. G. Armstrong, "Water Pressure Machinery." (Part 2.)
Statistical, Somerset House-terrace, Strand, W.C., 7¾ p.m.
Pathological, 53, Berners-street, Oxford-street, W., 8½ p.m.
Zoological, 11, Hanover-square, W., 8½ p.m. 1. Dr. Fracis Day, "To Exhibit and make some Remarks on a Specimen of *Coregonus oxyrhynchus.*" 2. Mr. G. S. Brady, "A Monograph of the Fossil Ostracoda of the Antwerp Crag." 3 The Marquis of Tweeddale, "The Species of the Genus *Batrachostomus.*" 4. Mr. Edward R. Alston, "A Undescribed Shrew from Central America."
Royal Colonial, 15, Strand, W.C., 8 p.m. Capt. Colomb, "Imperial and Colonial Responsibilities in War."

Wed.... **SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. Mr. W. Stephen Mitchell, "The Practical Use of the Food Collection of the Science and Art Department."
National Health Society (at the House of the Society of Arts), 4.30 p.m. Mr. W. H. Corfield, "Knowledge, the True Enemy of Disease."
Meteorological, 25, Great George-street, S.W., 7 p.m. 1. Mr. R. E. Power, "An Improved Form of Mercurial Barometer." 2. Rev. W. Clement Ley, "The Relation between the Upper and Under Currents of the Atmosphere around Areas of Barometric Depression." 3. Mr. Robert. H. Scott, "Contributions to the Meteorology of the Pacific. No. II.—The Island of Rapa."
Pharmaceutical, 17, Bloomsbury-square, W.C., 12 a.m. Annual Meeting. 8 p.m. Conversazione at South Kensington Museum.
Archæological Association, 32, Sackville-street, W., 8 p.m.
Royal Horticultural, South Kensington, S.W., 1 p.m.

Thur. ..Sanitary Institute of Great Britain (at the House of the Society of Arts), 3 p.m.
Royal, Burlington House, W., 8½ p.m.
Antiquaries, Burlington House, W., 8½ p.m.
Chemical, Burlington House, W., 8 p.m. 1. M.M. P. Muir and S. Sugurra, "A Slight Modification of Hofmann's Vapour Density Apparatus." 2. Mr. J. W. Mallet, "Note on the Fluid contained in a Cavity in Fluviopar." 3. Mr. J. B. Hannay, "Examination of Substances by the Lime Method." 4. Mr. W. Ramsay, "The Dehydration of Hydrates." 5. M.M. P. Muir, "Certain Bismuth Compounds" (Part VI.). 6. Mr. J. Philippson, "Theory of the Luminous and Non-Luminous Flame."
Society for the Encouragement of the Fine Arts, 9, Conduit-street, W., 8 p.m. Mr. J. Jeremiah, jun., "The Development of the Pre-Shakspearean Drama."
Royal Institution, Albemarle-street, W., 3 p.m. Prof. Tyndall, "Heat." (Lecture VI.)
Numismatic, 4, St. Martin's-place, W.C., 7 p.m.
Royal Society Club, Willis's Rooms, St. James's, S.W. 6 p.m.
Psychological, 11, Chandos-street, W., 8½ p.m.

Fri.......Royal Institution, Albemarle-street, W., 8 p.m., Weekly Meeting. 9 p.m., Lieut.-General Richard Strachey, "Physical Causes of Indian Famines."
Philological, University College, W.C., 8 p.m. Anniversary Meeting. Mr. Henry Sweet, President's Annual Address.

Sat.......Royal Institution, Albemarle-street, W., 3 p.m. Mr. W. H. Pollock, "Modern French Poetry" (Lecture II.).

JOURNAL OF THE SOCIETY OF ARTS

No. 1,278. Vol. XXV.

FRIDAY, MAY 18, 1877.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

HEALTH AND SEWAGE OF TOWNS.

The following are the papers brought before the Conference which deal with the dry and other systems of treating sewage*:—

THE PRACTICAL EXPERIENCE OF THE DRY SYSTEM, SHEWN BY THE USE OF MOSER'S CLOSETS, IN A SMALL DISTRICT, FOR TWO AND A QUARTER YEARS.

By Alfred Carpenter, M.D. (London), C.S.S. (Cambridge.)

It may interest the Conference to have laid before them the practical facts connected with the application of ash-closets in a small district.

It is well-known that Croydon is drained in the ordinary way; that is, more or less imperfectly, but there are small areas which are not sewered at all. Among these, is the hamlet of Waddon; it lies between Beddington and the south-western part of the parish of Croydon. It is a district in which the water line is constantly changing, according to the requirements of the miller who works the water mill, which has existed from time immemorial at the confluence of the several small streams which give rise to the River Wandle. The occupiers of some of the fields close to the hamlet have also the right to dam up the Wandle, and use it as a sheep wash, and also the right to irrigate the pastures themselves. The result of the maintenance of these rights is, that the subsoil is generally waterlogged, water existing within a few inches of the surface of the ground. Notwithstanding this state of things, a number of cottages were built on a part of this land close to the left bank of the principal stream of the Wandle. When the plans were first deposited by the speculators who proposed to erect these houses, there was no law by which they could be compelled to provide a dry basement. Application was made by the builders to the local authority, to sewer that district at the public expense, but the Local Board declined to do it except at the expense of the owners. It was contended by the writer that the ratepayers of the parish ought not to be called upon to turn a swamp into building land, for the benefit of speculators. Nevertheless, the houses were built, and immediately occupied by a swarm of poor. The result, which was predicted when the plans were deposited with the Local Board, soon came to pass. The inhabitants suffered continually from the effects of enthetic disease. Scarlatina, diphtheria, and fever were constant visitors. The neighbours then began to complain; many deaths occurred. The stench from the continually overflowing cesspools was plainly perceptible in the public road, and great pressure was brought to bear upon the local authority to compel them to sewer the district, at an expense almost equal to the value of the cottages themselves. But it appeared to the writer that, to put sewers into such a district would be a sanitary mistake, at least, one half of the time they would be waterlogged, and be the means of retaining mischief in close proximity to the houses, instead of conveying it away. It appeared that, before sewering the district, the water-line should be permanently lowered, that the owners should give up the right to flood the neighbourhood, and thus make the land fit for building purposes, before the local authority provided sewers for the sewage. There was also another consideration in the case. The sewage from these cottages would have to be conveyed to Beddington sewage farm. There would then be a 12-inch sewer, constantly discharging subsoil water instead of sewage upon a farm which already receives more subsoil water than it is entitled to. The owners refused to do this duty, and it was left to the sanitary committee of the Croydon Local Board of Health to devise a remedy for the insanitary state of the hamlet, which state the law had allowed to grow up close to our own noses, and in spite of our protests. The year 1874 was a very fatal one to the inhabitants of the cottages; the owners did not—indeed, they could not—empty the cesspools which had been constructed, and it was evident that something must be done. The property had changed hands, and the new owners were willing to do what the Sanitary Committee recommended. The writer had been much struck with the simplicity and cheapness of Moser's closets, as exhibited at the Social Science Congress at Glasgow, in 1874, and ultimately 20 closets were erected by Mr. Moser, at a cost to the owners of something under £3 per closet. They were completed December 24th, 1874. The cottages are in a block close to the road, and about one-third of a mile from the outfall sewer, near to which the town refuse of the Croydon district is conveyed. It was agreed with the owners that they should erect the closets, but that the Croydon Local Board should collect the refuse, and supply the hoppers with dry ashes, and the pails with sawdust, as often as should be necessary. The whole of the arrangements were carried out, and have since been superintended by Mr. Mitchell, the sanitary inspector of the Croydon Local Board of Health, and I learn from him the following results:—He states that, whereas serious illness always prevailed in those houses before the erection of the closets, there has been very little since, and scarcely any of that class of disease which formerly visited them; that the houses, instead of being pest-houses to the neighbourhood, are now perfectly healthy. It is also stated in Dr. Buchanan's report upon the epidemic of fever which visited Croydon in 1875, that these cottages at Waddon altogether escaped. Mr. Mitchell also states, in a written report of last week's date—

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* A report of the discussion will be issued in subsequent numbers of the *Journal*. For the convenience of those wishing to have the account of the proceedings in a more compact form, the same will also be published as a pamphlet, which can be had (as soon as ready) on application at the Society's House. Price 3s.

> "That he had had no complaints in writing at all. That there were a few verbal complaints at first, in consequence of the trouble the occupiers were put to whilst the workmen were about; but that they soon settled down, and that when they got used to the closets they expressed great pleasure at the change, stating that they were now free from the offensive smells to which they had been previously subjected, and that they now suffered no inconvenience, except when the men were late in removing the contents of (changing) the tubs."

It ought to be stated that almost frantic efforts were made to rouse the people against the use of the closets, and to compel the local authority to sewer the district, and that a strong antagonistic feeling had to be contended against when they were first introduced.

The closet consists of a hopper at the back, large enough to receive a week's supply of earth or ashes (we use the latter from the siftings of the dust heap). By means of an exceedingly simple arrangement, the hopper discharges the ashes upon the solid fæces, as the user rises from the closet. The pail is placed beneath the seat. It consists of half a petroleum cask, well bound, with an upright diaphragm, which separates the anterior part of the pail from the posterior, the former being arranged to receive the urine, and is charged with sawdust. The pails are changed weekly, between five and six in the morning. The duty of collection is performed by one of the dustmen, who collects town refuse during the later hours of the day. The total cost for two years and a quarter, that is, to the end of March, 1877, has been as follows:—

	£	s.	d.
Wages of man and boy	47	4	6
Horse and cart (use of)	14	12	6
Sawdust	8	9	0
Total cost for 118 weeks' collection	70	5	6

That is, £70 5s. 6d. appears in the accounts of the Local Board as the cost which the ratepayers have incurred during the last two and a-half years, in collecting and replacing the pails at Waddon. Against this sum there is a set-off, in the value of the material collected. This is mixed with other refuse at the filtering-house, and is sold, with that refuse, to market gardeners at 2s. 6d. a yard. It is probably worth rather more than that, but not having been kept separate, its practical value is not known. About a yard and a half is collected every week, which reduces the actual cost by 3s. 9d., or to 8s. 3d. per week instead of 12s., which would appear to be the cost according to the published accounts. Twenty closets were erected in 1874, and two have been added since; thus 22 houses, occupied by 122 persons, have been provided for, the cost being £1 8s. 5d. per house, or 5s. 1½d. per person per annum; or, if we allow the value of the produce to be deducted, the cost is reduced to 3s. 6¼d. per person, or to a trifle under £1 per house per annum. Of course, the experience of a small district puts the expense at an outside amount, and if, instead of 22 houses, there had 220, the expense would be reduced by one-half. I am inclined to think that 10s. per house would amply cover the cost of the collection of excreta in a country village of 200 houses, and if the average rateable value of the houses in such a village is put at £15, it would entail a rate of 9d. in the pound to provide for the removal of excreta by a dry earth plan. At the same time, there would be no debt incurred, and no mortgage of the rates necessary. I simply submit the facts for the consideration of the Conference.

It may be asked in what way the slops are provided for at the houses to which I have referred. When the closets were fixed, the cesspools were pumped out and the concrete broken down; the communications between the closet and drain broken off, the waste pipes from the sinks were made to deliver upon a trapped grating in the yard, which led by a drain into the old cesspool. From the cesspool a filtering bed of loose stones and gravel, in a trench from where the drain pipes had been taken up, was provided, and this filtering bed led off to the River Wandle. Whenever the level of the water in the bed of the Wandle is below the level of this trench, it draws off into the Wandle without leaving the least trace of defilement or pollution. When the bed of the Wandle is full, the subsoil is necessarily filled with an impure water. If the Wandle was never dammed up, there would be no difficulty whatever on the score of the slop water; in the case in point and in most cases, if one of Field's flush tanks could be used, I see no reason whatever to suppose that any evil would arise at all, the only necessity being that houses should not be allowed to be erected on land which is water-logged.

For small blocks of houses at a long distance from any system of sewers, or in thinly peopled districts, I can confidently recommend some such plan as that of Moser's, as amply sufficient to prevent defilement of subsoil by sewage, and enough to provide for the removal of nuisance. But such arrangements must be under the control of a local authority, who must see that the proper removals are made at proper times.

ON THE AGRICULTURAL AND COMMERCIAL VALUE OF PREPARED NIGHT SOIL MANURES.

By Dr. Aug. Voelcker, F.R.S.

The removal of human excreta of large populations from the urban districts to the country, without creating a nuisance or injuring the health of the inhabitants, and the economical utilisation of these matters for the production of food, are questions surrounded by practical difficulties of no ordinary kind.

In the country, in small country towns, and in isolated establishments, such as county prisons, workhouses, and asylums, the disposal of human excreta presents no great difficulty, but their removal from towns is generally attended with considerable expense, no matter what particular system the authorities may adopt.

There is no doubt that excretal matters, and all kinds of house refuse, are removed from towns more rapidly, with less nuisance to the inhabitants, and with less injury to their health, by means of water, than in any other way that can be adopted on a large scale. There can be, further, no doubt that the land is the proper medium for the reception of all excrementitious matters, and that nothing effects so complete and rapid a deodorisation and disinfection of putrid animal matter, of every kind, as a well aërated soil.

In towns where an ample supply of water is at command for the removal of human excreta, the water-closet system is sure to extend with the march of human civilisation. Where it has once been introduced it is not likely to give way to any other system, notwithstanding the expense it will in many cases entail upon the ratepayers.

In villages, or suburban districts inhabited by people in a humble position in life, whose mode of living necessitates the exercise of strict economy, the dry or pail systems of dealing with human excreta, if properly carried out, have, without doubt, much in their favour, and in consequence have found many consistent supporters.

If it were possible to collect human excretal matters and house-refuse, and to remove them without either nuisance or injury to health, and to manufacture these refuse matters into a concentrated dry and portable manure, their utilisation would unquestionably be attained more economically by such means than by the water system.

How far, it may be asked, has the problem been solved to manufacture profitably sewage and night soil manures, and what prospect is there for the attainment of this desirable end, in case our inquiry should lead us to the conclusion, as I am afraid it will, that hitherto all attempts to convert human excreta and house-refuse into portable manures have proved unsuccessful in a commercial point of view?

In approaching these questions, the following particulars obviously demand careful consideration:—

1. What is the character and chemical composition of unmixed solid human excreta, in their natural condition?
2. What is the composition of urine, unmixed with water, and in a fresh and stale condition?
3. Is our present knowledge of the requirements of the various crops usually grown as food for man and beast, adequate to determine, with sufficient accuracy for all practical purposes, the comparative utility and value of the various constituents which enter into the composition of human excreta, ordinary farmyard-manure, refuse matters used as manure, and specially prepared manufactured or artificial manures?
4. Is it possible to ascertain by chemical analysis, with a fair amount of precision, the theoretical or chemical value of solid and liquid human excreta, and that of the manures prepared from them, and what is their value?
5. What is the composition and fertilising value of coal-ashes, town-sweepings, charcoal-refuse, burnt bituminous shale, peat, peat-charcoal, burnt clay, dried spent tan, saw-dust, and other bulky materials, which are employed as absorbers and deodorisers in the manufacture of night-soil manures?
6. To what extent is the theoretical or chemical value of night-soil manures affected by purely practical considerations, which require to be kept in view in attempts to determine the practical or money value of such manures?

Under these headings I beg to submit to the Conference a few remarks, which it is hoped may lead to useful discussion.

1. *What is the character and chemical composition of unmixed solid human excreta in their natural condition?*

The composition of the solid excrements of man, I need hardly say, is subject to considerable variations, and, consequently, all calculations based upon analyses of these matters are liable to considerable variation. The food of man, being a mixed vegetable and animal diet, is richer both in phosphates and nitrogen than the more bulky food upon which farm-animals are fed; and as the greater part of the phosphates and nitrogen, upon which the value of the manure chiefly depends, passes through the body and the excrements, the fertilising value of human excreta is greater than that of the excrements of horses, cows, pigs, and sheep. Hence, human excreta are highly esteemed as fertilisers in China, Japan, and Flanders, and all countries where the primitive mode of collection and transportation of these matters is considered no obstacle to their utilisation in an unmixed state.

According to Professor Way, human fæces in a recent condition are stated to contain in 100 parts:—

Water	75·00
*Organic matter	22·13
Insoluble siliceous matter	·37
Oxide of iron	·13
Lime	·43
Magnesia	·38
Phosphoric acid	1·07
Sulphuric acid	·06
Potash	·30
Soda	·08
Chloride of sodium	·05
	100·00

Allowing for variations in the composition, arising chiefly from the character of the food consumed, solid human excreta, as they leave the body, may be said to contain one-fourth of dry matter, including 1½ per cent. of nitrogen, and 1 per cent. of phosphoric acid, and three-fourths of their weight of water.

Although we are in the habit of speaking of solid excreta, it will be seen, they contain, if unmixed with anything else, three-fourths of their weight of water, and, as usually collected, the percentage of water no doubt is still greater.

It is well to bear this in mind, for the main difficulty in disposing of human excreta is due to the circumstance that, at the very least, either three-fourths of useless matter have to be carted into the country, or some of the water has to be absorbed by porous materials, or, somehow or the other, to be got rid of before the expense of collection and cartage can possibly be recouped.

2. *What is the composition of urine, unmixed with water, and in the fresh and stale condition?*

Fresh urine contains, on an average, only 3 per cent. of solid matter, and, according to Professor Way's analysis, consists of:—

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* Containing nitrogen, 1·50; equal to ammonia, 1·82

Water	97·000
*Organic matter	2·026
Insoluble siliceous matter	·003
Oxide of iron	·002
Lime	·018
Magnesia	·014
Phosphoric acid	·040
Sulphuric acid	·014
Potash	·055
Chloride of potassium	·162
Chloride of sodium	·566
	100·000

Urine enters rapidly into decomposition, giving rise to foul-smelling gaseous products of decomposition, and to volatile carbonate of ammonia, and on keeping loses much of its most valuable constituent. The collection and preservation of urine, in consequence, is attended with practical difficulties, which are greatly enhanced by the trouble and expense of getting rid of the large proportion of water which urine naturally contains. For these reasons all attempts to collect urine, and to obtain from it a solid manure by evaporation, have hitherto proved failures in an economical point of view.

Where urine can be collected unmixed with an undue proportion of water, the ammonia of stale urine may be obtained from it by distillation, and converted into sulphate of ammonia. This is done in some places, amongst others at Courbeville, near Paris, where the manufacture of sulphate of ammonia from urine has been carried on for a number of years successfully, leaving a moderate profit to the manufacturer for working expenses.

General Scott, it will be known to many present on this occasion, has patented a process for the manufacture of ammonia salts, and the extraction of other useful fertilising products from the liquid portion of human excreta, and it is to be hoped his labours in connection with the utilisation of human excreta will be crowned with success.

Notwithstanding the much larger proportion of water in urine, as compared with the per-centage of water in the solid excrements, I am of opinion there is more hope of obtaining, at a remunerative expense, from urine, useful fertilising products than from solid excreta.

3. *Is our present knowledge of the requirements of the crops usually grown as food for man and beast, adequate to determine, with sufficient accuracy for all practical purposes, the comparative utility and value of the various constituents of human excreta, farmyard manure, refuse matter used as manure, etc?*

Without entering at length into a discussion of the wide subject of nutrition of plants, it may be briefly stated that well established facts have proved the absolute necessity of certain plant-food to the vigorous and luxuriant growth of all our cultivated crops. The greater portion of plant-food, as is well known, is supplied by the atmosphere; but no less essential to the life and healthy growth of plants are the smaller quantities of matter which are furnished, either by the soil upon which our crops are grown, or by the manure with which the fertility of the soil, impaired by the removal of agricultural produce, is restored. Some of the soil or manuring constituents, it is further well known, occur in great abundance in most soils, or if deficient may be supplied at little cost, whilst others, more sparingly distributed in the land and occurring only in minute proportions, even in soils of the most fertile character, are precisely the materials which enter largely into the composition of wheat, barley, oats, hay, root-crops, and every description of agricultural produce. The substances more sparingly occuring in land are phosphoric acid, available nitrogen, and potash. In an agricultural view they are, I need hardly say, of greater importance than lime, magnesia, oxide of iron, and other mineral matters, which, although equally essential to the healthy development of plants, occur in abundance in most soils, and therefore do not engage the same attention which the restoration to the land of phosphoric acid and of nitrogenous matters, and, in a minor degree, that of potash, demands.

Our present knowledge of the chemistry of vegetation, based as it is on experimental evidence, warrants us in attaching greater value to the presence of available nitrogen in the land than to that of phosphoric acid, and to regard that acid of greater importance, in an agricultural point of view, than lime or magnesia. Apart from all theoretical considerations, actual experience has proved unmistakeably that the productive powers of different soils are intimately connected with their comparative richness or poverty in available nitrogenous plant-food and phosphoric acid and potash, and that the practical or fertilising value of common dung and guano, and other manures, rises or falls with the greater or smaller proportions of these identical matters, in these manures.

4. *Is it possible to ascertain, by chemical analysis, the theoretical or chemical value of solid and liquid human excreta, and that of the manures prepared from them? What is their value?*

The fertilising value of all manures, it has been pointed out, mainly depend:—

1. Upon the proportion of available nitrogen they contain;
2. On the proportion of phosphoric acid;
3. On the proportion of potash.

These constituents admit of ready determination by chemical analysis; and, in a great measure, the combinations in which they occur in manure and their comparative degree of activity or efficiency may likewise be ascertained by a careful chemical examination.

Nitrogenous fertilising matters have a certain commercial value, differing with the state of combination in which the nitrogen occurs in the fertilising matters. The same remark applies to phosphoric acid and to potash. Hence, by determining the precise amount of nitrogen, phosphoric acid, and potash in any description of manure, and examining the form or states of combination in which they occur in the manure, we can form a very good estimate of their chemical or theoretical value.

The fertilising constituents upon which the value of manures mainly depends can be bought at the present time in the form of concentrated artificial manures, such as guano, bone-dust, sulphate of ammonia, &c., at the following rates:—

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* Containing nitrogen, ·58; equal to ammonia, ·71.

Phosphate of lime	at	1d. per lb.
Potash	„	2d. „
Nitrogen, calculated as ammonia	„	8d. „

According to these rates, I find a ton of unmixed solid human excreta has a theoretical value of 30s. in round numbers, and 1 ton of urine 10s.

It has to be borne in mind, however, that these estimates are given to the essential fertilising matters of human excreta, supposing they could be extracted from them, and presented to the farmer in a dry and fairly concentrated powdery manure.

Moreover, in practice, human excreta cannot be collected in a perfectly unmixed state, nor is it possible to collect urine without its becoming more or less diluted with water, or losing, by evaporation, some of its most valuable constituents.

It has never been shown by a single experiment that either solid excreta or urine can be profitably converted into portable manures, and I do not think any attempts to deal with human excrements in that way will ever be successful.

In the preparation of night soil manures, coal ashes, peat, peat-charcoal, burnt shale, town-sweepings, and such like bulky materials, having no intrinsic fertilising value, are generally used as absorbents or deodorising materials. It cannot, therefore, excite surprise that the theoretical or calculated money value of prepared night manures is much lower than what persons expect it to be who merely take into account the value of the perfectly dry constituents of human excreta.

In the course of my long experience as an agricultural chemist, I have had occasion to analyse, I may say, every kind of night soil manure which has found its way into the market, and the general result of my experience, founded on the analysis of a very large number of samples, is, that unless such manures have been specially fortified with concentrated fertilising matters, such as guano, bone-dust, superphosphate, sulphate of ammonia, wool-dust, &c., I did not find the theoretical or calculated value of one of them to amount to £1 a ton.

The better-prepared night soil manures I find usually range from 15s. to 17s. 6d. in calculated value, and the wetter and less carefully made manures of that kind I find generally are worth theoretically from 7s. 6d. to 12s. 6d. per ton, taking for basis of calculation the preceding rates.

We shall see, however, presently, that the calculated value of night soil manures does by no means coincide with their real commercial value, or the price which the farmer can afford to pay for such manures. When night soil manures, not fortified by concentrated fertilising matters, are offered for sale at prices varying from 30s. to £2 a ton, we cannot feel surprised that they do not find a ready sale, and accumulate to an inconvenient extent at the works were they are produced.

5. *What is the composition and fertilising value of coal ashes, town sweepings, charcoal refuse, burnt shale, &c.?*

My remarks under this head may be summed up in very few words.

All these materials, which are used as absorbers or deodorisers of human excreta, have no intrinsic fertilising value, and certainly are not worth the cost for the removal and carriage from the town to the country. Their addition to wet night soil reduces its fertilising value, and hence the addition of coal ashes, burnt shale, and charcoal refuse, &c., diminishes the commercial and fertilising value of night soil, in proportion to the quantity of the bulky absorbent material employed in the preparation of the portable manure.

This is now generally acknowledged to be the case, and some manufacturers of night soil and sewage manure have adopted the plan of adding to their products some sulphate of ammonia, superphosphate of lime, or similar concentrated fertilising agents, with a view of increasing the commercial value of the manure, and securing for it a more ready sale.

The policy of this procedure, however, it appears to me, labours under a fallacy, and I think cannot be defended on good grounds.

It is true the intrinsic and commercial value of night soil manure thus fortified may be increased, but this is not the question at issue, for nobody can deny that the addition of a valuable concentrated fertilising matter to one of little value, increases the fertilising properties of the latter. The real question to be decided is, does such an addition enhance the original fertilising value of the night soil, apart from the value the concentrated fertilising matters possess. So far from doing this, the addition of concentrated manure to night soil results in a reduction of the commercial value which the concentrated manures themselves possess. In reality, manures which in a concentrated condition have a higher market price than the same materials in a more bulky or more dilute form, without enhancing the original value of the night soil, lose in commercial value when they are employed for the purpose of fortifying night soil manures of low fertilising qualities, and consequently there is no economy, but the reverse in thus diluting otherwise more valuable concentrated manures.

6. *To what extent is the theoretical or chemical value of night soil manure affected by purely theoretical considerations, which require to be kept in view in determining the practical or money value of such manures?*

It has been stated already that 8d. per lb. is the market price at which ammonia is sold at present in concentrated portable manures, and that in such manure bone phosphate of lime is worth 1d. per lb., and potash 2d. per lb. can be bought. I may add, soluble phosphate of lime is worth 2d. per lb. The money value of these fertilising constituents, however, is much less in bulky manures, in which a comparatively small amount of ammonia and phosphate of lime is supplied, together with a large proportion of bulky materials of little or no agricultural value. In buying such voluminous fertilisers, necessarily, expense has to be incurred for carriage and for their distribution upon the land, which a farmer will save in a great measure, who buys the ammonia or phosphate of lime he wishes to apply to his crops in the shape of concentrated portable manures, which admit of a ready application to the land, and can be placed upon it where the manure is most wanted, that is, in more direct contact with a starting crop, than is the case with the bulky night soil manures, which have to be ploughed in and mixed with a large proportion of the soil. The practical advantages obtained by the use of concentrated artifical manures, in enabling the farmer to incorporate them with only a small portion of the soil, in more direct contact with the starting crop, receive a practical acknowledgment in the higher price which practical men find it answer their purpose to pay for ammonia or phosphate of lime, in concentrated ammoniacal or phosphatic manures, than they have to give for the same amount of ammonia or phosphate of lime in bulky manures.

It is, therefore, manifestly incorrect to estimate the money value of night soil manures, the theoretical or calculated value of which generally ranges from 12s. to 17s. 6d. per ton, on the same basis upon which the market value of guano, bone dust, super-phosphate, and similar concentrated manures, sold at from £7 to £12 a ton and upwards, is estimated. A far more correct and rational proceeding is to compare the theoretical value of low-priced night-soil manures, as ascertained by analysis, with the market value of ordinary farmyard manure, the calculated value of which amounts to about the same figure as that of most samples of night soil manures. Leaving unnoticed the details of full analyses to which I submitted farmyard manure, I may state that a ton of good rotten farmyard manure contains in round numbers:—

	s.	d.
8½ lb. of soluble phosphate of lime, worth, at 2d. per lb.	1	6
13 lb. of insoluble phosphate of lime, worth, at 1d. per lb.	1	1
11 lb. of potash, worth, at 2d. per lb.	1	10
Nitrogen equal to 16½ lb. of ammonia, calculating ammonia at 8d. per lb.	11	0
Total calculated money value of a ton of rotten dung	15	5

It will be seen that, if we estimate the money-value of good farmyard manure according to the same rates at which the principal fertilising constituents in the dung can be bought in concentrated artificial manure, one ton of farmyard manure would be worth, in round numbers, 15s. a ton. However, good dung can be bought in many places at 5s. per ton, or one-third its estimated money-value; and probably the highest price which a farmer would feel justified to pay for good dung does not exceed 7s. 6d. per ton, or one-half its estimated money-value.

The difference between the estimated money-value of farmyard manure (calculated at the market rate of the constituents when sold as concentrated artificial manure) and the actual market price, may be fairly taken to represent mainly the difference in the practical value caused by the greater expense of the carriage and application of farmyard manure.

The estimated value of most night soil manures does not exceed 15s. per ton, and hence we are only acting in accordance with the same principles upon which the actual market price of farmyard manure is determined, if we allow only 5s., or, at the most, 7s. 6d. per ton as the real money-value of night soil manure, the estimated value of which, as ascertained by analysis, amounts to 15s. a ton.

I fear, in dealing with human excreta, the cost of collection and manufacture will be found in all cases to exceed the market value of the prepared night soil manures.

We cannot feel surprised at this, if we bear in mind that even in countries like Flanders and Germany, where the night soil is collected unmixed with any ashes or similar diluents, and applied direct to the land, the cost of collection and removal to the country, as a rule, is greater than the price which the farmer can afford to give for the excreta.

The ready disposal of night soil and its utilisation for agricultural purposes, I am of opinion, can only be successfully promoted by incurring the least possible cost in manufacturing it into portable and inodorous manures, and by selling such manures at prices which can stand a fair comparison with the market value of good dung.

The manufacture of portable inodorous night soil manures, and their sale at prices which can stand a fair comparison with the market value of ordinary farm-yard manure, in my judgment, entails a considerable loss, which probably amounts to not less than 1s. per head in most places.

SEWAGE UTILISATION.

Dr. J. H. Gilbert, F.R.S., writes as follows:—

I have to thank the Society of Arts' Committee on Health and Sewage of Towns, for the compliment of asking me to give a paper at the coming Conference, on some point, either practical or scientific, in connection with the sewage question. I have, in times past, devoted much time and attention to the subject, and am still much interested in it, and hence was unwilling to say no to the request, but now find that it will be quite impossible for me to take any part in the Conference.

I may observe, however, that I should consider it most unfortunate and disappointing if the prominent reference to "sanitary pails" and "cinder manure," is to be taken as indicating that the resultof the Conference is to lead in the direction of an extension of the systems in question, as in any sense solving the sewage difficulty. It is true that such systems may be improvements upon existing plans, and they may relieve the liquid sewage of much putrescible matter, rendering it less offensive and injurious if not further dealt with, and even less objectionable, though less valuable for irrigation. But, besides the obvious objection of retaining the mixture so long near the dwellings, in this case, at any rate, of all large populations there will still remain a liquid sewage to be dealt with, and there can be little doubt that, wherever this has to be turned into a water supply stream, purification will before long be enforced. It will then be a question whether both systems should be maintained, and if not, much unnecessary outlay will have been incurred for a mere temporary expedient. It may, too, be confidently stated that no solid sewage manure, obtained by any known either interception or precipitation process, will be worth more than its carriage beyond a very limited area, nor even that to any considerable distance.

I enclose a printed note of mine referring to some of these points.

Wishing all success to the labours of the Conference.

Remarks communicated to the Institution of Civil Engineers in reference to the Papers by Mr. Redgrave "On Sewage Interception Systems, or Dry Sewage Processes," and by Mr. Shelford "On the Treatment of Sewage by Precipitation," read March 28, 1876.

Dr. J. H. Gilbert observed, that there could be no doubt whatever that the interception or dry processes, referred to by Mr. Redgrave, were an immense improvement upon the old midden-pit, or common privy systems;

but no such plan could be accepted as a solution of the sewage difficulty. About four-fifths, or more, of the manurial value of human excretal matters were due to the urine. It was a desideratum with all such systems to exclude as much of the urine as possible, and the complete separation of the liquid from the solid dejections had been recommended. Of course, this would much reduce the value of any dry manure so produced, which was already so low as not to be worth more than its carriage beyond its immediate locality. Without such special separation, at the outside about one-third of the urine would be collected with the fæces. Under any such dry system there was, therefore, from two-thirds to the whole of the urine, besides all wash and other house-drainage, still to be dealt with; and if the liquid had to go into a stream which served as the water supply for other populations, sooner or later purifications would be enforced. Passing the liquid through land was not only the best mode of purification, but promised the greatest return for the constituents it contained—whether profit to the towns, depended on many local circumstances. Then as to precipitation methods. There could be no doubt that any of those referred to by Mr. Shelford would be a vast improvement upon doing nothing whatever with sewage that had to be turned into an open stream. No such plan was, however, likely to collect more, and would generally collect less, than one-fourth of the nitrogen of the sewage in the solid manure. This one-fourth was, moreover, the least active and least valuable part. These plans also, as a rule, carried down the phosphates, but in a precipitated, not in a soluble, form; and in more than one scheme soluble phosphate had been used, and was converted from this more valuable into the less valuable precipitated condition. The estimate of the value of the nitrogen (reckoned as ammonia) in such a manure, containing only from 1 to 2 per cent. of it, at the same rate as when provided in guano containing about 12 per cent., and in a much more valuable condition, was entirely fallacious; as also was the valuation of precipitated phosphate at 3s. 3d. per unit. Would, then, such precipitated manures pay for their manufacture as such? He thought not. If the process were adopted mainly as a means of purification, what was the result? About three-fourths of the nitrogen of the sewage would remain in the liquid. This would exist, in the main, not as nitrates, but as ammonia and soluble organic compounds. This liquid, with all other house drainage, remained to be dealt with. He did not think that such a liquid would eventually be allowed to run into a water-supply stream. Passing it through the land would best purify it, and would yield the largest return. If the sewage were employed for irrigation, the less taken out of it, beyond the sludge, before use, the better; and if the phosphates were removed, they should be returned either to the sewage or to the land irrigated. In fact, where irrigation was to be eventually adopted, the less effective the precipitation process the better; indeed, the exclusion of the natural sludge was all that was desirable. He was by no means unconscious of the many difficulties involved in the general adoption of sewage irrigation, but he believed if rivers were to be kept from pollution it would eventually have to be adopted, wherever practicable, before the liquid was discharged into them.

CARBON-FERTILISER COMPANY, LIMITED.

Memorandum on the Collection and Treatment of Excretal Manure, as undertaken by the Company.

By **Major-General Synge.**

The company collect and treat under what is termed the dry system. In collection, the speciality of the company is the application of a deodorant *in loco*, and for this purpose it uses charcoal. On the disinfectant and deodorant virtue of charcoal it is assumed to be unnecessary to say anything further. The medical and chemical testimony which has been brought forward on former occasions is positive, and corroborated by all concurrent testimony, and, so far as is known to the writer or the company, this testimony is uniform and without contradiction. The efficacy of the charcoal deodorant is dependant only on application; the mode and the merits of various methods of application are matters simply and only of mechanical contrivance.

In Oldham and in several other Midland or Lancashire and Yorkshire districts, the privy construction consists largely of what are termed sanitary pans. It is for the best sanitary pan that a prize of £20 has been offered by the Society of Arts on the present occasion. The merits sought are, collection of pure excreta, that is, without refuse or ash; cleanly use; separation of urine from fæces; a ready and cleanly means of removal and transport. These points are well selected and well defined, and their importance is easily rendered obvious. One important point only is not specified, possibly as not coming within the structural consideration of a sanitary pan, that is, deodorisation *in loco*. A sanitary pan, as ordinarily understood, is a moveable metal privy; its demerits palpably are, the peripatetic character of this form of privy, and thus the constant transport, at a heavy and permanent cost, of a dead weight containing matters, the ideal association of which is unpleasant, and this in a form that leaves no doubt whatever about the substance that is being conveyed, inasmuch as the vans in which the pan removal has to be effected are necessarily peculiar and exceptional in make. The merits of the sanitary pan system are, the certainty that no latent evil can grow up undiscovered in out-of-the-way or other localities. The Carbon-Fertiliser Company found the sanitary pan a localised institution at Oldham, and one in which it had no option. Waiving all question of its merits or otherwise, in consequence of the imperative condition of the circumstances with which it had to deal, the company have given their attention to deriving as much benefit and as little damage as may be from the use of the sanitary pan. The non-admixture of ashes, and of all refuse except such as is improperly and wantonly inserted, is absolutely obtained. The simplest mode of effecting the separation of the urine from the fæces in the sanitary pan is by the insertion of the patent Alver sanitary pan tray. This consists of a flat perforated false bottom, inserted a certain height above the solid bottom of the sanitary pan. This tray is suspended from the top, and lifts in and out readily. It effects the required separation, which is a point of very considerable importance, and it admits, besides, of very perfect application of the deodorant. A mere sprinkling over the solid left on the tray effectually hinders all effluvia. This tray should be applied to a pan of greater depth than is in use at Oldham, as otherwise very frequent removal becomes necessary, or the contents soon come unpleasantly near the top. However, it admits of being so applied as very greatly to facilitate this frequent removal. Where collecting stations are used, vans containing fresh and perfectly cleansed pans can go out from these, and bring back those in use. The contents of these latter are then separately taken out of the pan. The solids are lifted out with the tray, the liquid is poured into barrels, the solid put into carts. The solids, properly coated with char, are undistinguishable as to the substance of which they consist, and inodorous, and in point of fact require only a tarpaulin or other covering, to keep out wet, to be transported without offence and in bulk to the factory. In like manner the barrels sprinkled well with char are transported without any offence. A company or other contractor, however, who may attempt to carry out such an arrangement practically must throw the onus of the protection he requires on the corporation, or other body locally empowered to act, and capable of dealing with local conditions, or they will otherwise find themselves sorely impeded in the adoption of every and any improvement and modification they may desire to adopt.

No. 2 Alver sanitary pan meets the difficulty occasioned by the want of depth in the dimensions of the commonly received sanitary pan. For the ordinary bottom of the pan is substituted the Alver tray bottom, and the pan is placed over a patent Alver trapped drain. The liquid passes through, the trap effectually prevents all effluvium, the full capacity of the ordinary pan is secured for the solid residue, the same efficacy is secured for the application of the deodorant as in No. 1, and the liquid is carried off by light and inexpensive glazed pipes, of small dimensions, into store tanks, from which they are emptied only as the capacity of these or the requirements of the factory may require.

No. 3 Alver sanitary pan is merely a modification of No. 2. A vertical Alver tray is introduced, and the trap can, in consequence, be made much less in dimensions. It has the advantage of favouring the separation of the urine from the fæces more completely. In theory, the perforations in No. 2, if too large, are liable to allow the trap underneath to become coated and choked, and, if too fine, they are liable to become clogged. Practically, however, the advantage of No. 3 over No. 2 is chiefly in the reduced dimensions of the trap, and consequent cheapness in this respect, although the pan itself is somewhat more expensive. In No. 2 the central perforations may be large, and lessen as they extend from the centre. Both No. 2 and 3 have the great advantage of not necessitating the carriage of the dead weight of the privy for the transport of liquid, but only when the receptacle, or privy itself, requires to be cleansed.

When removal takes place in vans, the company spread a layer of char on the floor of the van, so that the shaking effect of the carriage is completely counteracted. It will be obvious that all the advantages are obtained in an enhanced degree, and the disadvantages avoided in the like extent, just in proportion as the carriage of the privy construction, *per se*, can be avoided, and the frequency lessened of the transport of the contents. Now, liquid is the sole cause of difficulty. It is liquid which hastens decomposition, spreads pollution, creates offence, and causes danger. Yet it is not so much urine itself which does this mischief as the abominable amalgamated compound of mingled urine, excreta, and slops. Having, therefore, gone so far in the right direction as to avoid the admixture of ash, which admixture is practically destructive of commercial results, and having only pure excreta and urine to deal with, it is clear that the principle of separation, as made practically applicable to pits, by means of the patented Alver traps, is a further step in advance over any sanitary pan; but, for cottage construction, in very many localities, probably the most perfect system that can be adopted, is the collection of urine by means of pneumatic carts from store tanks, formed to receive the aggregate of liquid flowing from a nest of houses, and the emptying upon the spot, at night, into any description of covered cart, of the perfectly and absolutely inoffensive dry and deodorised residue. For complete and perfect cleanliness, it requires only the conveyance and removal of empty receptacles. Nothing can be more costly in mere cost of carriage, and nothing can render the pan contents more difficult to deal with, than the removal of urine and excreta in a mingled condition. Besides the utterly unnecessary carriage, with all the dangers of mishap incident to fluid condition, the jolting of the journey causes a pasty substance to form out of the admixture, which substance is extremely difficult and very costly to deal with. But, when this has to be done, the company do not consider a more perfect cover can be devised for carrying off liquid than "Harescrugh's improved patent spring lid receptacle;" it is a perfect way of doing a wrong thing.

As different as possible from the dry system thus set forth, are cesspools. Ordinarily, they leak and admit surface-water, as well as soakage-water. They are devised to suffer the ammoniacal and manurial values of the matter collected to escape where their power and efficacy can only work incalculable ills; and, when they are what is called emptied, it is simply facilitating the more rapid operation of fresh soakage. Thus they engender a perpetual spread of continuous evil, and they effect permanent depreciation of values, and practically involve the baling out of accumulations of deteriorated water-sewage. They are, in fact, sewers, with all the disadvantage of leakage. The entire responsibility and cost of dealing with these should be borne by the locality which suffers them to exist; but they can be made into pits, as above described, without either great difficulty or great expense.

The company's commodes only require a trial. They are absolutely perfect for the sick room, or yacht, or indeed wherever perfect closet accommodation may be required. The capacity of the receptacle is the only determinant of the necessity of removal. The contents may remain open in the sick room in the hottest weather without offence, so long as the char is properly applied.

In respect of health where charcoal is supplied, it may be broadly stated infection is, humanly speaking, impossible.

The company observe and act upon the principle of separation, as far as they can bring it to bear in their manufacture. Labouring, as they do at present at Oldham, under the necessity of dealing with a great deal of matter not separated in the manner above described, but also and mainly with stuff tumbled about in unperforated sanitary vans, and collected out of pervious sewers, that is, out of cesspools, they have applied themselves to the very onerous task of making the best they can out of these conditions, which are, at all events, there at least, the conditions for the time being. The semi-liquid collection is poured into a series of patent Alver filtration separating tanks. These are enclosed, and, by the application of charcoal, kept perfectly sweet. By the processes adopted by the company, the liquid is as much as possible extracted, separated, and clarified. It is then distilled, and the effluent brought to a sufficient state of purity to pass off in drains. The solid portion is put into Milburn's patent floors, and treated in combination with specialities of arrangements which are combined to render the amount of output a maximum, and by which the expense, in erection and maintenance of the very perfect system of manufacture without offence, which the company has adopted, is turned to account in driving off moisture, until no more is left in the manurial produce than is deemed desirable in a finished manure.

The Society of Arts invites "additional facts to those stated in the Local Government Board report on disposal of sewage." The Carbon-Fertiliser Company is, as will have already appeared, so utterly and completely at issue with the primary enunciations of this committee of the Local Government Board, that they have deemed themselves under some difficulty in complying with the invitation of the Society of Arts. As a commercial undertaking, they can scarcely care to contend with declarations claiming to be, at one and the same time, scientific and to carry the weight of some measure of the administrative authority of the Government of the country, the tenor of these declarations being precisely that which the company has been expressly formed to show to be based on inaccuracy, and the contravention of such allegations as are advanced in that report is the very *raison d'être* of the company. Thus, the committee lays down, as an absolute law, that the retention of excreta in cesspits must be utterly condemned. Under proper conditions, the company holds this to be the very most desirable thing to do. The committee declares, "the excreta is likely to be a nuisance during the period of its retention, and a cause of nuisance in its removal;" the company holds it practicable absolutely to secure neither the one nor the other being the case. The committee declare that "towns situated on the sea coast, or tidal estuaries, may be allowed to turn sewage into the sea or tidal estuary below the line of low water, provided no nuisance is caused; and that such mode of getting rid of sewage may be allowed and justified on the score of economy." The company hold that the whole of this announcement is error, from beginning to end. If it means anything that is clear and intelligible, it refers to mere unreclaimed, untreated sewage, and it is simply impossible to pour a volume of nuisance into the sea without causing a nuisance. The company holds, moreover, that it is utterly and completely impossible to "justify" the practice of putting excreta and urine into pure water, and no other is avowedly used, or contemplated for use, in either water-closets or in urinals. The practice has to be dealt with as an existing fact, but it cannot, according to the judgment which the company has deliberately and determinately formed and adheres to, be "justified" under any circumstances or conditions whatever. The committee also state:—"So far as our examinations extend, none of the manufactured manures made by manipulating towns refuse, with or without chemicals, pay the contingent costs of such mode of treatment, neither has any mode of dealing separately with excreta, so as to defray the cost of collection and preparation by sale of the manure, been brought under our our notice." This extremely qualified statement is clear only on the single point of guarding anything it may be thought to say from being taken as conclusive, or as committing the propounders of this oracular announcement. It seems to teem with suggestion and to guard against statement. The company holds the entire report to be but the very inconclusive and feeble advocacy of a foregone conclusion on the part of persons committed to that application of water which the company utterly condemns, and, but for the invitation of the Society of Arts, would have not noticed it otherwise than by daily endeavouring more and more to refute it. Assuming, however, that this last allegation is intended to imply and to desire to convey the suggestions that merchantable manure cannot be made out of excreta, and that, consequently, water-closet construction and sewers are costless, they withhold assent from either assertion, and quite as strongly from the illogical and inconsequential connection sought to be established between a statement which is incorrect and a conclusion in no way connected with the statement if it were correct. If it is not the serious intention of the committee to assert that water carriage is to be adopted at all cost and at all hazards, the report contains absolutely nothing but platitudes as to water carriage, and fallacy as to dry systems. To assert that irrigation is applicable for the disposal of sewage where conditions are favourable, is simply saying it is applicable where it is applicable; to say that the discharge of crude sewage is objectionable is, however, to condemn water carriage wholly, as it in practice exists; and to assert that deposit in tanks and the use of chemicals do not make much change, is to assert that the state of things is pretty nearly irremediable without stopping the abuse at the fountain-head. On the other hand, the company holds that, in the face of apparently insurmountable obstacles, they have been enabled, speaking humanly, by the mere force of the truth and principle on which they have based their operations, to demonstrate incontestibly the following facts, which they can formulate without suggestion, and can state without reserve, viz.:—

That they have perfected, that is to say, completed and put together, a system of dry treatment, under which they convert that which is the prime difficulty in water-carriage, and which is liable at all times, if improperly treated, to become a dangerous nuisance, into a perfectly inoffensive substance. That they accomplish this by means under which excreta and urine are collected, conveyed, and may, if required, be stored without offence or nuisance. That the manufacture is carried out without risk, danger, or possibility of infection. That at every stage and step it stands in advantageous contrast with water-carriage. That the product is a manure in the most perfect physical condition, and by addition of chemicals, principally phosphates, in the course of the manufacture, the product contains those per-centages of phosphatic and ammoniacal value which are laid down by the highest authorities on the subject as most requisite to ensure the largest sales in the country. The reports on the company's manures are of a very favourable character, and its sales are effected on analysis. That this manufacture of such incorporated manure is carried out under conditions which demonstrated that it cannot be justified "on the score of economy" to throw away the manurial value obtained from the excreta and urine. Yet nothing short of this is the contention of this Committee of the Local Government Board, who, however, have said nothing on the subject of the cost of water-closet construction and maintenance, nor on the costly sewer construction and maintenance, nor on the cost and hopelessness of any and every suggestion which can be so much as guessed at for re-purifying the crude sewage, which it is "highly objectionable to discharge into rivers," nor on the cost of sewer construction and maintenance, to carry the accumulated aggregate of the excrement and urine of Great Britain to discharge on the various bathing places on the sea-coast, "provided no nuisance is caused." It seems almost necessary to add that the company is not aware of the Committee having at heart been in the interest of dry systems, and the company itself is entirely free from having in any way underhandedly urged on the preparation and publication of "this utter condemnation of the water-carriage of excreta and urine, and this refutation of the various fallacies by which it has been sought to support a practice so fraught with injury."

TREATMENT AND UTILISATION OF NIGHT SOIL AND CONVERSION INTO A CONCENTRATED MANURE BY MILBURN'S DRYING MACHINERY.

When we remember that more than three-quarters of the population of the United Kingdom are dependent upon pails, privies, or cesspits, for the reception of their excreta, we cannot but regret that so little has hitherto been accomplished towards profitably utilising the large quantity of natural guano, probably amounting to at least 2½ millions of tons, which is thus annually produced. Night soil has too often been considered simply as a nuisance which has to be got rid of with as little expense as possible, and in as cleanly a manner as existing appliances will permit, but without due reference towards preserving its valuable fertilising properties. Decomposition, which sets in at an early stage after the fæces are voided, renders it of the highest importance that all purely excrementitious matters should be removed at frequent and regular intervals; hence the development of the tub or pail system of collection, and the gradual displacement of the old privies, middens, and cesspits.

At the same time, it must not be forgotten that if proper disinfectants be applied to the excreta, there is not that absolute necessity for frequent collection which exists when no disinfectant is applied, or when the soil is merely mixed with ash, cinders, or even charcoal. The addition of ashes to the excreta is considered in many quarters to be the simplest, and on the whole, the best method of ultimate treatment, the ashes being used as a vehicle for absorbing a large proportion of the liquid contained in the soil. This mixture, however, is quite fatal to any hope of producing a manurial compound of more than merely nominal value, and there can be but little doubt that the separate collection and separate treatment of excreta and ashes is the only system that can prove satisfactory, when considered both in its sanitary and commercial aspects. Disinfectants are not necessarily ammonia fixers; it is, therefore, important to determine the right kinds which ought to be employed. They should not only deodorise, but have a conservative action upon the fertilising constituents of the excreta.

The tendency of ashes and similar agents, when mixed with the night soil, is to induce rapid oxidation, and even charcoal, when applied by itself, has the same tendency. Mr. William Crookes, F.R.S., in his report to the Cattle-plague Commissioners, states :— "Oxidising disinfectants possess little, if any, continuous action . . . They remove the products of decomposition, but they do not take away the power of further putrefaction." Probably one of the best deodorants for excreta is a mixture of sulphurous and carbolic acids, combined with phosphate of lime and magnesia, in some such form as McDougall's powder. It must be remembered that although these agents add somewhat to the cost of treatment, yet they return far more than their cost in the increased manurial value of the soil. In the report before alluded to, Mr. Crookes remarks —"Sulphurous acid, in addition to its antiseptic qualities, is a deodoriser of considerable energy. It destroys the powerful odour of the most offensive gases; it attacks and oxidises sulphuretted hydrogen, entirely destroying it; it neutralises the strong smell of ammonia and other alkaline bases, converting them into sulphites, but without destroying their manurial value, or losing its antiseptic qualities;" and, with reference to carbolic acid, he adds, that it possesses the power "of arresting and preventing decomposition, it checks the evolution of these offensive odours, and, by retaining the nitrogenous compounds (ammonia makers) in the manure, it greatly increases its value."

The object of this paper is, however, more particularly to describe what has been done in different localities, with excreta dried and converted into a pulverulent manure, by means of the machinery introduced by Milburn's Engineering Company. The drying apparatus is thus described in *Engineering*, of November the 17th, 1876:—

"The machine consists of a floor or bed formed of cast-iron plates, on to which the wet manure is fed. Beneath this floor, at the feeding end, is the furnace, which is covered in with a fire-brick arch terminating in a double bridge. In the bridge are openings through which the heated products of combustion pass away under the iron drying floor. The brickwork furnace-crown prevents the floor being overheated at that point which would cause damage to the manure. The heated air from the furnace, after passing under the floor, returns over it through the drying chamber, which forms a flue, the hot air carrying with it the vapours arising from the drying process, which pass away together through a chimney over the feeding end of the machine. A cast-iron frame is placed over the drying bed, and extends nearly the whole length of the floor. This frame is movable, and it carries a series of transverse bars, which form scrapers, the edges of which rest upon the floor. The frame also carries a series of slowly revolving agitators or rakes, which are placed intermediately between the scrapers' and which move to and fro with the frame. The duty of these agitators is to stir and break the manure up at the wet end and along the bed until it is dry, when their action causes the manure to become pulverised until at the exit end it is in a finely powdered condition. On the top of the frame are brackets, arranged so as to form vertical slots in which crank-pins work, the cranks being attached to gearing at each side of the machine, and the whole being so arranged as to revolve together. The vertical slots are equal to the full length of the stroke of the crank, so that at each stroke the frame is moved slowly to and fro. The transverse scrapers sweep the entire surface of the bed, and by keeping the manure in constant motion prevent its caking on the iron plates.

"On the top of each of the slots, or crank-pin guides, is mounted a moveable stop-block, which is adjustable by means of a screw, and by which the length of the slot is increased or reduced as required. According as the slot is longer or shorter, so is the frame lifted to a greater or less height at its backward stroke, when the scrapers and stirrers pass over a portion of the manure. At the return stroke each scraper passes on a portion to the next scraper, and thus the manure gradually travels the whole length of the plates until, from a wet coherent mass at the feeding end, it becomes a dry powder at the delivery end of the apparatus where it makes its exit. The drying floor is covered in with iron plates which are carried on the top of the frame, thus enclosing the manure whilst being dried, and forming the return flue already alluded to. If it should be found desirable to destroy the noxious gases, that is effected by means of a special furnace, through which they are forced and in which they are entirely decomposed."

As an illustration of the system advocated by this company, it may be convenient here to describe the *modus operandi* adopted at Bilston; and, although the process was most imperfectly carried out, yet it thoroughly established the fact that, under Milburn's patents, night soil can, without entailing any nuisance, be converted into a highly valuable manure, which will amply repay the cost of collection, and yield a fair profit on the manufacture. The soil is principally collected in tubs and pails (the contents being sprinkled with gypsum), and brought to the depôt for manufacture into guano. Rags, stones, and foreign substances being roughly extracted, the pails or tubs are emptied direct into the drying machine, sulphuric acid being added in the proportion of 30lbs. to each ton of night soil, in order to fix the ammonia. After passing along the machine, the manure is delivered therefrom in a condition containing 30 to 35 per cent. of moisture. It is then placed on a supplementary drying-floor or finishing chamber, heated at not too high a temperature by the waste products from an arrangement of furnaces, constructed for decomposing or destroying the noxious fumes which arise from the machine during the drying process. After the manure has remained for a few hours in this chamber, exposed to a gentle heat, it is taken to a mill and ground ready for sale.

The machine would complete the drying operation without the aid of the finishing chamber, but the latter is employed on the score of economy, as the machine would turn out a larger quantity in a given time by this means, and the finished manure becomes somewhat better in quality. The manure thus treated was certified by Dr. Voelcker to analyse as follows:—

	Per cent.
Moisture	10·49
Organic matter and salts of ammonia[*]	59·69
Phosphate of lime	5·12
Oxides of iron and alumina	5·72
Sulphate of lime	9·19
Carbonate of lime	2·01
Alkaline salts and magnesia	1·93
Insoluble siliceous matter	5·85
	100·00

The market value of this manure may be taken as £7 10s. to £8 per ton, and it was sold at this latter price in several instances. It may be mentioned that when the acid was omitted and nothing else mixed with the soil, the dried manure contained 2 per cent. less ammonia. The cost of the acid came to about 7s. 6d. per ton of dried material.

In one instance a small quantity of superphosphate and of sulphuric acid was added to the excreta — probably the proportion was scarcely sufficient. The analysis, determined by Mr. E. W. F. Jones, F.C.S. (of Wolverhampton), was as follows:—

	Per cent.
Moisture	10·80
Organic matter, combined water, &c.[†]	58·10
Bisphosphate of lime	2·09
(Equal to soluble phosphate, 3·28 per cent.)	
Insoluble phosphate of lime	7·75
Sulphate of lime, alkaline, salts, &c.	12·01
Insoluble siliceous matter	9·25
	100·00

In case it might be thought that the practical results of the manure do not bear out the chemical analysis, it may be mentioned that a practical agriculturist writes:—

"I have found the manure from Bilston very good indeed. I have this year grown mangolds, swedes, and potatoes, and find excellent effect. All these crops are growing on poor land, without any other manure, and are as fine as any in the country. It had also a very marked effect on the growth and yield of a field or barley grown by one of my tenants."

And another states:—

"I am now able to report favourably of your manure, having tried it in a ten-acre field with two other well-known artificial manures costing much more money per ton. I find the swedes grown with your Bilston manure far superior to the other swedes in the same field."

It is a matter of regret that the association which has carried on the manufacture at Bilston during the last two years, has, from a variety of causes—for which the process is not, and cannot be, in any way blamed—ceased operations, and the works are, at the moment, in abeyance. The population of Bilston is about 26,000.

At Oldham, with a population of 100,000, the Carbon-Fertiliser Company are satisfactorily manufacturing a dry manure from the excreta of the town. This company employs five of the drying machines, and are enabled, by exercising ordinary care, to thoroughly destroy the noxious vapours by means of the decomposing furnaces before alluded to. The collecting pails are provided with perforated false bottoms, by which the greater portion of the urine can be kept separate from the more solid constituents. For some time the Carbon Company extracted the major part of the liquid before the drying process, mixing the residue with animal charcoal and a little shoddy. Two separate trials of the machines in January and February, 1876, gave the following results, the finishing chamber not being in use:—

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[*] Containing nitrogen 6·48, equal to ammonia 7·37 per cent.

[†] Containing nitrogen equal to ammonia, 6·32.

1*st Trial.*—(1 machine working 77 hours.)

	Tons.	Cwts.	Qrs.
Wet compound put in the machine	26	13	2
Dry manure taken out of ditto	14	16	2
Fuel used (coke)	2	7	1

Yield of dry manure equal to 4 tons 12 cwts. 1 qr. 18 lbs. per 24 hours.

2*nd Trial.*—(1 machine working 100 hours.)

	Tons.	Cwts.	Qrs.
Wet compound put in the machine	31	0	0
Dry manure taken out of ditto	14	17	0
Fuel used (coke)	2	7	2

Yield of dry manure equal to 3 tons 11 cwts. 1 qr. 3 lbs. per 24 hours.

In this trial one pound of coke evaporated 6·80 pounds of water. If more fuel had been used an increased quantity of manure would have been obtained. The cost of the coke was 7s. per ton.

The Carbon-Fertiliser Company do not now, as a rule, separate the liquid from the more solid excrement, but pass the mixed contents of the pails through the machine. The deodorant used, is a particular preparation of animal charcoal.

Mr. Wm. Wilson Hulse, Mem. Inst. C. and M. Engineers, in his examination before the Royton magistrates in December last, stated:—

"I was called in to examine the Carbon-Fertiliser Company's Works . . . and so far as I know, there is no machinery more perfect for its purpose than that used at their works. . . . . There is nothing more practical, nothing more simple, nothing more efficient."

At Berlin, the Berlin Phosphate Sewage Company have had these drying machines in operation on night soil during the past three years. The analysis of their manure, by Dr. Voelcker, is as follows:—

	Per cent.
Moisture	11·77
Organic matter and ammoniacal salts*	64·06
Soluble phosphate of lime	4·11
Insoluble phosphates	1·68
Alkaline salts	10·86
Insoluble siliceous matter	7·52
	100·00

The company state they sell all they make of the manure at £6 per ton.

At the town of Gratz, in Hungary, where three machines were erected, each machine, from a compound between night soil and sludge, turned out three tons of finished manure per day of 24 hours. The latest statistics regarding the drying machines are from Bombay, where the municipality are testing the efficacy of Milburn and Company's process. The result of 130 hours ($5\frac{1}{2}$ days) continuous trial was communicated as follows:—

"3,914 baskets of night soil were brought to, and tipped into, the machine, at an average of 43 lbs., thus giving a total of say 75 tons night soil, which gave off a total of 15 tons of fine dried manure in 130 hours, whilst the consumption of coal was 16 tons. This was sufficiently dried by the machine to be packed without any further drying."

The fuel used at this trial included that consumed by the furnace for destroying the noxious vapours, as well as for supplying driving power. As a rule, although apparently even more liquid, seven tons of night soil will yield one ton of dried manure. Taking, as an example, a town of 50,000 inhabitants, where fuel is fairly cheap, an approximate estimate of the financial result of working Milburn's system, may be taken as follows:—

COST OF WORKS.

Plant, say	£2,000
Buildings, &c.	1,500
Cost of ground, &c.	500
	£4,000

WEEKLY EXPENSES.

Say 100 tons excreta, costing, for collection, 4s. per ton	£20
Coal, including that for furnaces and driving power, 20 tons, at 7s.	7
Labour and management	14
Disinfectants (acid, &c.)	7
Repairs, interest on capital, and sundry expenses, say	12
	£60

WEEKLY INCOME.

14 tons manure, selling at £6 per ton net	£84
Add saving in present payment for collecting and removing the soil (not ashes), probably at £1,000 per annum, say	20
	104
Deduct expenses as above	60
Leaving a net weekly profit of or say £2,000 a-year.	£44

The above estimates would vary somewhat, according to the price of coal, whether the excreta be collected in pails, or from privies, or cesspits, and whether or not disinfectants be used to any considerable extent.

It is claimed for this process that it is applicable in nearly every case where any so-called dry-sewage system is in operation, or wherever night soil has to be collected and disposed of. It does not clash with existing interests, and it is maintained that lengthened trials have abundantly proved that, with ordinary care, the process can be carried on without creating the slightest nuisance; whilst, excepting in very small towns, the manufacture of the manure can be made to yield a very remunerative return.

As manure from precipitated deposit can, apparently, never be produced of sufficient value to recoup the cost of working any of the precipitation processes, it is not now proposed to enter into particulars respecting the application of machinery for drying sewage sludge. It may, however, be observed that each of Milburn's machines will, with a consumption of 16 to 18 cwt. of fuel, turn out from $2\frac{1}{2}$ to 5 tons of dried deposit per day of 24 hours, the quantity varying according to the consistency and description of the sludge.

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* Containing nitrogen 5·19 equal to ammonia 6·30.

CHEMICAL SECTION.

Thursday, May 10th, 1877, WALTER WELDON, F.R.S.E., in the chair.

The Chairman, in introducing Mr. Davis, said, even in that hall—in which, now for several generations, every problem of real moment which had arisen from time to time with reference to our arts, our manufactures, or our commerce, had undergone discussion—there had never been discussed any problem having reference to the chemical industries either more important, or of more pressing importance, than was to-day the problem of how to manufacture soda without producing any offensive residue. The alkali-makers of Great Britain now converted into soda every year not less than 500,000 to 600,000 tons of salt; and, for every ton of salt thus converted into soda there was produced more than a ton of a residual product which, for the most part, had to be piled up in the neighbourhood of the works in which it was produced, and which was there subjected to influences which rendered it a perennial source both of atmospheric pollution and of river pollution, more offensive in kind and more serious in degree than could be readily imagined by any one unacquainted with the localities in which the soda industry was carried on. In the case of, at any rate, some of these localities, their ordinary atmosphere could only be described as a mixture of air and sulphuretted hydrogen; while what were trout-streams within the memory of living men were now pestiferous currents, of the colour of pea-soup, of a more or less nearly saturated solution of those delightful compounds, the various sulphides of calcium. This was a state of things which the inhabitants of those localities naturally cried out against; and the need of a remedy for it became more and more pressing year by year, by reason of the constant growth of our soda manufacture, and the consequent continual increase in the number of persons who suffered from the nuisances which thence arose. The manufacturers of soda were usually blamed for this state of things, as though they could help it; but the fact was that, for the most part, at any rate, they really could not help it. They could not help it because they must make soda; the public must have soda; without soap, glass, paper, and the hundred other things which were manufactured by means of soda, we should all soon sink into comparative barbarism; and the only process which had hitherto been known by which soda could be manufactured on the scale on which it was manufactured in Great Britain, and otherwise under the conditions which prevailed in this country, was the process, from all other points of view so admirable, which was unfortunately attended by the inconvenience to which he had referred. During the 90 years or so which had now elapsed since this process sprang complete—for although the mechanical means of carrying it into effect had been improved, the process itself had undergone no improvement from that day to this—from the brain of the most illustrious but most unfortunate of all chemical inventors, countless attempts had been made, on the one hand so to modify it as to avoid its one great drawback, and on the other to supersede it by some other process; but, despite all these efforts, and the vast amount of money, labour, and ingenuity which had been spent on them, we were still obliged to say of this most important—and, despite the nuisance which it created, this most beneficent—process, what Dr. Hofmann said of it in 1862, namely, that it "remains to this day, what it was when Leblanc first gave it to the world, the cheapest and simplest means of effecting the most important of all known chemical transformations." Well, the author of the paper which was about to be read, undeterred by the utter failure of the many previous workers in the same field, proposed, not so much to change this process as to modify it, in such wise as at once to avoid the production of nuisance, and to realise certain other very important advantages. Mr. Davis's object was thus one of such great importance that that audience, which he was glad to see included five or six of the leading members of the soda trade, would certainly listen to his paper with unusual interest.

The paper read was—

A NEW PROCESS FOR THE PRODUCTION OF CARBONATE AND CAUSTIC SODA, WITHOUT THE FORMATION OF ANY NOXIOUS WASTE, AND THE RECOVERY OF THE SULPHUR.

By George E. Davis, Esq.

It has often been said, "that familiarity breeds contempt," and in no instance is this more true than in the application of natural substances to the requirements of the arts and manufactures.

We send to Spain, Portugal, Norway, and several other countries for our supply of sulphur, from which we manufacture sulphuric acid, the greater portion of which sulphur lies near to where it is worked, in the shape of alkali-waste, a nuisance to both the manufacturer and the neighbourhood, and we pass over that natural acid which lies under our feet in such vast quantities and so widely distributed, and the combinations of which nature has given us so many examples, and every possible variety of combination. I allude to silica, the silicic anhydride of the chemist, the sand of the builder, the founder, the machinist, the farmer, and others.

Why does this silica lie so neglected? Is it because its properties are not generally known? Is it because it is one of the most admirable examples of neutrality known, that it is disregarded as an acid? Or, is it being kept in reserve for when the sulphur supplies become exhausted? Whatever may be the answer to these questions, it is known that silica, or sand, only takes part in chemical reactions in a reasonable time, at high temperatures, except in the cases of mortars and cements, and we have examples of the action of silica at high temperatures, in the blast furnace, the puddling furnace, the glass and enamel furnaces, and in other metallurgic operations.

Crystals even of flesh-red felspar have been found in old copper furnaces, and crystals of adularia in iron furnaces, the operations of nature having been repeated, and the use of silica as an important manufacturing acid is certain to become more general, when our knowledge has become more extended of the proximate constitution of natural things.

Silicic is the acid destined to drive out sulphuric, and to effect a reformation in some of our most important industries. It may be a long time before the use of silica, as a manufacturing acid, is thoroughly effected; nevertheless, in my opinion, that time will come, and it will be as well to lay before you a few facts, to show you that I am warranted in making these statements.

As far back as February, 1840, Messrs. Blanc and Bazille obtained letters patent for the decomposition of common salt by heating with silica and passing a current of steam. I have not yet followed up this reaction as far as I intend to do; but I have heated mixtures of salt and sand in a current of steam, and have obtained hydrochloric acid, given off during the reaction.

This process of Messrs. Blanc and Bazille's has, I believe, been tried upon the manufacturing scale, the objection to it being the length of time necessary for the decomposition, which need be no objection, now that the Hargrave's process for the manufacture of salt-cake is worked upon the large scale, in which a 40-ton cylinder of salt has taken as long as thirty-one days for complete conversion, and the shortest time I have known for a 32-ton cylinder has been 21 days.

As a specimen of a natural silicate which can be formed artificially, I may specially instance Wollastonite, the silicate of calcium. It is produced at a high temperature, by the direct combination of silica and lime, and can be formed in many other ways from calcium salts.

The nitrates of the alkalies are decomposed by finely-divided silica. This is a well-known laboratory reaction. Therefore, in speaking of silica as the future universal manufacturing acid, I think I have produced sufficient evidence to show that this is extremely probable.

Again, by the introduction of silica as a manufacturing acid, an outlet is found for the large quantities of waste sand produced in the grinding-sheds of the glass works. To most glass works, the disposal of this waste sand is a very serious question; it is too finely divided for most mechanical purposes, but is just in a state the most suitable for chemical operations.

I did not intend, at the outset, to deal so lengthily with silica and simple silicates, the object of this paper being to show how caustic soda and carbonate of soda may be made, without the formation of a noxious waste, by the action of sand or silica upon native phosphate of alumina, used, of course, in conjunction with an alkaline salt; a double silicate of alumina and soda being formed, and by this means the alumina is eliminated, phosphate of soda being formed, which is soluble, and which is afterwards converted into either carbonate or caustic soda.

In nature we have many silicates of alumina and soda, of which the following may be taken as examples:—Albite, or soda-felspar, eudnophite, othoclase, analcime, mesotype.

The ease with which silica, alumina, and soda combine to form an insoluble double silicate suggested to me this process I am about to describe, so that, in working it upon a manufacturing scale, there would be produced a high class precipitated phosphate of lime, either carbonate or caustic soda, sulphurous acid, and an insoluble matter containing all the alumina which may be utilised in one of many directions.

I had previously noticed this formation of the double silicate of alumina and soda in nearly every branch of the alkali manufacture. The black ash processes, the lixiviation of the balls, the evaporation of the liquors, all produce insoluble matters containing this compound silicate, and in a paper read in Manchester, in May, 1875, upon the manufacture of white caustic soda, I gave an analysis of this silicate, which is anhydrous when formed in the furnace, and hydrated when formed in the wet way.

When this process of separating the alumina from its phosphoric acid was first devised, it was thought only to make phosphate of soda, therefore a mixture of soda-ash and sand was used to effect this object. The phosphate of alumina came from the island of Redonda in the West Indies, and may be taken as an average type of the whole deposit there. It possessed the following composition:--

Moisture at 100° C.	3·666
Combined water and organic matters	12·206
Phosphoric acid..	39·232
Silica and insoluble matters	3·850
Alumina..	23·986
Oxides of iron (as Fe_2O_3)	10·000
	99·940

Phosphate of peroxide of iron 18 per centum.
„ alumina 57 „ „

One hundred pounds of this phosphate were mixed with 175 pounds of 50 per cent. soda-ash, and forty parts of moist waste sand from the glass works, and the whole heated to redness in a furnace. After furnacing, the mass weighed 221 pounds, 89 pounds having been driven off. The furnaced mass was lixiviated, and the insoluble residue, after drying, weighed 100 pounds, exactly the weight of the Redonda phosphate operated upon, 121 parts having therefore passed into solution.

Two analyses were made of the insoluble matter: (*a*) The heavy light coloured sandy residue, and (*b*) the lighter, more finely divided, and dark-coloured residue obtained from the insoluble residue by levigation.

	A.		B.
Silica	33·365	..	31·365
Peroxide of iron ..	11·280	..	10·400
Alumina	26·975	..	26·330
Soda..	28·280	..	31·793
Phosphoric acid ..	traces	..	traces
	99·900	..	99·888

These analyses show that a double silicate of alumina and soda is really formed, and the insoluble residue contains practically no phosphoric acid.

The reaction which takes place was formerly thought to be as follows:—

$$Al\,PO_4 + Na_2\,CO_3 + Si\,O_2 = Na\,Al\,Si\,O_4 + Na_3\,PO_4 + 2\,CO_2.$$

But the analyses of the insoluble residue show that there is not formed in this process the same silicate as that produced in the alkali manufacture. The analyses of the caustic soda silicate agrees well with the formula ($Na\,Al\,Si\,O_4$) for the anhydrous, and $2\,(Na\,Al\,Si\,O_4) + H_2\,O$ for the hydrate, or—

Soda	one equivalent.
Alumina	„ „
Silica	two equivalents.

while that produced in the present instance agrees more nearly with—

Soda	two equivalents.
Alumina	one „
Silica	two „

Both, however, are insoluble in water, and gelatinise on being treated with a mineral acid.

The solution produced by the lixiviation of the calcined mass is mainly composed of tribasic phosphate of soda, containing also a little silicate of soda and chlorides, sulphate and sulpho-compounds of the soda-ash used.

Rhombic phosphate of soda may be made from this solution, by neutralisation of the third atom of the soda with phosphoric acid and crystallising in the usual way.

Of course it would not be a commercial advantage to use carbonate of soda for the manufacture of caustic soda; but even considered thus far, this is a good means of making the ordinary commercial rhombic phosphate of soda, and it may be thought that I have been a long time in coming to the real point in my subject; but I have of necessity brought you to this gradually; first, to show you that silicates and double silicates can be easily formed, and to show you also the kind of reactions which are likely to take place.

In the present process of manufacturing carbonate of soda and caustic soda—that known as Le Blanc's process—salt-cake is fused with limestone and slack, carbonate of soda is formed, while the lime, freed from the carbonic acid which accompanied it in the limestone, seizes hold of the sulphur, with which it combines to form the well-known alkali waste, which can be both seen and smelt in the vicinity of any alkali works.

In the present process, salt-cake is still used as the source of alkali; but, instead of limestone, the sand and phosphate of alumina are used in order to recover the sulphur, and to form an innocuous waste; and, in order that you may understand this new process thoroughly, and in all its details, I will divide it into the following sections:—

1. Preparation of the mixture.
2. The furnacing and collection of the gaseous products.
3. The lixiviation.
4. The treatment for caustic soda.
5. The treatment for carbonate of soda.
6. The treatment of the insoluble residue.

There is one advantage which this process has, which cannot be said of all new processes, viz., it can be applied to existing caustic soda works without any change of plant; not a single alteration is requisite, and there is only one addition necessary, and that is a mill, or disintegrator, for the preparation of the mixture.

I will now turn to the various sections I have already indicated.

1.—*Preparation of the Mixture.*

A mixture is made of:—Phosphate of alumina, 100 parts; upon a basis of 35 per cent. of phosphoric acid (P_2O_5); salt-cake of 95 per cent.; sand, 35 parts; slack, 30 to 50 parts; which is ground and intimately mixed. The mixing and grinding together is of great importance, as by this means the use of a large excess of sulphate of soda is avoided, as well as the subsequent production of the double sulphide of iron and sodium, which would cause a certain amount of trouble in the after operations.

2.—*The Furnacing and Collection of the Evolved Gases.*

After grinding and mixing intimately, the mass is introduced into a reverberatory furnace, such as a close or open salt-cake roaster, or a black ash furnace, either a hand furnace or a revolver, and there heated with agitation by means of a rake or slicer, until the decomposition is complete, which takes about the same length of time as an ordinary black ash ball. The mixture is very refractory, and it is almost impossible to spoil by over-firing; the decomposition is nearly complete by the time the slack has all burnt off, and the mixture has just commenced to frit together. In several charges of 2½ cwt. each, which were heated in an ordinary black ash furnace, an intense fire was urged on each charge for about 1½ hours without fusing the mass.

During the heating of the charges, sulphurous and carbonic acids are evolved; the former may be collected or utilised preferably in connection with Hargrave's process for the manufacture of salt-cake, now that process has been found a commercial success. If it is required to use the sulphurous acid for any other purpose, with which the smoke would interfere, it will be necessary to heat the mixture in a close salt-cake waster, this keeping the sulphurous acid from the fire-smoke. The decomposition of the phosphate was not as complete as in the case where carbonate of soda was used; nevertheless, there was a very fair practical decomposition, and would probably be better if the charges had been worked in a revolving black ash furnace. I give an analysis of the insoluble residue from the salt-cake process:—

Silica	30·928
Sulphide of iron	11·162
Alumina	27·468
Soda (by difference)	28·036
Phosphoric acid	2·406
	100·000

3.—*The Lixiviation.*

After the mass has been withdrawn from the furnace, it is allowed to cool, and then lixiviated in the same manner as ordinary black is now lixiviated. It lixiviates easily, even with cold water, and drains readily, not requiring so long to drain as the present black ash waste. The insoluble portion gives off no odour when exposed to the atmosphere.

A small portion of the double sulphide of iron and sodium dissolves out, colouring the solution green; but the liquors from the vats consist substantially of tribasic phosphate of soda. The vat liquor can be obtained in a very concentrated form, and, if run off into crystallising vessels, a crop of crystals of tribasic phosphate of soda can be obtained.

After running the liquor from the vats, they may be advantageously treated with phosphate of iron; by this means phosphate of soda is formed from the sulphide, and both the sulphide and the iron simultaneously extracted from the liquors.

4.—*The Treatment for Caustic Soda.*

The vat-liquors, consisting mainly of phosphate of soda, are diluted to about 24° Tw., or a specific gravity of 1·12, and treated in an ordinary causticising vessel with caustic lime, and the operation is conducted in exactly the same manner as in the present causticising process, so well known to soap boilers, paper makers, and many others, with the difference that the operation is conducted until some of the filtered liquor, after neutralisation with an acid, shows only a slight precipitate with magnesia mixture instead of the effervescence test at present employed.

The solution of caustic soda produced from the above operation is treated in exactly the same manner as the causticised liquor from ordinary black ash, and the salts which separate during the evaporation should all go back into the mixture for furnacing as their equivalent of salt-cake.

I need not point out that the lime precipitate formed in this process is not a waste article, as the present article is; it is a phosphate of lime of high quality, and being a precipitated phosphate, is a useful manure without further treatment. By further treatment of this phosphate with sulphuric acid, I have produced superphosphates of lime from it, which have contained only 1 per cent. of phosphate of lime in the insoluble form. This precipitated phosphate of lime may be made of a very high strength, and may be easily sold in very large quantities.

5.—*The Treatment for Carbonate of Soda.*

This operation is conducted in the same manner as when treated for caustic soda; but powdered chalk is used in the place of quick lime, and there is produced the precipitated phosphate and soluble carbonate of soda, which is boiled down and treated as in Le Blanc's alkali process, and it will be readily seen that a combination of these two operations, four and five, would give an alkali manufacturer an absolutely carbonated liquor, or one as highly caustic as he may wish.

Having thus disposed of all the soluble substances in the furnaced mixture, I now turn my attention to the insoluble portion, which corresponds to the present alkali waste of the soda manufacturer, and this brings me to section 6.

6.—*The Treatment of the Residue.*

The residue remaining in the vats, of which I have already given an analysis, after having drained sufficiently, is taken away for further treatment.

Now, it is well known that a sulphide of iron, when produced in the humid way, such as by the absorption of sulphuretted hydrogen by oxide of iron, as in the purification of coal gas, when submitted to atmospheric influences, produces an oxide of iron and free sulphur; on the other hand, a sulphide of iron when produced in the dry way, as in a furnace—in this process to wit—becomes oxidised into copperas; therefore the best methed of working up this insoluble residue would be to submit it to atmospheric influences, and manufacture copperas from the 11 per cent. of sulphide of iron it contains, which copperas would be washed out and obtained in any useful form, leaving the double silicate of alumina and soda nearly free from iron, and in a state suitable for the manufacture of alum or alum cakes.

After the extraction of the copperas, the residue is treated with dilute sulphuric acid, in which it dissolves, and the solution can be run into a reverberatory furnace, leaving behind the sand and coke which is present in the crude mass. The solution, when evaporated to dryness and lightly calcined, yields a soda-alum cake.

Such is the process, but as the cost of the phosphate of alumina introduces a new element of value into the cost of manufactuing caustic soda, or soda-ash, it is very necessary that the commercial merits of the process should be carefully considered. An alkali manufacturer might say, "My business is to make soda. What have I to do with the manufacture of phosphate of lime?" To use it as an agent, in the same way as he now uses sulphuric acid and limestone as the most convenient means to attain a desired end. In the one case, the resulting bye-product is a very valuable one, upon which a profit can be made; in the other it is utter rubbish, a perpetually perplexing evil, costly to the producers, and annoying to those who unfortunately have to absorb its unpleasant and deleterious exhalations. At present, comparitively little of the sulphur is recovered. On a future occasion I hope to show how even the use of sulphuric acid may be dispensed with in the manufacture of alkali, but at present I must confine my remarks to this phosphate of alumina process. All, and nearly all, the sulphur in the salt-cake may be recovered; that which is evolved as sulphurous acid may be used in the production of fresh salt-cake, and here is an immediate source of profit. Native phosphate of alumina, guaranteed to contain a minimum of 35 per cent. of phosphoric acid ($P_2 O_5$), can be bought at about 1s. 9d. per unit delivered ex-ship at any safe port in the United Kingdom, or I can safely say it may be bought either for present or forward delivery at £3 3s. per ton, or three 35 units of phosphoric acid calculated into its equivalent of phosphate of lime, 76 per cent., at 10d. per unit per ton. For these 35 units of phosphoric acid, alkali manufacturers should have no difficulty in obtaining 3s. 9d. per unit after it has been converted into a precipitated phosphate of lime, or in this condition 1s. 9d. per unit for the corresponding 76 units of tri-calcic phosphate, worth £6 13s., thus leaving an ample margin of £3 10s. per ton to cover labour, working expenses, and profit, for converting a ton of phosphate of alumina, containing 35 per cent. $P_2 O_5$, into a ton of phosphate of lime containing 35 per cent. of phosphoric acid; but in fact the ton of phosphate of lime, as it would be manufactured, would contain more than 76 per cent. of tri-calcic phosphate, and there should be no difficulty in making it as high as 90 per cent., or even higher if necessary.

This would make no difference in the money paid for the phosphoric acid in the phosphate of alumina bought; but it most likely would in the money realised for the phosphoric acid in the phosphate of lime produced, in consequence of the high strength, and would likely reduce the cost of converting the phosphate of alumina per ton. And as the phosphate of alumina contains on an average 37 per cent. to 38 per cent. of phosphoric acid, the difference between its cost per ton and the value of the corresponding phosphate of lime per ton would of course be proportionately more than I have stated, consequently the working expenses would be less per ton, for if the raw mineral contained 38 per cent. of phosphoric acid, there would be a margin of £3 15s. per ton to cover labour, working expenses, and profit, for converting the ton of phosphate of alumina into phosphate of lime, and therefore the more phosphoric acid in the raw mineral, the better for the manufacturer. The sand used would cost very little; about the same quantity of fuel would be required as in ordinary black ash making; the phosphate balls would be more easily lixiviated than ordinary black ash balls, on account of their sandy nature; and less lime would probably be required per ton of soda produced than in the present process; the lime mud is a waste product, and in the new process it is an element of value, and the working of this portion of the process would be better looked after than it at present is in many works.

From this point, the *modus operandi* for making caustic soda or soda-ash is identical with the present process, and the labour and working expenses from first to last, including the manufacture of the phosphate of lime, need not be more than is now incurred in making caustic soda or soda-ash by the present process.

By Le Blanc's process about 54 tons of 60 per cent. caustic soda are obtained from 100 tons of salt-cake; by this phosphate process I do not at present think that more than 44 tons will be obtained in consequence of the quantity of soda required to constitute the insoluble aluminous compound; but I expect that more than what has been paid for this portion of the soda originally as salt-cake will be realised for it in the sale of the aluminous compound or soda residue, irrespective of the money obtained for the alumina.

The $1\frac{3}{4}$ tons of salt-cake required to decompose the ton of phosphate of alumina, would cost at present £5, and the 15 cwts. of 60 per cent. caustic soda, which would be obtained from this, valued at 12s. per cwt., would be worth £9, leaving a margin of £4, and as there is an additional profit in making the phosphate of lime, £6 10s. in all, to cover labour, working expenses, and profit, in converting one ton of phosphate of alumina with $1\frac{3}{4}$ tons of salt-cake into a ton of phosphate of lime of 76 per cent., and 15 cwts. of 66 per cent. caustic soda.

The precipitated phosphate of lime would be readily bought by manure makers, it being a very superior article, and free from iron, and so finely divided, that almost all the phosphate of lime can be rendered soluble by sulphuric acid. Being a precipitated phosphate, I have no doubt but that our agricultural authorities would give it a fairly enhanced value for direct application to the soil, and for this purpose, and for mixing with other manures, it may easily be sold in large quantities; and it would also be useful for many other purposes, to which bone-ash is now applied, and this article is now selling at £6 10s. in Liverpool, on a basis of 70 per cent. of phosphate of lime. Taken together, the manufacture of phosphate of lime, and caustic soda, there is a good margin for the alkali manufacturer.

Considered as a means of utilising phosphate of alumina, this process is also of interest to artificial manure manufacturers, inasmuch as it introduces a new and cheap method for making soluble phosphates. Good raw phosphates of lime are becoming very dear, and phosphate of alumina is a cheap source of phosphoric acid. I have already stated that it could be obtained at 1s. 9d. per unit of phosphoric acid, or, say 10d., calculated as tricalcic phosphate on 76 per cent. = £3 3s. per ton, the alumina is not charged for, but instead of going into this question of cost, I will leave this to my manufacturing friends to make their own bargains, and, very probably, they will find that they may be able to buy for less money than I could safely base my calculations upon.

The phosphate of soda would undoubtedly be a very valuable manure, and for producing this salt a very large quantity of phosphate of alumina might be operated upon, for the consumption of manufactured phosphates has become enormous, and the great desire seems to be for a soluble phosphate only. By this process, as a means of making soluble phosphate for manure purposes, the phosphate of soda ball, when drawn from the furnaces, need simply be allowed to cool, and the whole mass sold as a manure. About two tons would result from each ton of phosphate of alumina worked, and containing about 16 per cent. of soluble phosphoric acid. One black ash revolver could turn out about 200 tons of this new manure in one week, the total labour on the manufactured article not exceeding 4s. per ton.

In this instance the insoluble residue would be sold with the phosphate of soda, and supposing no value were placed upon the soda, either soluble or insoluble, and simply the soluble phosphoric acid paid for, there would be a good margin for manure manufacturers also. They should obtain at least 7s. 6d. per unit for the soluble phosphoric acid, or corresponding to 3s. per unit of tri-basic phoshate of lime made soluble by acid; or, suppose they only sold it extensively to manure merchants at 7s. per unit for the soluble phosphoric acid, corresponding to 2s. 10d. per unit of tribasic phosphate of lime made soluble, there is a margin of 5s. 3d. per unit of phosphoric acid, or 2s. per unit of tribasic phosphate of lime made soluble, so that 35 units of phosphoric acid, costing £3 3s., would be worth £10 15s. converted into phosphate of soda, and there is thus an example margin of £7 12s. to cover the cost of the raw materials, other than phosphate of alumina, the labour, working expenses, and profit, in converting a ton of phosphate of alumina of 35 per cent. of phosphoric acid into crude phosphate of soda, by means of about $1\frac{3}{4}$ tons of salt-cake and one ton of coal, and six cwt. of sand, and the cost of so doing would not be greater than is now incurred in converting $1\frac{3}{4}$ tons of salt-cake into crude black ash, for the process is nearly the same. The salt-cake would cost at present 55s. per ton, and the coal 5s. per ton, the sand say 3s. 6d. per ton, say in all £5 5s. for decomposing agents, which in addition to the cost of the 35 per cent. phosphoric acid in the phosphate of alumina, would be about £8 5s., as against £11 7s. to be realised for the manufactured article, including the value of the sulphur at pyrites price, leaving a difference of £3 to cover labour, working expenses, and profit.

If a purer salt be wanted, the fused mass would only require to be lixivated, and the solution boiled down to dryness or allowed to crystallise. In the latter instance the weight would be about two tons for every ton of phosphate of alumina furnaced, and the quantity of soluble phosphoric acid about 17 per cent., the value of the aluminous compound should pay the cost of lixivating, &c. At present there is only a very limited demand for phosphate of soda, but this may be in consequence of its high price; now that the cost of production can be largely reduced, an increase in the consumption will most likely result.

But I must not forget that the end and purpose of this paper was to demonstrate how caustic soda and soda-ash might be made without the production of a noxious waste and the recovery of sulphur; still I would wish it understood that the process, although worked out in the laboratory, and afterwards worked upon several hundred weights of phosphate of alumina in an alkali works, has not had the test of continuous practical working. Having been in correspondence with a manufacturing firm for the introduction of this process, I had hoped to have been able to give some results of practical trials, but owing to circumstances over which I had no control, I have not yet been able to work it continuously upon the large scale.

As to the supply of phosphate of alumina, there is no doubt it exists in the island of Redonda and elsewhere in the West Indies. I am credibly informed that it can be obtained *ad libitum*, and from what I know of the sources of supply, I believe it can.

It first came into notice about 10 years ago, when the surface deposits on Redonda were imported into, and sold in, the States of America as guano. There was a little phosphate of lime in this material, but it was very soon discovered that the deposit was one of phosphate of alumina only. When first introduced into this country, it puzzled a few of our manufacturers in their attempts to work it with an acid, and this has not been accomplished with any degree of satisfaction, either for the production of alum or manure.

Value of the Material consumed and produced in making Caustic Soda by means of a Ton of 35 per cent. Phosphate of Alumina.

	Value Consumed.	Value Produced.	Value Increased.
	£ s. d.	£ s. d.	£ s. d.
FURNACING PROCESS.			
Used—			
35 units of phosphoric acid = 76 per cent. $Ca_3\ P_2\ O_8$ at 10d. per unit	3 3 0	..	..
1¾ tons of salt cake, at 55s. per ton	4 16 0	..	..
1 ton of slack	0 5 0	..	..
6 cwts. of sand	0 1 0	..	..
Made—	8 5 0	..	..
2 tons of "phosphate balls," containing 35 units $P_2\ O_5$ = 76 per cent. of $Ca_3\ P_2\ O_8$ made soluble, at 2s. 10d. per unit	..	10 15 0	..
6 cwts. of sulphur, as SO_2 and pyrites, price 2s. per cwt.	..	0 12 0	..
		11 7 0	..
Margin for labour, working expenses, and profit	..	..	3 2 0
VATTING PROCESS.			
Used—			
2 tons of "phosphate balls," as above valued	10 15 0	..	..
Made—			
2 tons of tri-sodic phosphate, containing 35 units $P_2\ O_5$ = 76 per cent. of $Ca_3\ P_2\ O_8$, at manure price of 2s. 10d. per unit	..	10 15 0	..
1 ton of aluminous soda residue, at 20s. per ton	..	1 0 0	..
		11 15 0	..
Margin for value of the insoluble material	..	..	1 0 0
CAUSTICISING PROCESS.			
Used—			
2 tons of tri-sodic phosphate, as above valued	10 15 0	..	..
½-ton of lime, at 14s. per ton	0 7 0	..	..
6½ tons of slack, at 5s. per ton	1 12 0	..	..
3 drums for 15 cwt. caustic soda, 60 per cent.	0 10 0	..	..
Made—	13 4 0	..	..
1 ton of tri-calcic phosphate, 76 per cent., at 1s. 9d. per unit	..	6 13 0	..
15 cwts. of 60 per cent. caustic soda, at 12s. per cwt.	..	9 0 0	..
		15 13 0	2 9 0
Margin to cover labour, general expenses, and profit, in converting a ton of phosphate of alumina into a ton of phosphate of lime, and making ¾-ton of caustic soda, on an outlay for raw material of £10 14s.	..	..	6 11 0

DISCUSSION.

The Chairman said that the process which Mr. Davis had described must be regarded as a process for the utilisation of Redondo phosphate, rather than a process for the manufacture of soda. Precisely the same process had been suggested in his own laboratory, by his friend and assistant, Mr. Bunker, more than 18 months ago. As his experiments with respect to it had not been published, they in no degree affected the originality of Mr. Davis's proposal, nor the validity of Mr. Davis's patent; and he mentioned them now only to show, by the fact of his having abandoned them, the strength of his conviction that the process was not commercially feasible. Mr. Davis had given figures which made the process to yield a considerable profit; but the true way to settle that question was to compare the cost of a given quantity of caustic soda produced by it with the cost of the same quantity of soda as produced by the process at present in use. In making this comparison he would use the figures for Mr. Davis's process which are given in Mr. Kingzett's book, as Mr. Davis had assured him that they were accurate, and he had already worked out the comparison on the basis of them. Mr. Davis's mixture, as given by Mr. Kingzett, consisted of 2·75 parts salt-cake, 1·5 parts Redondo phosphate, 0·75 parts slack, 0·75 parts sand, the total weight of the mixture being thus 5·75 parts. Calling the P_2O_5 in such a mixture one molecule, the salt-cake in it was five equivalents. Even, therefore, if Mr. Davis could get his reactions to take place with absolute completeness, so as to get all his P_2O_5 converted into $3Na_2O, P_2O_5$, he would obtain as sodic phosphate only three-fifths of the salt-cake he employed. Even with theoretically perfect results, he could thus get from five parts of salt-cake only as much soda as was ordinarily got from three parts of salt-cake. To get by the ordinary process the quantity of soda which was the utmost that Mr. Davis could get from the mixture given above, the mixture employed would consist of 1·65 parts salt-cake, 0·68 parts slack, and 1·18 parts limestone, these being the proportions used by Mr. Mactear. The total weight of this mixture is 3·51 parts, so that, calling the weight of this mixture 1·0, the weight of Mr. Davis's mixture was 1·63. Calling the quantities of the various elements of the two mixtures tons and fractions of tons, he would write on the black-board a debtor and creditor account, putting on the debit side those items of cost which Mr. Davis's process incurred which were not incurred in the ordinary process, and on the credit side what it saved of what was consumed in the ordinary process, and what it produced which the ordinary process did not produce. Mr. Davis's process had to be debited with 1·5 tons of Redondo phosphate, which, at the price quoted in the latest lists, came to £5 5s. It had also to be debited with 1·1 tons of salt-cake more than the ordinary process requires, costing at the current rate £3 6s. It was fair to suppose that it would require as much fuel to heat a ton of Mr. Davis's mixture as to heat a ton of the ordinary mixture, and as Mr. Davis had to heat 63 per cent. more materials than have to be heated for the same production of soda by the ordinary process, he would require, on this part of the process, 63 per cent. more fuel. Having 63 per cent. more material to manipulate, he would similarly require 63 per cent. more labour. He must also be debited with something for the cost of grinding his materials to fine powder, and with the fuel and labour required for drying and manipulating his phosphate of lime, which he would obtain as sludge, and must therefore dry and manipulate before he could send it to market. Moreover, per quantity of soda obtained, Mr. Davis's residue would be nearly twice as heavy as that produced in the present process, and its manipulation and storing would be proportionately more costly. If these last-mentioned five items, together with the sand which Mr. Davis used, were put down at £1, they would surely be put down at less than they would cost in practice. There remained one other item on the debit side, namely, loss of soda. Mr. Davis's own published analyses of the soda remaining with the carbonate of lime mud produced at present, in caustifying carbonate of soda liquors, showed that not less than 11·9 per cent. of the total caustic soda produced remained with that residue. This figure seemed very high, but, accepting it on Mr. Davis's authority, it was impossible to suppose that any smaller proportion would remain unwashed out of Mr. Davis's phosphate of lime mud; and whereas the soda which remained with the carbonate of lime mud produced in the present process was not lost, but went back into the black-ash furnace, and was so recovered, what soda should remain with Mr. Davis's phosphate of lime mud would not only be lost utterly, but would moreover diminish the value of his phosphatic product by increasing the quantity of sulphuric acid required to convert it into superphosphate. Taking the soda thus lost at 10 per cent., its value, as 60 per cent. caustic, would be about 29s. 6d.; but, taking into account that it would be lost before having incurred certain manufacturing charges, and, on the other hand, that the carbonate of lime mud produced at present had to bear some such charges, the proper amount with which to debit Mr. Davis's process on its account was £1 2s. The total amount on the debit side was thus £10 13s. Turning now to the other side of the account, Mr. Davis's process had to be credited with (1) the value of the phosphate of lime produced in it; (2) the value of the limestone used in the old process, but which Mr. Davis did not use; (3) the value, if any, of the SO_2 given off in Mr. Davis's process; and (4) the value, if any, of Mr. Davis's solid residue. As regarded the value of the phosphate of lime, it would be by no means pure tricalcic phosphate. It appeared from Mr. Davis's published analyses of carbonate of lime mud, that 1·26 equivalents of lime are now used to caustify carbonate of soda liquors. There were many reasons why an excess should be required, and these reasons were at least as applicable in the case of phosphate of soda as in the case of carbonate. Mr. Davis would therefore require to use at least $1·26 \times 3 = 3·78$ equivalents of lime per 1·0 equivalent of $P_2 O_5$. Moreover, as had already been seen, there would remain with the phosphate of lime mud at least one-tenth of 3·0, or 0·3 equivalents of soda, so that the product would contain rather more than 4·0 equivalents of bases per 1·0 of $P_2 O_5$. In relation to the quantity of sulphuric acid required to convert it into sulphate, such a product would have exactly the same value as a material containing 75·47 per cent. of tricalcic phosphate, and 25·6 per cent. of carbonate of lime. He believed that such a material was worth only 1s. 3d. per unit, so that, for his phosphatic product, Mr. Davis's process could be credited only with £7 3s. 6d. The limestone with which it had to be credited might be put at 7s. 6d. As for the SO_2 produced in it, the speaker could not regard it as having any real value at all. If produced in a reverberatory furnace, it would be too dilute to be capable of being profitably utilised; one might as well try to utilise the SO_2 contained in ordinary coal smoke; and he believed that it would be difficult, on account of the temperature required, to conduct the process in a close furnace. The SO_2 would thus count for nothing but a source of atmospheric pollution. As for the solid residue, it would be "waste," and nothing else. Its utilisation was outside the pale of serious discussion. Aluminous products could be manufactured more advantageously from other materials, and as for the copperas which had been spoken of, it would for the most part be simply a nuisance. One or two manufacturers might collect it; but they would be able to supply all the copperas the world wanted. All others would have to allow this product to simply pass into the water-courses. On the supposition, however, that the SO_2 and the residue together were of the same practical value as the quantity of pyrites containing the same quantity of sulphur, they would be worth only 27s. 6d. The total amount on the credit side, even in this case, would be only £8 8s. 6d., as against £10 13s. on the debtor side; and this on the supposition that so perfect a reaction could be obtained between Redondo phosphate, salt-cake, sand and coal, as should yield up absolutely the whole of the $P_2 O_5$ of the Redondo phosphate as $3Na_2O, P_2 O_5$, and this without the four bodies ever being in more intimate contact with each other than bodies are in when merely mixed together in the state of fine powder. That Mr. Davis should have obtained such a result, or nearly such a result, even in experimental operations, conducted no doubt with unusual care, was very surprising; but that such a result could be obtained regularly, under ordinary working conditions, was inconceivable. You could rarely obtain such a result even when bodies were fused together; and in this case fusion did not take place. As to what could be done in the way of selling Mr. Davis's crude tri-sodic phosphate for use directly as a manure, the speaker had no opinion to offer; but he was satisfied that as a means of obtaining caustic soda and phosphate of lime, the process could not pay.

Mr. Wills suggested that, as Mr. Weldon expressed such pronounced views upon the process under consideration, it might, perhaps, be advisable that he should be liberated from the duties of a Chairman, and thus be rendered quite free in his criticism.

Mr. Weldon complying, **Mr. Wills** occupied the chair during the remainder of the proceedings.

Mr. Kingzett said he could not submit Mr. Davis's figures to so severe a criticism as the Chairman had done, but he should like to ask that gentleman whether he should not put the value of the phosphate of sodium on the credit side of the account?

Mr. Weldon replied that he had put the phosphatic product as phosphate of lime. He had regarded this process as one for the manufacture of soda; yielding not phosphate of soda, but phosphate of lime.

Mr. Kingzett thought he ought to put the value of the soda produced.

Mr. Weldon replied that he had not put the soda on the other side.

Mr. Kingzett said the proportions shown as intended by the re-action were not those indicated to him by Mr. Davis.

Mr. Weldon said that Mr. Davis had assured him that the proportions he had taken as the basis of his calculation were correct.

Mr. Kingzett said Mr. Davis showed that he produced from phosphate of aluminium of a given value a quantity of try-basic phosphate of sodium of a given value, and he got, as a by-product, tri-basic phosphate of calcium. It appeared to him questionable whether it would be better to sell that as it was, or to use it for a further process. But beyond those products, there was also a valuable residue, consisting of a double silicate of sodium and aluminium. Now, some years ago, Newton patented a process, consisting in fritting felspars and phosphate of lime, and an excess of lime, which was not necessary for the process itself, but simply served in the after process of caustifying it. It consisted of fritting the felspar with phosphate of calcium, and in that way he produced a double silicate, and the whole phosphoric acid was realised as phosphate of sodium. He suggested that Mr. Davis might more profitably employ the phosphate of calcium by using it by this process, and performing a second furnace operation, in which the insoluble residue obtained of silicate of sodium and aluminium, if furnaced with phosphate of calcium, would produce a further separation of the lime, and in that way he would not get three-fifths of sodium, but the whole of it. In any case, if Mr. Davis could realise the reaction which he had given him, he would obtain four-fifths. He should like, also, to ask Mr. Davis whether he had ever observed the formation of ultramarine in this process, because that was formed under conditions extremely liable to be obtained in the process he had described. He agreed with Mr. Weldon as to the value of the sulphurous acid and hydrate. If the operation were conducted in hand-worked furnaces, no doubt it would be so diluted with the products of combustion that it would be too weak to make sulphate of sodium, even after Hargreave's process. But he should be open to conviction as to its value when the operation was conducted in revolving furnaces, because such a furnace supplied conditions far more likely to give good theoretical results.

Mr. Brock said he had an utter horror of patented processes in the alkali trade, for there was no branch of manufacturing industry which had been so much harassed by patents during the last 10 years. Mr. Davis referred to the use of sulphurous acid from this process in Hargreave's process; but if that sulphurous acid were diluted with an excessive quantity of air, it would be utterly useless for that process, since a very important point in the successful working of it was that in having the sulphurous acid as strong as possible. It was impossible, having the process so freshly brought before them, to follow either Mr. Davis's or the Chairman's figures, but it did not appear to him that there was that commercial value in this process which Mr. Davis seemed to think. It was, perhaps, worthy of further consideration, and he should certainly give it more attention in his leisure.

Mr. Squire said it seemed to him that the recovery of the sulphur, so far from being an advantage, was the reverse. It was evidently in such an extremely diluted condition, that no use could be made of it; and, if anything were to be made of the noxious vapours, it would have to be condensed in some form or other, how, he did not know; because sulphuric acid mixed with air was one of the most incondensable things you could deal with. Mr. Davis, he thought, had been rather sanguine in his calculation of the chemical value of the thing. Nothing, probably, was so delusive as figures, but of all varieties of figures, a manufacturing calculation, based on theory, was the most delusive. As a rule, you might divide by two, and then allow a margin. He recollected, some time ago, when the Chairman described his beautiful process for making chloride of lime, an estimate of the cost was shown, which showed that each ton would cost £3 1s. 2¼d.; but they all knew it could not be made for that price.

Mr. Davis replied to the observations which had been made. He said Mr. Squire referred to new processes generally, but when a new process was introduced into an entirely new firm, who had had no experience, it could not be expected to work so advantageously as it would in a firm established many years; he could understand, of course, that any beginner would not get such results as he would after some years working. Mr. Weldon's process for chloride of lime was not considered a commercial success at first, and one or two firms who commenced it were on the point of giving it up. Of course every one would look at his process in a similar manner. He did not say it was perfect at present, and by continuous working in an alkali works it might be wonderfully improved.

Mr. Weldon said his point was that there was no margin for profit, even taking it on a purely theoretical basis.

Mr. Davis said the sulphurous acid was said to be in a very diluted state, and scarcely worth collecting—Mr. Brock having said he would have it as strong as possible. It was well known that the strongest possible gas obtained was pure sulphurous acid, which contained an excess of oxygen; and, therefore, if you had no excess of oxygen in the gas, you could not expect a mixture which contained four equivalents of oxygen to one of soda to be obtained from sulphurous acid with only two equivalents. When the Atlas Company first opened their works at Widnes, they turned the fire-smoke which contained the sulphurous acid through the cylinders to heat them before they sent through the sulphurous acid from the pyrites burners. Then the steam coal smoke and gas were allowed to blow up from the flue into the open air. He went over to see the process, but instead of finding sulphurous acid from the coal smoke blow up through the grate, he found there was hydro-chloric acid, the sulphurous acid having become converted into salt-cake, and the hydro-chloric acid liberated. Working on this idea that very diluted gas would do, he had placed salt-cake in manufacturing flues containing a great deal of sulphurous acid, and had obtained salt-cake in the flues from open roasters, containing as much as 50 or 60 per cent. of salt-cake. He had found that diluted sulphurous acid would do. He did not mean to say it would be as cheap as using strong gas, but you had the gas there, and he had only calculated the value of the sulphur from the pyrites, and had not put the cost of burning upon it; and as one of these contained 6 cwt. at 2s. a cwt., he thought he had not valued it too high. He had never seen any ultramarine in this process, nor any bluish colouration. Mr. Weldon had said that in an experimental case, it might possibly be that a complete result was obtained; but in the first part of his paper he had said that the material must be mixed, and he thought a disintegrator would grind everything up together perfectly. In the laboratory they had a process for the estimation of silica in insoluble silicates, by the fusion or partial fusion with carbonate and hydrate of baryta. But the process there was not carried quite to fusion, as it would be with the mixture of carbonate of soda and carbonate of potash, therefore he thought that, if any laboratory experiment performed for the purpose of quantitative estimation would give a complete analysis, it should do the same in this case, where the mixture was more complete—first in the disintegrator, and then in the furnace. The experiments he had made on the subject in a reverberatory furnace, working 3½ cwt. charges, showed 2·4 per cent. of phosphoric acid left undecomposed, though he should not like to say that quantity would be worked as a rule; because he knew what black-ash men were, who would probably go to sleep while the charge was cooking. But he should very much like to see the thing worked. Mr. Weldon said it was hardly worth while to collect the copperas. But it was now selling at £15 a ton. There was 11 per cent. of sulphate of iron oxidised in this residue, and he knew a chemical works in Manchester who made copperas by buying shale and boiling it in heaps, and their carts were running all over Manchester under-selling every one else. If, then, the residue were to be thrown away, it might as well be boiled in heaps, and the copperas allowed to oxidise.

Mr. Weldon remarked that one or two factories would produce more copperas than would supply the whole human race.

Mr. Davis said that would bring down the price. Then it was said that the muffle furnace would not give heat enough. But he would remark that flint glass was made in an essentially muffle furnace, in beds, with corners to them, a flame blowing on the top, and not on the materials. Again, if muffle furnaces could be used for the manufacture of salt-cake, which was selling at a low price, you might surely employ them for making an article which would sell at £6 or £8 a ton. But then Mr. Weldon alluded to the 10 per cent. of caustic soda in the phosphate of lime; and he did not see why that 10 per cent., if put on the one side, should not be put on the other side also.

Mr Weldon said his point was that it was not only lost, but consumed sulphuric acid in the manufacture of superphosphate.

Mr. Davis, with regard to that point, said a ton of coprolites generally took a ton of sulphuric acid at 120. That was tremendously in excess of the phosphate of lime calculated. They all knew there was a tremendous quantity of carbonates in ordinary coprolites, which took up the acid. There was 16 per cent. of carbonate of lime in this phosphate he made himself, and he had made it up to 90 per cent. It all depended on the manipulation. Mr. Townsend, of Glasgow, who had also worked on this subject, said that if he had to do it, he should make it up to 90 per cent.; but he had given just the result obtained in the laboratory as shown in the sample on the table, which contained 80 per cent. of phosphate of lime. With regard to the 11·9 per cent. of lime, he had investigated a great many things connected with the alkali, and he had never found a combination of phosphate of lime with phosphate of soda, though there was a combination of carbonate of soda with carbonate of lime. He could always wash the phosphate of lime free from soda.

Mr. Weldon said he found that the soda in ordinary lime mud, according to Mr. Davis's own analysis, as given in Kingzett's "Alkali Trade," page 124, did not exist as carbonate, but as sodic-hydrate.

Mr. Davis said those figures were taken from the ordinary working of the manufacture, and the analysis of the lime was made in a works which was not working very well. In another works, at St. Helen's, where a much better product was obtained, if you divide the figures by 5, it would be about correct. Then, Mr. Weldon said there would be nearly double the amount of insoluble matter; but he could not understand that, because he used 275 tons of salt-cake, and the quantity of Redonda he used gave just the same amount of insoluble matter. Therefore, 175 parts of salt-cake would not give 175 parts of residue, but 100 parts of salt cake would give about 60 parts of residue, because 100 parts of Redonda gave 100 parts of residue; and he used more salt-cake than Redonda.

Mr. Weldon said he also used sand, and there must be some cinder from the slack; but it was not a very important point.

Mr. Davis said, with regard to the 63 per cent. extra of fuel and labour, he worked 2½ cwt. of Redonda phosphate, and the necessary quantity of salt-cake, sand, and slack under a furnace, and was able to pull out the quantities he mentioned in the same time as ordinary black-ash balls could be turned out, and the men only fired the same number of times, namely, twice on a ball therefore, the amount of slack must be the same.

Mr. Weldon said the point was whether he obtained the same quantity of soda per operation in the furnace? He unquestionably obtained very much less soda per operation than was obtained from the black-ash process.

Mr. Davis said there might be a little difference in the fuel, but not so much as 63 per cent.

Mr. Weldon said the manipulation of 1·63 tons must cost 63 per cent. more than the manipulation of one ton.

Mr. Davis thought that that did not follow, because you gave a man a ball to work, and gave him so much for it, and he would work a large ball for the same if you could get him to do it. Then Mr. Weldon had taken Mr. Mactear's proportions; but they were not generally used, and several manufacturers who had used them had gone back again to the old process. It was hardly fair, therefore, in comparing his process with LeBlanc's, to introduce Mactear's proportions. He had seen Mactear's process at work in at least three works, and if anyone had shown him the black-ash balls lying in the yard he should have said they were short of limestone. They evidently looked as if they contained an abnormal amount of sulphide of sodium. The process was a very good one, enabled a large quantity to be turned out by furnace, and was probably profitable; but it did not follow that Mactear's proportions were to be applied to his process.

Mr. Weldon said he was sorry to interrupt; but he was authoritatively informed that Mactear's process was now worked in many more than five or six factories, and he was informed that the results were, from all points of view, better than those from the ordinary mixture. That was especially the case in France, where very excellent qualities of soda-ash were made by the old process. In comparing the theoretical advantages of the new process with the old one, it was only right to compare it with the old process in its most perfect form.

Mr. Davis said Mr. Weldon had also contended that, even if the reaction was fully obtained, the process would be a loss. He had, however, some figures which he thought would show a different result. He then went through the figures as contained in the table at the end of the paper, and explained the mode in which he arrived at them, contending that the net result was to show £15 13s. to the credit, against £12 19s. on the debtor side of the account.

Mr. Weldon said Mr. Davis had not pointed out where he had been wrong in his figures, and he could not exactly point out where Mr. Davis was wrong. But it was quite clear to him that Mr. Davis assumed that he would get theoretically perfect results, and put the value of his phosphate at a much higher figure than he had ever found any dealer in phosphates put it at. But he could only say he should be extremely happy if Mr. Davis turned out to be right.

Mr. Wills said there could not be two opinions with regard to giving their best thanks to Mr. Davis for having brought forward this paper. There seemed to be such a difference of opinion between these two gentlemen, both equally competent to form an opinion, and to set it forth, that one could only desire that the controversy should be carried still further. It would, therefore, be a good thing if some enterprising, and possibly self-sacrificing, manufacturer would start the process on a large scale, and see whether Mr. Weldon's figures or Mr. Davis's could be justified. It appeared to him that in such a gigantic manufacture as the alkali trade, a very slight margin one way or the other would amount to a wonderful success or a great loss. It might be, therefore, that if the figures were very little in favour of Mr. Davis, there would be a considerable amount of profit open to any one who worked the process. Processes had been introduced, notably by M. Claudet, for the recovery of gold and silver from burned pyrites, in which it seemed, looking at the process commercially, as if it never could be made a financial success; but it was now being worked, and a considerable amount of profit was derived from it. Mr. Davis might think that he had been rather unfortunate in his Chairman, but he was quite sure that he would be only too pleased to have his process thoroughly examined, and its real value determined.

The vote of thanks to Mr. Davis for his paper was carried unanimously, and the proceedings terminated.

EXTRA MEETING.

The discussion on Captain Tyler's paper on "Continuous Breaks" was resumed on Friday evening, the 11th inst., W. Galt, Member of the Royal Commission on Railway Accidents, in the chair.

The Secretary, at the request of the chairman, read the following letter which had been addressed to him by Mr. H. A. Denne, the superintendent of the District Railway, on the subject of the break in use on that line.

District Railway, Superintendent's Office,
Victoria Station, Pimlico, London, S.W.,
11th May, 1877.

Sir,—I have read the discussion on "Continuous Breaks" in the Society of Arts *Journal* for the 4th inst., and I find Mr. Hale very properly asks as to the powers of the different breaks; and as I think I can supply that information so far as the Westinghouse break is concerned, I think it my duty to the public to do so.

We have had that break in use four years, and as soon as we adopted it, we had a case where a driver ran past both distant and stop signals, and the guard of the preceding train signalled to the approaching train, when the driver instantly put on the air-break, and it pulled up in about 70 yards—the length of the engine and train being 80 yards—and in a period of five seconds, giving 15 yards to the second, and to within two or three yards of the other train. This occurred on a rising gradient of 1 in 70, and the driver had not time to reverse his engine.

When I heard that Captain Tyler was leaving the Board of Trade I thought it would be a national calamity, but if it is the means of introducing continuous breaks on all our railways the Board of Trade will easily be able to dispense with his services, as practically their occupation will be gone, as there would be very few accidents to investigate.—I am, &c.,

H. A. Denne, Superintendent.

To the Chairman of the Meeting on "Continuous Breaks."

P.S.—If you think this of any value, you are at liberty to make use of it at the adjourned meeting to-night. H. A. D.

The Chairman then called upon Mr. Saunders to open the discussion.

Mr. Saunders said before doing so, he thought it right to remark on the manner in which the discussion had been conducted. Certain inventors had seized the opportunity of speaking against particular breaks, and statements had been made, which in his opinion were not quite fair. On his own part, and of others, he was willing to give a description of his break if other inventors would do the same, and thus give an opportunity for comparison, and valuable information would be obtained, which might lead to the solution of the important question they had to discuss as to which really was the best break. But before opening the discussion, he desired to ask the chairman whether such a course would be permitted.

The Chairman replied that it would be quite in order for them to proceed in that way. The better the breaks were the better would it be for the public, and he thought a person could hardly describe his own break without comparing it with others. It appeared to him that was the legitimate way of conducting the discussion.

Mr. Saunders asked that he might be permitted to put a diagram upon the wall to illustrate his break.

The Chairman thought, however, it would be unnecessary.

Mr. Saunders said it must be distinctly understood that in his observations he did not in the least allude to other inventions slightingly, but he would give his reason for adopting the one he did. When he first took up the question, he had to work over Indian railways, where there were steep inclines of one in 37, and where they were working with the old van break. Compressed air was the power which he then thought might be made applicable. The train was fitted up with a pump and a pipe throughout the train, connected with a small piston, and a steam-whistle. The pressure of air was maintained at about 30 lbs. When the air was let out of the pipe, the steam-whistle was blown. In connection with that, it was necessary to keep up a store of air, the object being to have a reserve power to keep the thing in motion, but the leakage was so great that he had to give up the compressed-air system altogether. Then he commenced with the vacuum, and he had never known a coupling come undone. There was no trouble, no breakage, and the whole thing worked most satisfactorily. To test the various methods of applying the vacuum, he laid down 300 feet of pipe, one three-quarters of an inch in diameter, and the other two inches. Both pipes were connected with the same apparatus and steam-whistle, and his object in doing that was to see what advantage would be gained by destroying the vacuum and by creating it. He found that the $\frac{3}{4}$-inch pipe was no use at all, for there was too much friction. The larger pipe he found he could work the whistle almost instantly, but it took him considerable time to shut it again. That led him to destroy the vacuum instead of creating it. The means he first of all employed—at any rate, to work over steep inclines—was a weighted lever attached to each carriage, which was held up by means of an exhausted drum, and, when the vacuum was destroyed, the lever fell, and destroyed the break. When he came to England he found the carriages, during his absence in India, had increased in weight, and he had not quite sufficient power. He then introduced another drum, the two being so placed that they worked against each other. The larger drum pulling against the other, pulled the break off. Upon the destruction of the vacuum the power of the larger drum was rendered neutral, but the vacuum was maintained by something which hermetically sealed it, and there it remained. The action of that break was clear; in ordinary stoppages, when the train was complete, the driver destroys the break by means of a cock on the engine, but in the case of a train accidentally separated, the vacuum in the rear portion of the train being destroyed, his breaks go on, but the action of the pump on the engine maintained it against the friction of the air passing through the pipe. The vacuum was not destroyed near so often as in the rear portion of the train, and the rear portion of the train could not overrun the other. That had been proved by actual experiment. But the great merit he claimed in the automatic system was not so much to provide against the accidental separation of a train (because there were very few instances in England of that), as to make a train reliable. Unless the breaks were automatic serious accidents might ensue. With the automatic plan the driver, before starting, creates the vacuum, and having his train complete, he starts fearing nothing, because the vacumm cannot be destroyed without applying. In his case the vacuum was created first of all by means of the ejection, and so easily was that vacuum maintained, that he could state for a positive fact that for six months a train had run 180 miles a-day and never lost a vacuum, and it had still maintained 12, 13, and 14 rounds, on the square inch all the time.

The Chairman asked on what line?

Mr. Saunders replied on the Great Western trains running between Bristol and Taunton, and now it was being applied at other portions. In this particular arrangement, having two powers pulling one against the other, there was a decided advantage, and that was that the break could not go on unless wanted; owing to the difference of area, there was a power of 1,500 lbs. pushing the break off. They not only remained off but were naturally pushed off. To get the breaks on, that 1,500 lbs. had to be taken off, and the vacuum throughout the pipe was reduced down to 8 lbs., but the breaks were not on then. The two drums were only in equilibrium, and it was not necessary to get rid of the rest. So long as there was any vacuum or 8, 10, or 12 pounds throughout the train, those breaks were always off, and it was impossible to put them off. Suppose a vacuum maintained equal to 13 or 14 pounds when the train was in motion, the driver applies his break, and you have only to create 8 lbs., and they come off as easily as possible. What he claimed for his break was all the advantages of the automatic system. A question had been raised about the power required to drive the pump, for he found when in India, and the punkahs had to be worked, it was necessary to put an extra power, and he very soon found he was using too much strain. But the position of the pump on the cross-head of the engine was very favourable for it, for supposing the plunger and the pump were working in a perfect vacuum, there would be as much pressure on the one side as on the other; therefore there would be no power required to work the plunger backwards and forwards, excepting to overcome the friction due to the valves.

Mr. Steel asked what arrangements were made to take the breaks off at night?

Mr. Saunders replied that the breaks in their natural state were off, and if put on they would, of course, remain on, except you got rid of the applying drum. There was a small lever which admitted the air in the applying drum and then the break dropped off.

Mr. Steel was very glad to have heard Mr. Saunders' description of his break, for it had raised the discussion from the tone to which it had fallen. On receiving th invitation to be present at the meeting, he had been somewhat afraid that Captain Tyler was going to lose his fine character for impartiality by throwing in his lot with the break-tinkers, but it came out that not only was he going to do that, but actually going to be a partner in a concern.

The Chairman observed that what Captain Tyler had said was, that he would not be connected with any break unless he was perfectly convinced it was the best, and he thought it would be as well to abstain from saying anything of a personal nature. That was most distinctly said.

Mr. Steel thought, with all deference to the Chairman that was only a begging of the question. He had been, told that Captain Tyler had been receiving promises of favours to come.

The Chairman again remarked it would be better to avoid personal matters. What Captain Tyler said was he desired to have this question of breaks fairly discussed, and that he wished all parties to be heard. Captain Tyler was exceedingly desirous that a trial should be made of all the breaks to see which was the best, and he stated at the same time that he had received a very good offer from the Westinghouse Company, or from Mr. Westinghouse, but that he would not accept any offer until the question was fully discussed, and if possible a trial made with respect to the relative merits of the various breaks so as to ascertain which really was the best.

Mr. Steel said it seemed to him that Captain Tyler ought to have kept his arrangements out of the question, and, in his opinion, it was a very improper proceeding altogether.

Captain Tyler asked Mr. Steel what he would have said had he not told them?

Mr. Steel said it seemed to him as if they were to provide a break for Captain Tyler, and that was what he very much objected to, and he questioned if, to use the phrase, it was exactly according to Cocker for him to ask that. He had submitted to a very great deal from the Westinghouse people, and the letter which had been read was only another unique job to cry up that particular break. He had patiently listened the other evening to the thrashing of all the breaks by the various speakers, and the only bit of sense that came out was that from the gentleman who was connected with the *Times*, and he was very glad he put the point so well. He said, why did not the railway men of experience come out who understood the position of things. Now they had come out, what did they say? They had some little wrinkles in the evidence taken by the committee, but they did not put the gentlemen on their oath. On the second night there was some amount of truculence, and the only sensible speech he heard was Mr. Yeomans, on adjourning the discussion; and if he had moved that the whole thing should be given up, it would have been much better. The honest breaks, in which there was no jewkry-pawkry, as they called it in Scotland, were very few, and without any pretension. What they do they do, and there was no mistake about them. There was Newall and Fay's breaks, and they were useful. Some people seemed inclined to fall back upon them, and just add a little power. If there was an automatic break to be got, they should get that. Those were two honest breaks. Then there was still another honest break. They had Clark's break. Clark's break, in face of Newall and Fay's, was hardly wanted. It worked in a very jerky, uncomfortable way, and it needed only to keep company with the old "Rocket" at Darlington. The water break was another honest break, but it was hard and harsh in its working, and the question of salting it in the winter was the difficulty. It must be well worked from the foot-plate, but had to be relegated to the van. But no break could be applied as a finished break unless it was applied by the engine-driver. Then there was the vacuum break, upon which a lawyer had expatiated very largely, and his imagination had led him to go a little too far. He attached importance to the fact that no pressure was required. But what was to be said of it? It was a bad system at the best. There could be no durability in the india-rubber, and it was not supposed to last over five years; and it was a bad thing to be obliged to renew the whole of your breaks every five years. Other breaks had only to be renewed in part. Supposing the railway companies had to re-break all their carriages, and there were eight thousand breaks a year that at £5 each would cost £40,000 a year, besides the annoyance you would be put to, and you would require to fit up 8,000 carriages a-year for five years, to go over the whole of the carriages of the system, and by the time the fifth year had expired, you would require to begin with the first again, and so on throughout all time, thus throwing a burden on the nation of about £40,000 a-year. There was another break he was glad to be able to speak well of, which had done good work in its day, and if it had had justice done it, it would have done better; but there was the Westinghouse break, and the Westinghouse people always trumping it, and the newspapers never could understand the question about it. First, there was the direct pressure break, then the vacuum break, and then the automatic break, and so the poor newspaper people did not understand the game which was going on. This break was planned by himself and a man named McInnes, seven years before Westinghouse came to this country, and their specification ran line for line, word for word, with the patent of John McInnes, so that the break was, in Bohemian language, really prigged. But the break really was a splendid break, and if it had been introduced into this country, and made by English mechanics, it would have done splendidly; but it came here with wretched couplings, wretched pipes, and the reservoirs came off and created several accidents. The speaker then proceeded to discuss the Westinghouse break, which he called the Westinghouse and Tyler break, designating it as a jack-in-the-box, a rattle trap, to please and decoy, and not an invention at all. No engineer had a hand in its manufacture. It was the discovery of some Philadelphia barber, or some such thing. He had spoken of honest breaks. This was a break which had all sorts of pretensions. It had not worked well, but whenever there was any row about its not working well, they got the papers to praise it up, and that was how the papers were under the thumb, and would not speak of any other. When he first introduced his break on the Caledonian Railway, the Westinghouse Company threatened the Caledonian Company with an action for damage, and he had to give the company a security for all the damage which the Westinghouse Company could recover before he could go on. He thought it would not do for railway companies to take a bad break, and Captain Tyler and Mr. Westinghouse be able to make their fortunes by floating a limited company for its introduction. They had heard of Emma mines and Lisbon tramways, and such like, and he felt it would not be well to stand by and allow this to be done. He came now to his own break, which had been in operation on the Caledonian Railway two years, and never once had given a cough. He came up once, and asked *Engineering* to put the break in their paper, and Mr. Maw bound him not to give it to anyone else to put in their paper. He complied. Time passed on, and it was not done. When he asked why it had not appeared, he was told that their space was so crowded, but it should appear in the next number—the engravings were ready, and it should appear at the first opportunity. But that opportunity never came off. Then he came up to London to see about it, and received a letter from the editor of the *Engineer*, to the following effect:—"Dear Sir,—I think you do not realise the importance of my objection; now, if your break leaks, it must be applied. Now I have yet to learn it is possible"—mark the impossible—"to make a piston which will remain without leaking under an air-pressure in half or even a quarter of an hour. The only way out of the difficulty is by floating the pistons with oil, and this expedient is hardly applicable to your case." It just so happened that he had arranged for this. "Again, it would be impossible to make the couplings between the carriages air-tight. After a little use, no matter how small the leakage, in the long run your break would be applied, whether you liked it or not. If you can prove that these difficulties are overcome, then I will readily admit the value of the principle involved; but till then you must pardon my incredulity." All this time the break had been running for several months and been working perfectly. The break could be applied as quick as any other over the whole train, and also gradually, from the slightest touch to full power, and taken off with equal facility, and to engines, guards' vans, passenger carriages, or trucks, and the break power was equal with every wheel in the train. And it was the only break in the world, except Mr. Saunders's, which he had not proved, that could run into a close station. The Caledonian engine-driver, before the Royal Commission, when a question was asked him, "How are you sure this break will go?" gave the answer "Because, my lord, if the break was not right, the train would not run; and if the train would run, it proved the break was right." You must have an automatic break if it was possible to get it. The speaker then concluded by alluding to the Westinghouse break and the defects which existed in his opinion, adverting also to the Heeley accident as a proof of the necessity of having an efficient break, capable of being applied under every condition and circumstance, if it was to prevent accidents taking place, and said he was perfectly willing to submit his break—a description of which he gave—to a trial with the Westinghouse break, or any other, and all he desired was fair play, which, he considered, he had not received.

Mr. Yeomans said, if after the discussion which had taken place, Capt. Tyler accepted the position which had been offered to him, the public would be led to understand that he had proved the Westinghouse break to be the best. He had been in all the railway countries of the world, but had never met with a set of men more honest, upright, and competent, than the railway engineers of England. They were perfectly capable of judging the merits of these different breaks, and he was quite content to leave the vacuum break to their judgment. He had not yet been in England three years, and he had so far fitted the break on fourteen different lines; in fact, the railways were doing all they could to adopt the continuous break. He might mention that he had just left Glasgow, after fitting the "Flying Scotchman," one of the fastest trains in England, with it, and he would not make any further remarks on its merits.

Mr. Westinghouse said it was his expectation that the discussion would be conducted in such a manner that he would not be obliged to take part in it. Mr. Yeomans could not fairly say he did not disapprove of the discussion, for it was one of his directors, Mr. Haughton, who first turned the discussion from the course it should have taken, while his solicitor, Mr. Harold Brown, without regard to other breaks, had set forth the advantages of the vacuum break in such a manner as required an answer. He could best answer the attack upon his break by a statement of a few facts that ought to be generally known. Mr. Brown had referred to the Smith vacuum break in America; but he should have recollected that it was owned by the Westinghouse Company, and had been since January 1875, since which time he had manufactured and sold the apparatus to all those desirous to use it. It had been stated by Mr. Brown that the rubber bags had been in use five years in America; but this is not so, as the break was only sold to railway companies for the first time in 1873. He might mention that, when negotiating for the purchase of the vacuum break patents and business for United States, the president of the Vacuum Break Company said the Westinghouse Company would have a large and profitable business from the renewal of the rubber bags, as they could not last long. This has been verified, for many bags had given out, some when not a year old, and the Westinghouse Company has had a good business from replacing these rubber cylinders. Mr. Brown had not described the vacuum break so elaborately as he had attempted to describe the Westinghouse automatic. It was quite right he should describe the vacuum break for Mr. Brown. The ejector has two valves within a steam valve for admitting the steam to apply, and a fourth valve for releasing the breaks. It is one of the most difficult mechanical devices to construct he had ever met with, the variation of even a hundredth part of an inch in the annular space through which the steam issues would make a great difference in the amount of the vacuum produced. The rubber bags under the carriages were, until recently, two in number, but by a great addition to their levers, and by the use of a double break block to each wheel, they could now do with a single bag to each carriage. Mr. Brown referred to their improved break on the Midland Railway, and said it could be put on with full force in about one second; but he had satisfied himself on the point by permission to time the application of the break on the very train alluded to. He found that it required over five seconds to produce a vacuum of five pounds per square inch in ten carriages, which is only half that required to fully set the breaks. The time to produce the second five pounds would increase the time for the full application to at least fifteen seconds. Why it took so long to get the vacuum was that two cubic feet had to be exhausted from the apparatus of each carriage, and moving along the train it had to travel, therefore, perhaps 450 feet before it would get from the rear to the front carriage. At the trials which have taken place, at Newark, on the North British and on the Midland Railways, the vacuum managers have always put on auxiliary apparatus and a lot of machinery which was never used in practice. These auxiliary appliances were of a most complicated character, wholly unfit for daily use, and were only intended to assist the ejector in getting out the air, that the vacuum break might not take a quarter of a minute to get on. They know that their break cannot stand a public test as they use it in practice, and so resort to the use of these extra pumps for each. They claim to have made a stop in 282 yards—which no one believes—and put these figures forward as the work of their break. Immediately after the trials were made on the Midland, the extra machinery was taken down and boxed, to be kept for further public trials. He had, on the contrary, always used his break at public trials without any extra appliances of any kind, and could thus give as good results in daily practice as when on trial. With regard to time of action, a number of gentlemen had spoken of the necessity and importance of instantaneous action; and Captain Tyler had also laid it down as one of the conditions of a good break. The importance of saving a second in the application of the break can be more fully understood by estimating the blow that would be struck by the train at a certain distance from the time of the first act of application. If in one case, by the instant action of the break, the train can be brought up from a speed of sixty miles just against an obstruction, it would, by the loss of only one second in getting the breaks fully on, have run into the obstruction at a speed of not less than 18 miles per hour, doing great damage. Mr. Brown says they could make their break automatic. If he had an idea that this was accomplished by putting machinery in the vans, he was very greatly mistaken; for the rupture of a bag, separation of a coupling, or breaking of a pipe, would render the vacuum break useless. To make a break automatic, required that each carriage should carry its own store of power, as a train might be broken into several pieces by an accident. In this sense, the Smith vacuum break has no approach to automatic action. It had been objected that his break did not fly on or off properly, but the best answer to that was, that there was no break so extensively in use as the original Westinghouse, or even the Westinghouse automatic, as upwards of 2,000 carriages and 800 engines had been fitted with it. In 1873, when they began fitting trains with it, the Smith vacuum break was being very highly praised, and trials for quickness of action, with a train of only four cars, running side by side at 40 miles an hour, they had saved 120 feet. As the capacity of air cylinders were almost alike, the ultimate breaking pressure might be said to have been about the same for both, and thus the whole saving was effected by the quickness of application of the automatic over the vacuum. These trials took place on parallel tracks of the Philadelphia and Reading Company's line, and led immediately to the adoption of the automatic, notwithstanding the officers of that company had up to that time favoured the vacuum. Further trials of the two breaks led to the substitution of the automatic break in the place of the vacuum break on the Toledo, Wabash, and Western Railway, which line had been using the vacuum on all of its stock for one year. The automatic has also been substituted for the vacuum on the Delaware, Leackawanna, and Western Railway, whose stock was fitted with the vacuum for about one year. On the Leehigh Valley, and the Milwaukie and St. Paul, where the vacuum break was tried, they have since adopted the automatic; and in all of these cases the prices charged for the automatic have been above that ever charged for the vacuum. It is a complete answer to the charge of complication, so freely made by the vacuum advocates, to be able to show the automatic is so much superior to the vacuum, that the latter is thrown off to make room for the former. Railway companies do not change for the sake of changing. In this discussion it has been said that his break would, if applied, go on with full force, and would in case of accident come off so quickly as to be of no use in lessening consequences. No break is superior to the Westinghouse automatic for ease in applying, releasing, or graduating the force for gradients. Captain Tyler was upon a train fitted with the automatic break in 1874, the speed of which was regulated down a grade on the Pennsylvania Railway of eleven miles in length, averaging 1 in 55. This train was driven by an experienced driver. The trials of the automatic were so satisfactory to the officers of Penna line that they have been changing his original air-break to the automatic during the past year. They have recently tested the automatic on the same gradient with twelve cars, with a driver who had never worked it, and with entirely satisfactory results. Mr. Steele's reference to the Heeley accident was quite excusable, as he did not seem to understand the Westinghouse break.

Mr. Steele—Nobody does.

Mr. Westinghouse said the reservoir contained about five times as much air as was used in the application of the break. It was sealed as tight as any piston, and he had known the air stay in for six or eight hours, a longer time certainly than would be taken in going to the rear of the train. Many people had not studied the question of quickness of action as much as they might have done. Mr. Steele, like himself, had practically a reservoir of compressed air under each of the carriages, which was brought into use by discharging air from the break-pipe. The quantity of air to be moved had most obviously a great deal to do with the quickness of application of any air-break. With his automatic break he had less than 40 cubic inches of air for each carriage, to discharge to set the break to its full force; or, in a train of 12 carriages, only about 500 cubic inches, or less than one-third of a cubic foot. The instant the discharge of air began, there was a movement of each triple valve, and an instantaneous application of the breaks from the small reservoir under each carriage. With the Steel break, as in use on the Caledonian trains, all of the break cylinders and pipes had to be emptied, requiring the discharge of 600 cubic inches of air per carriage. The Saunders's break required that 4,000 cubic inches of air should flow into the pipes and cylinders of each carriage to fully set the breaks. The Smith vacuum required the removal from the pipes and bags of each carriage of about 3,500 cubic inches. Less air is required to be moved to set the breaks upon a train of fifteen carriages fitted with the Westinghouse automatic than is required for one carriage fitted with the Smith's vacuum, Steele's, or Saunders's break. He thought this discussion had at the outset taken a turn that it should not have taken, because of the interests at stake. They were all working for the production of the best break, and he was ready for any trial of his own against any other in use, to extend over any period of time, for quickness of action, and stoppage within a minimum number of yards. He had no doubt of the superior capability of his automatic break, as well as its complying with every condition arising in traffic, or in the cheapness of maintenance. In the early part of the discussion, a gentleman had asked for information in regard to the power required to do effective breaking. He said, in answer to this question, the power necessary to do efficient breaking was equal to a ton weight falling 18 inches. A considerablo portion of the movement of this weight was lost in moving the blocks against the wheels, and in providing for the wear of the wheels and blocks. No one had taken up the question of the conditions laid down by Captain Tyler, and discussed whether they were necessary or not. He believed they were all essential, and that the great thing was to put a break in the hands of the driver that would never fail when being depended upon. Lack of efficiency and certainty in a break might cost many lives, and a great money loss that can be saved in the first cost by taking a cheap break. The failure of a break when approaching a junction, drawbridge, or running into a terminal station, might be most disastrous, and so fully has this fact been recognised in America that the hand breaks are almost universally used in all such cases, except with those trains having the automatic break. The failure of the vacuum break near New York, alluded to by Capt. Tyler, is an instance of tho mistake in trusting such a break at a terminal station. Unless a break is automatic, in the event of a failure of any vital part, it will be a necessity to so use continuous breaks that, if they do fail, there is still time and space for the guard to stop the train with the hand breaks before running past the proper point. He thought one of the strongest evidences of the merit of his break was the fact that all of the other break owners and their friends were opposed to it, and lost no opportunity to try to prove it worthless. He was sorry to have spoken against any break, or to have stated facts adverse to them; still, they were there for discussion, and others had said and might say what they liked about his own break—it had been too long in use to be damaged in public estimation, and he was willing to submit it to any further test the public, railway officials, or scientific men could put it to.

Mr. Edwards said they should not care whose break was adopted, so long as they got the best; and, whenever anything held its own against all comers, never mind what might be said against it by way of prejudice, there must be something good in it; and our railway engineers had never been open to anything like bribery to push an inferior or unreliable apparatus. Though himself patentee of a break, he could not, unfortunately, point to any trial of it, and it, so far, rested only on theory. Speaking of the points which all breaks should possess, each coach should be made to put on its break according to its own particular load at the time, and that, whatever power might be used, it should not skid the wheel, so that command should not be lost over the train. That condition his break fulfilled. Mr. Steel's also did something of the kind; but, he thought, in all other breaks in use, the same power was applied to every coach, whatever might be its load, and, that being so, either it would be necessary to pick up the wheels of the light coaches, and file the faces of the others, or else there would not be sufficient command over the train. Cost was also a great consideration, and his plan was both simple and inexpensive; from £8 to £10 per coach would cover everything, and they would afterwards cost little to maintain, as the blocks might be worn completely out before they would want looking to. Every break in existence would skid the wheels but his own, which it was of great importance should not be done.

Mr. Wilkin said the retirement of Captain Tyler from the important post he had occupied for so many years would be a loss not only to the Government but to the public at large; still they had to thank him for affording this opportunity of discussing a subject which the Prime Minister had stated in Parliament was one of the most important domestic questions of the day; though it was to be feared that the discussion would not lead to the issue they all desired, while it had given an admirable opportunity for patentees, and those connected with them, to ventilate their various schemes. It had been observed that the railway men had studiously abstained from coming forward to take part in it, but it was not to be expected, with the immense responsibility resting on them, that they should come and give the meeting their confidence.

Mr. Steel—Why not?

Mr. Wilkin said because they had duties to perform, both to their companies and to the public, and were therefore quite right in keeping away. But, after all, they must decide the question. Mr. Brown, representing the Smith vacuum break, had favoured them with a very long speech, principally taken up with an incisive criticism of the Westinghouse, but also embracing a very high eulogy on the vacuum break, meeting the objections to which he instanced, among other points, the india-rubber bags, which he said were not perishablo; and he had mentioned what had occurred on the Metropolitan Railway in corroboration of his statement. Their experience of india-rubber bands left round papers for a few years would show whether the substance was or not perishable. It must be kept in continual use. The Metropolitan Railway had an omnibus traffic going on all day and night almost, but the question was, what about the main line breaks? When a carriage was brought in, it was put in the shops or open sheds for three, four, five, or six months, and it would be expecting most wonderful concert between the railway companies and the Vacuum Break Company, to suppose that the carriages would always be dismantled of these "accordions," and that they would be immediately put on other carriages in succession. Mr. Brown had said there were only three breaks really before the public, the Clarke and Webb, the Westinghouse, and the Vacuum. Honouring the Clarke and Webb break by putting it first, he classified it as an "emergency break," very good for use on special occasions in sections, but nothing more, and it was therefore out of the contest; which must remind them forcibly of Burns's remark when he said "If you want to knock a man down or disparage anything, admit all the virtues claimed for them, but say it is a pity they do not possess those you want." It was notorious that the London and North-Western were adopting that break, and fitting it on their rolling stock as fast as possible, using it as an emergency break and in sections, and as they liked, for a railway company must of course be guided by the requirements of their own traffic; but if another railway company wanted to use it otherwise than for emergencies or in sections they would be quite at liberty to do so. Though he had many other instances, he would only mention one on account of its importance: two trains started every day on the Great Northern from King's-cross fitted with the Clarke and Webb break, which it was found could be used on 20 or 30 carriages if wanted.

Mr. Steel—Question!

Mr. Wilkin said the question could be settled any morning at King's-cross at eleven o'clock.

Mr. Steel—It is very recent then.

Mr. Wilkin would have been glad if Mr. Smith had attended the debate. Referring to interchange of traffic, he was only a commercial man, taking a common-sense view of the question, and there could be no doubt that was a very important element in railway working and economy. They had been told they could not depend on any one break being adopted throughout the country, and it was asked how that could be consistent with interchange of traffic. If that were so, and the vacuum, or Westinghouse, or any other break were to a great extent adopted, then every railway in the United Kingdom must be fitted with that apparatus, involving an expenditure of something like £1,000,000.

Mr. Steel said the statement was altogether wrong.

Mr. Wilkin stood to be corrected; at all events it would require a very considerable expenditure. One engineer had stated it would cost £67 per locomotive, and if they took the carriages at 12,000, that would require between £600,000 and £700,000 for fitting up.

Mr. Steel said two-thirds of the carriages were small and only used for minerals.

Mr. Wilkin said Mr. Brown had told them the Clarke and Webb was out of the contest, and so it was in one sense, when they came to the question of power. The controversy, bending to and fro, revolved on that pivot of power, and with the Clarke and Webb break that was no longer in question. The only point to consider was how best to control that power, and anyone could see on the Great Northern how it was controlled. Railway men were too business-like to throw away their money without a return for it. He had lately spoken to the chairman of a railway company about adopting breaks, and had mentioned the stir being made about the Westinghouse, but being asked the expense of the Clarke and Webb, he told him it was about half the cost of the other, and his friend said that if the London and North-Western were adopting that break, and found it answer, and it only cost half as much as the other, his company were not, in the present and probably future depressed state of things, going to throw away money on an expensive break, when they had the precedent of the first railway company in the kingdom. Railway companies, as a rule, did not like to put themselves in the hands of patentees, and if they were to adopt these other breaks they would not have done with the patentees for years, but would have a formidable chain forged round their legs, because they would be dependent on the patentees to provide them with every pin and every bag. He must, in conclusion, take the opportunity of publicly thanking Captain Thurlow for the way he had spoken of the performance of the Clarke break on the occasion when the Duke of Sutherland went to inspect it.

Captain Tyler was much obliged to the gentlemen who had taken part in the discussion, though it had not taken the line which might have been most advantageous; nor was the tone exactly what might, in the general interest. have been desired, He had hoped that it would hav turned more on the conditions he had ventured to submit, and less on the respective merits of particular breaks. However, allowances must be made for gentlemen who had been labouring anxiously, and spending their money, in many cases for years, to bring forward their own patents or inventions. Many of those gentlemen were old friends, whose exertions he had watched for many years with great interest. Travelling about the country, he had seen a good deal of these breaks, and had watched their progress impartially. The conditions he had laid before them were not new, but had been in his mind for many years, and before most of the breaks now spoke of were thought of; and there had been a general concurrence on the part of the meeting that the conditions he had laid down were those which should be possessed by a good continuous break. The only dissent from these conditions had regard to the automatic principle, and was put forward on behalf of breaks which did not in practice comply with that most important principle. The gentlemen connected with Barker's hydraulic break, for instance, did not like the automatic principle; although, by-the-bye, they had published diagrams of a modification of their system in which that principle was adopted. Mr. Brown, too, who spoke "not wisely, but too well," did not like the automatic principle, nor did Mr. Haughton. Mr. Brown, indeed, the solicitor of Smith's Vacuum Break Company, had objected altogether to the very term automatic, but it would be preferable, perhaps, to deal with Mr. Haughton first, as one of the first speakers. That gentleman, as a Director of Smith's Vacuum Break Company, began by saying he (Captain Tyler) had given an elaborate puff to the Westinghouse break, which was undoubtedly the greatest compliment the Westinghouse break had received in the discussion, and the more so as it came from an open and avowed enemy. The conditions he had laid down had met with general concurrence at that meeting, and he (Captain Tyler) was confident that they would meet with the approval of all impartial gentlemen acquainted with the subject. If, as was no doubt true, the Westinghouse break best performed those conditions, Mr. Haughton was quite right in saying so. Then Mr. Haughton went on to say that no break could do more than skid the wheels of a train, and that all the breaks did this about equally well. That was a misleading statement. One break might skid the wheel of a train in one or two seconds, and another break in eight or ten seconds, so that one would be in that case much better than the other.

Mr. Haughton said his meaning was that they each did it in pretty nearly the same time.

Captain Tyler said the official documents of the experiments before impartial judges for the Royal Commission, showed that the breaks did not all skid the wheels equally quickly, or nearly so. Mr. Brown had said it was wrong to call a break automatic unless an accident to any part of the train, not being part of the break apparatus, would put it on, and that was not the case with the Westinghouse break; indeed, he said that unless carriages could be fitted with nerves, automatic action could never be obtained; and the intention in the mind of Mr. Brown was generally to condemn the automatic principle. To those gentlemen whose breaks were not automatic it might be perhaps useless to prove how necessary that principle was to a break; but before the Westinghouse, or the vacuum, or almost any of the breaks now brought prominently forward, were thought of, he had given attention to it. Mr. Westinghouse came to him some years ago, and so had Mr. Yeomans, and other gentlemen, and he had told them all the same thing. They had all consequently tried to make automatic breaks, and some had succeeded better than others. The gentlemen who thus did not approve of automatic action, asserted that the couplings of passenger trains seldom became detached; indeed, they had hardly ever heard of such things. Such cases did not, it is true, very frequently occur in running, but they did sometimes occur, even whilst a train was running; and they did frequently occur when trains, or portions of trains, left the rails, from defects of the permanent-way, or from accidents at points or crossings, or from accidents resulting from defects of rolling stock. Brierley-hill, Helmshove, Shipton, Wigan, all recalled the memories of accidents in which fearful loss of life was occasioned, and in which automatic action would have prevented such loss of life. He did not wish so much to point out the defects of one break more than another, as to show that automatic action was one of the most important qualities which a good break should possess, and there were, as proved in the paper, several reasons for it. Not only so, but it was dangerous to use a break which was not automatic, and he felt more and more convinced of this day by day. Without automatic action a train may be improperly started from a station, with the apparatus defective, or the couplings detached, at the same time that the driver does not know whether his breaks are in proper order or not; and also, in the event of any failure of the apparatus on the journey, a driver running up sharply, as drivers would certainly do in using continuous breaks, to close stations and drawbridges, and suddenly finding he had no break, a frightful accident would result, and the public would condemn the whole system of continous breaks; whereas, the fault would be from using a particular continuous break which did not possess the proper principles. Referring to the Heeley accident, one of the most frightful that could happen, he could only wonder that no more than five people had been injured in it, and that hardly any damage had been done to the rolling stock. This was entirely attributable to the automatic action of the Westinghouse break, under very remarkable circumstances. There certain vehicles behind the engine left the rails, in consequence of defects in the permanent-way, whilst the engine was going at a high speed, and in that respect it was very like the Wigan accident, where the leading part of the train had gone on, and the hinder part was left behind. The difference between those two accidents was that in the Wigan case many of the carriages were damaged or destroyed, and a great number of people were killed; whilst in the Heeley case the hinder vehicles were pulled up one behind the other, not running into each other, but all in their places as they had been in the train. Seeking for the cause of this, he had examined the witnesses, and was told by the engine-driver that the first he knew of anything wrong was from his communication-cord being pulled, and just as it did so he felt the break go on. This must have been at the moment when the couplings separated. The guard in the leading van turned his handle to apply the break, after feeling a jerk, whilst the train was going at 60 miles an hour, but the guard in the hinder van knew of nothing being wrong until he felt the break fly on, and the train come to a stand. It was perfectly certain in that case that it was the automatic action of the break that the guard behind felt, because there was clearly no time for the guard in the leading van to put on the break until the couplings became separated, and there could be no doubt it was the automatic action of the break which prevented the accident from being of a far more serious character. In all accidents of this description, and numerous others, in which, on failure of road or rolling stock, the trains became divided, automatic action was an essential element of security. But the question now before the meeting was not so much whether one break or the other was best; perhaps on a future occasion he might be tempted to go into the merits of each break; but at present he would simply conclude by expressing the hope that whichever break was the best might be adopted; and he was convinced that by its adoption more good would be done in the prevention of serious accidents and in the saving life and limbs on our railways than by any or all the other improvements that could be made on railways put together.

The Chairman thanked Captain Tyler for his paper, and the meeting for the important discussion which had arisen upon it. The importance of the subject of breaks was being brought forward in the House of Lords that evening by the Duke of St. Albans, in reference to the overwork of railway servants, and several noblemen had pressed upon the Government the great importance of other matters on railway management, and that, whatever might be the report of the Commission on railway accidents, it was of the greatest importance that immediate action should be taken on the break question. Whether or not the Government would take steps in the matter, of course they could not say. Captain Tyler had proposed in his paper two tests for the decision of the break question, and one was by discussion; but he was greatly afraid that the meeting would no doubt agree with him that if the question were left to be decided by the various arguments they had heard from the gentlemen interested in their several breaks, or if they were thrown into a committee on the subject, their report would be anything but unanimous, and not much, therefore, could be expected from the first test advocated by Captain Tyler. But that gentleman had put forward a second test, viz., the trial of the various breaks. It would be remembered that scarcely two years ago a trial on a very extensive scale had taken place down in the country. The companies gave the Royal Commission every facility, and all the breaks that were then in use, or which the owners or patentees chose to bring forward, were then tried. Some of the gentlemen interested, complained that they were not properly prepared, and it appeared great progress had been made in several of the breaks, and no doubt Capt. Tyler would think it desirable that the question should be practically settled by another trial of the breaks; but, of course, such a proposal could only be satisfactorily carried out with the concurrence of the great companies. Capt. Tyler had not stated whether he had reason to believe that the companies would afford facilities for such a trial as took place two years ago, but failing that, the meeting would agree to any trial which had not the concurrence and support of the great companies, and in which only two or three breaks should be tried, would be a most unsatisfactory test, and that no proper conclusion could be drawn from it. They must wait for such a decision, however it might be brought about, in order that the really best break should be discovered. That discovery they were all anxious for. They had a vast amount of evidence before them showing the importance of having uniformity of break throughout the country, by carriages and mineral waggons coming up from foreign lines; where that rule was not observed, great confusion was caused, and without it the break system would not be carried out in a perfect and complete manner.

The meeting concluded with votes of thanks to Capt. Tyler for his interesting paper, and to the Chairman.

TWENTY-THIRD ORDINARY MEETING.

Wednesday, May 16th, 1877; Major-General F. C. Cotton, R.E., C.S.I., Member of Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Collins, William, 139, Stirlings-road, Glasgow.
Nichols, A. D. C., St. Stephen's Club, Westminster, S.W.
Sandheim, Isaac, 16, Suffolk-street, Dublin.

The following candidates were balloted for, and duly elected members of the Society:—

Blank, Emil, Trump-street, Cheapside, E.C.
Blank, Robert, Trump-street, Cheapside, E.C.

Bradford, R. W., 3, Clement's-lane, E.C., and Frankland, Sutton, Surrey.
Bright, Henry (Mayor of Leamington), 100, The Parade, Leamington.
Butler, James William, Stonebridge-park, Willesden.
Carpmael, Arthur, 24, Southampton-buildings, Chancery-lane, W.C.
Carter, William Allan, 5, St. Andrew-square, Edinburgh.
Farley, Reuben, West Bromwich, Staffordshire.
Loch, C. S., Charity Organisation Society, 15, Buckingham-street, Strand, W.C.
Rankin, James, Bryngwyn, Hereford.

The paper read was—

THE PRACTICAL USE OF THE FOOD COLLECTION OF THE SCIENCE AND ART DEPARTMENT.

By W. Stephen Mitchell, M.A.

In wording a title short enough for inserting in a list of meetings for the week, it is not always possible to indicate the scope of a paper with exactness. The title announced for this evening's paper is "The Practical Use of the Food Collection of the Science and Art Department." By that title I wish to indicate that what I have to say has reference to the ways in which our national food collection, formed under Government direction, and paid for out of the public funds, may be used for the practical benefit of our population. Very little is known about the connection between food and mental work, and it is solely the connection between food and muscular work to which this paper refers. It is the uses that may be made of the collection itself (including in the term "collection" the labels and catalogue) that I shall alone speak about; not the uses that have been and may be drawn directly from the scientific work on which the collection is based. The collection is an attempt to select from the work of chemists and physiologists such information about foods as bears upon the wants of every-day life, and then to give that information in a way that can be understood by those who know nothing about the natural sciences. As it is the wage classes and the very poor to whom that information is of the greatest importance, it is the ways in which it may be made of use to them that I have had mainly in view, though not exclusively. I do not suppose that the suggestions I have written are the only ways, or even the best ways. My hope in reading this paper is to open a discussion in which we may exchange opinions as to how far the collection has proved of use up to the present time, and how it may be of greater use for the future.

The collection is so well known to you all, I need only remind you that it has been open to the public just twenty years, and that during that time, at successive periods Dr. Lyon Playfair, Dr. Edwin Lankester, Professors Huxley and Frankland, and Professor Church have been appointed "scientific referees" to direct its arrangement. The most important practical outcome of the scientific work which it is arranged to explain popularly is, that a certain amount of carbon and a certain amount of nitrogen is needed daily in the food of a person in health and in active employment. When the collection was first formed, Liebig's calculation was adopted, which gave the daily amount of nitrogen needed for a labourer at five ounces. It was then believed that muscular force originated entirely in the destruction of muscular tissue. Lawes and Gilbert, as far back as 1852, had, in consequence of experiments they had made, brought forward the view that muscular force is produced by the oxidation of carbonaceous food, but it was not accepted in face of the high reputation of Liebig's name. In the first four editions of the Guide to the collection the nitrogenous foods therefore were called "force producing." But the view that carbonaceous and not nitrogenous foods are the source of muscular power was recognised in the edition of the Guide superintended by Professors Huxley and Frankland. Liebig himself had then given up his first inferences that nitrogen was the source of muscular power. It will be recollected how recent was the study of organic chemistry, more especially that branch which was called "animal chemistry." It was not till 1842 that it received much attention in England, and the number of observers through all Europe together was small. The early mistakes arose from generalisations on but few experiments.

But the interest taken in the questions thus raised has led to so large an increase of both chemical and physiological experiments, that the literature on the subject is now already extensive, and there have been experimenters in almost every European country.

In the last edition of the hand-book by Professor Church, and in the recently mounted labels of the collection, the daily amounts of carbon and nitrogen are given as:—Carbon, 4,900 grains; nitrogen, 300 grains. This may be taken as an average of the amount arrived at by all the experiments made. The late Dr. Edward Smith, in his official[*] reports to the Privy Council, stated that among poorly-fed operatives subsistence has been known to be maintained on 3,600 grains of carbon and 170 grains of nitrogen, but this was attended with enfeebled health. The amount required by the same labourer varies according to condition of climate, moisture, and temperature, and the amount of work to be done. The carbon may vary from 4,000 to 6,000 grains, and the nitrogen from 250 to 350 grains. The information thus obtained by special experiment, and by properly organised observation, has been tested by making it the basis of the dietaries of the army and navy prisons, workhouses, hospitals, &c. There is now abundant testimony that since dieting has been arranged on these chemical principles, the health of the people so dieted has been excellent. We may, therefore, rest fairly well assured that after all the fluctuations in results that may be expected to exist in a young science, we have at last arrived at a result that may be relied on as, at least, approximately true. These numbers refer to men in activity, in full health, and they refer to the amount of carbon and nitrogen taken into the body in food which can be actually assimilated and pass into the blood. However the amounts for women and children may vary (amounts which, so far as I know, have not been worked out), for the purpose I have in view, it is enough to consider this—that a labourer is told that the results of the work of men of science is, that he must daily take into his system 4,900 grains of carbon and 300 grains of nitrogen.

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[*] 5th and 6th reports of medical officer, 1862-3.

Now, what idea does this convey to his mind? how is he to turn such information to practical account? Supposing that he is told that the amount required by his wife and by each of his children is slightly different, what is he to do with the information that they each require daily an ascertained amount of carbon and an ascertained amount of nitrogen? If the question were put to the most intellectual of our countrymen who earns his livelihood by muscular work (and I have already said we are not considering mental work), "Why do you eat, and what do you eat?" he would probably reply, I eat because I am hungry, and I eat just what my "missis" has cooked for me. I take the case of an intellectual labourer, a man who has confidence in his wife. And if you ask him what his children eat, he will probably reply that they ask for food at all sorts of times during the day, and they eat just what their mother can spare them. Between his household economy and the teaching of "our national food collection," the gap is so wide that there is not a single point of contact.

Let us take the case of a labourer—a man earning his living by muscular work—a man we will say of two or three and twenty. He has a fixed wage and a prospect of continuous work. He marries the girl who has won his heart, a girl that he is sure will make a true wife and a kind mother. She enters on her new duties with the highest resolve to make his little home a happy one, to do all in her power, as far as she knows, to be a good housewife. The first few years pass pleasantly enough. The husband goes home from his work to his rooms tidied up for his return, plays with his little children, chats with his wife, and enjoys his sleep undisturbed by money cares. But the wages remains fixed, the number of children increase, and the supplies that sufficed for a few with comfort hardly furnish the needs of the growing family. The problem before her is, how to make the wage that sufficed for three suffice for six or seven. How this too frequently ends in the bread-winner taking care of himself on what is called a principle, and leaving his wife and children to do what they can, I need not remind you.[*] We cannot shut our eyes to the fact that some may urge that the real remedy for this should be for the family not to be too large for the income of its head; and that a "philosophy" which has so recently been brought into prominence should receive some attention. So far as our labouring population is concerned, it must be recognised they have a hereditary tendency to have large families. The family will increase. And what is a young mother to do? She looks about for advice, but where is it to come from? How, with the fixed wage of her husband, is she to meet the increasing appetites of her growing family? She gives them food that staves off their hunger, and yet she sees them thin and haggard. She does not know that satisfying the appetite does not necessarily mean nourishing the body. She lacks the knowledge of how to obtain the daily needed supplies of nitrogen and carbon.

We have, on the one hand, the national food collection teaching, "Take each of you 4,900 grains of carbon and 300 grains of nitrogen every day;" and, on the other hand, we have the mother willing to sink the pride of her own self-knowledge if any one will tell her how to make her children look less sickly. Between the two is a wide gap.

To open a discussion as to how this gap may be bridged over is the object of this paper. Before proceeding to any suggestions, I shall, perhaps, be expected to make good my assertion that there is a gap between the teaching of the collection and the capability of applying that instruction to those who most need it. Some may assert that the food collection teaches plainly, not only what is the daily needed amount of carbon and nitrogen, but also what are the weights of different kinds of foods that can furnish these amounts. Here are samples of some of the labels. The cases of the collection show the weighed amounts of each, and the only difference between the information given by the labels (also printed in the hand-book) and the collection is, that one gives the amounts in figures, and the other shows weighed quantities to teach by the eye.

White turnips contain :—

			In 1lb.	
	In 100 parts.		ozs.	grs.
Water	92·8	..	14	371
Albumen	0·5	..	0	35
Pectose	4·0	..	0	210
Fat	0·1	..	0	7
Cellulose and lignose	1·8	..	0	126
Mineral matter	0·8	..	0	55

For one part of flesh-formers in turnips there are eight parts of heat-givers, reckoned as starch.

Dry ripe peas contain :—

			In 1 lb.	
	In 100 parts.		ozs.	grs.
Water	14·3	..	2	126
Casein	22·4	..	3	255
Starch	51·3	..	8	91
Fat	2·5	..	0	175
Cellulose and lignose	6·5	..	1	17
Mineral matter	3·0	..	0	210

For one part of flesh-formers in peas there are only 2½ parts of heat-givers, reckoned as starch. 1 lb. of peas contains flesh-formers equal to 3½ ounces of the dry nitrogenous matter of muscle or flesh.

Potatoes contain much starch, which is made into sugar, spirits, gum, &c. Numerous varieties exist, but the average composition is as follows :—

			In 1 lb.	
	In 100 parts.		ozs.	grs.
Water	75·0	..	12	0
Fibrin and albumen	2·3	..	0	161
Starch	15·4	..	2	210
Dextrin and pectose	2·0	..	0	140
Fat	0·3	..	0	21
Cellulose	1·0	..	0	70
Mineral matter	1·0	..	0	70

For one part of flesh-formers potatoes contain 10 parts of heat-givers, reckoned as starch.

Mutton chop contains :—

			In 1 lb.	
	In 100 parts.		ozs.	grs.
Water	44·1	..	7	24
Albumen	1·7	..	0	119
Fibrin (true muscle)	5·9	..	0	413

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[*] This remark was objected to in the discussion. The Privy Council Reports, however, contain the statement that the bread winner, in some parts of England, gets well-fed even when the family is very poorly fed.

	In 100 parts.		ozs.	grs.
Ossein-like substances	1·2	..	0	84
Fat	42·0	..	6	315
Organic extractives	1·8	..	0	126
Mineral matters	1·0	..	0	70
Other substances	2·3	..	0	161

In addition to these labels there is the following information given in a separate label:—

"*A Day's Ration; its Nature and Amount.—Daily Food.*

"If we look only to the chief constituents of human food, and set them down without regard to the particular vegetable or animal products which may be actually taken to supply them, we shall be able to construct a kind of ideal daily ration. Now, to make up for the daily waste of a man weighing 154 pounds, his food should have something like the following proportions and quantities of its main ingredients:—

	In 100 parts of food.		In 1 lb. ozs.	In 1 lb. grs.		In 24 hours. lbs.	In 24 hours. ozs.	In 24 hours. grs.
Water	81·5	..	13	18	..	5	8	320
Albuminoids, or flesh-formers	3·9	..	0	273	..	0	4	110
Starch, sugar, &c.	10·6	..	1	304	..	0	11	178
Fat or oil	3·0	..	0	210	..	0	3	337
Common salt	0·7	..	0	49	..	0	0	325
Phosphates, potash salts, &c.	0·3	..	0	21	..	0	0	170

"On adding the figures of the third column together it will be seen that the total daily ration ('meat' and 'drink' included) will weigh 6 lbs. 13 ounces, 128 grains. Of this amount 1 lb. 4 ounces, 245 grains, is actually dry-food substance, more than 5½ lbs. being water. But in reality a daily ration will amount to rather more than this, chiefly by reason of those minor constituents of animal and vegetable food which are not included in the above table."

To some extent, Professor Church, in his handbook, has indicated the way in which the food collection may be used. At page 51, for example, he writes:—"Such a mixed diet as we have been referring to might be furnished by the following foods, if consumed in the quantities here given:—

	Ounces.
Bread	18
Butter	1
Milk	4
Bacon	2
Potatoes	8
Cabbage	6
Cheese	3½
Sugar	1
Salt	¾
Water alone, and in tea, coffee, and beer	66¼

Altogether, these will contain about 1lb. 5¾oz. of dry substances, though they weigh in all 6lbs. 14½oz. This is the only one of the kind. The *menu* might do very well for a few days, but variety is needed.

The tables at pages 210 and 211 talk about the amount of food to be oxidised in the body to raise 140 lbs. to the height of 10,000 feet.

Now a question I wish to raise is, "Do you think this intelligible to the masses of the people?"

The *Times* of Jan. 19th remarked:—

"It is no doubt the better educated people who have the control of public dietaries whom Professor Church has in mind, when he says that those who have studied the tables will 'be in a position so to adjust the proportion of the several articles of food to one another as to construct useful dietaries, in which there will be no marked excess of carbon over nitrogen, or of nitrogen over carbon—that is, no marked excess beyond the quantities respectively required of each element.' But how about the artisans and the very poor? With rare exceptions, they have not the requisite knowledge to turn to practical use the data furnished by the tables, and they have no educated Board or committee to direct their family dieting. The smaller a man's means are, the more does he need the benefit of the help that scientific research can give him, to use those means to the best advantage. It is only the well-to-do who can afford with impunity to neglect such teaching."

In the opinion of some, it may be sufficient that such information should be thus placed available for use, and that it should be left to the people to make use of it as they want it. It is certainly in accordance with the past traditions of the Department to put information before the public and to leave it to the public to use that information. But the practical question remains, has this collection been of any use? So for as I know, the answer must be, not in the least. It is now sixteen years ago that Dr. Lankester led my attention to the subject, and in many conversations about it very much impressed me with the idea that such teaching as the food collection gave would soon lead to an improvement in the dieting of our labouring population. Being thus interested in the subject, I have made frequent inquiries, but I have not been able to hear of the information afforded by the collection being in any one case turned to practical use. I shall be very glad to know if my experience does not agree with that of other people. But for the present I must believe it true.

Now why is this? It seems to me that it is because the information is given in a form which those who most need it are not trained to understand. I wish to speak with all due diffidence on this, and not with any attempt to assume the authority of actual knowledge. There may be better teaching than I am aware of, and the intelligence of those who need to use the collection may be higher than I have rated it.

However this may be, the Department has sent this collection to the Bethnal-green, into one of the districts where its teaching may be of most value, and after it has been there now for some years the handbook by Professor Church is issued. In these remarks I do not mean in any way to reflect on the Science and Art Department, because I quite admit that if that Department puts information before the people they cannot be expected to compel them to make use of it. If they put it forward in a form in which people can use it, they have evidently done their duty, and very much more than was done some years ago. That it can be used is certain. As matters stand at present, it is left to the people to work out for themselves the practical teaching of the collection to the wants of daily life.

I think I have said enough on the subject of there being a gap between the information in the form in which it is given and the power of the people to use. I now proceed to suggestions as to how that gap may be bridged over.

One suggestion as to how the teaching of the collection may be made of use, I sent in a letter to the *Morning Post*, which appeared on Sept. 15, 1874. It was as follows:—

"The re-opening of the School of Cookery at South Kensington for the autumn session, the offer of the Society of Arts to institute scholarships for learning cooking, and the recent action of the School Board of London, again bring the cooking question into prominence. I have had recently brought under my notice the new code of the Committee of Education of the Privy Council, in which provision is made for instruction in elementary schools in cooking, house management, clothing, and health questions. This new feature in the code of the Privy Council must soon have an influence beyond the schools and training-colleges it directly affects. But I can see no reason why some portions, at least, of the subject should not at once be introduced into all schools which are in connection with the Science and Art Department as well. Let me take the first of the subjects enumerated—'Food and its Preparation.' Already a powerful machinery exists, which, with slight modification, might be used for instruction and for examination in it. Already animal physiology is one of the subjects for which classes are held, examination papers are set, and for which capitation grants are made. It is a somewhat popular subject, for according to the 'Science Directory' for 1874, it stood second in the number of students returned as attending the classes. Physical geography heads the list with 20,055; animal physiology is next with 10,325; 'acoustics, light and heat' follow with 7,112; while 6,434 are recorded for inorganic and 414 for organic chemistry. There is thus already given, though scattered over four subjects, much of the instruction which would belong properly to the special subject of "Food and its Preparation.' To make the subject an efficient one, all that is needed is to select certain portions from subjects already taught, "physiology," 'acoustics, light, heat,' 'inorganic chemistry,' 'organic chemistry;' to group these portions as one subject, and to add to it some additional instruction that is not at all more difficult than much that is already given Were such a new subject arranged, there would of course be many opinions as to exactly how much it should include, but probably all would agree in this: The selection from 'animal physiology' of the present so-called 'anatomical preliminaries,' and the description of the tissues of the body, their daily waste by action and their need of daily restoration, and while the alimentary system would have to be dealt with somewhat fully, the osseous, nervous, and muscular systems would not have, for the purpose in view to be taken so fully as these are in the subject "animal physiology" as it is at present arranged. In like way, in chemistry, only those sections that refer to the composition of the tissues of the body, and to the foods that supply the elements for those tissues, need be selected; with such sections as refer to the chemistry of combustion. As an illustration of the need of knowing what foods contain, I quote two cheap breakfasts suggested by the late Dr. Smith in his 'Practical Dietary':--

"'(No. 10.) Breakfast of tea, bread and butter:—Tea, ⅛ oz.; sugar, ½ oz.; skimmed milk, ¼ pint; water, ½ pint; bread, 6 oz.; butter, ½ oz. The cost, 1½d. Amount of carbon, 1,081 grains; nitrogen, 46 grains.

"'(No. 8.) Breakfast of oatmeal brose, treacle, bread and bacon:—Oatmeal, 5 oz.; skimmed milk, ½ pint water, ¼ pint; treacle, 1 oz.; bread, 3 oz.; bacon, 1 oz The cost, 1½d. Amount of carbon, 1,990 grains; nitrogen, 88 grains.'"

"Here are two breakfasts, each costing the same amount, and each, therefore, at first sight equally economic; yet see what a difference there is in the working power supplied. The one gives 909 grains of carbon and 42 grains of nitrogen more than the other. The chemistry of foods cannot be neglected in arranging the dieting of the poor.

"In a similar way with physics, only such sections of the heat teaching as directly bear on the subject need be selected.

"The new portions of the subject that would have to be introduced would refer to the relative prices of foods; their appearances when fit and unfit for use; the effects of keeping food for a long or for a short time; food preparation by cooking, and the management of a fire and cooking utensils. Now, it may be objected that though instruction might be given in cooking, examinations could not be held, and so the capitation grants could not be made for this subject. I do not see that this is more than at first sight an objection. Cooking involves principles as well as demanding skilful manipulation, and the knowledge of the principles could be tested just as efficiently by examination paper as could the principles of light and heat as is the method of examining in those subjects at present. As to the manipulation, let that be done practically. Take the case of examination in chemistry as at present conducted. Part of the examination is by paper, part by practical work. There surely could be no great difficulty in arranging an examination in one or two simple bits of cooking which, just as one or two practical tests in chemistry would be sufficient to show whether a boy or girl understood how to practically apply the principles they had learned. If the notion of the Science and Art Department appointing examiners to see if a school can boil a potatoe or prepare a stew should cause a smile, I would mention that at present her Majesty's inspectors hold a practical examination in sewing. The object to be obtained, the happier and more efficient condition of the masses of the people, gives a dignity to the subject which makes it worthy of the attention of those who rule the people. The results of such instruction and examination continued over years are likely to be so important; the influence of the Science and Art Department so great, and the machinery it at present has is so nearly all that is needed, that it is worth grave consideration whether such a course as that suggested could not be taken. It would probably lead to a large accession of students; for while many may not care to take up subjects as at present grouped unless they see a direct practical good to be gained, the direct gain of a course of instruction in cooking would recommend it to all who have the direction of the instruction of children."

That is the letter as I wrote it. I used the word "cooking" in a comprehensive sense, to imply all matters connected with the selection and preparation of food; there appeared at that time a tendency to use it in that sense at the South Kensington school of cookery. But, looking at the turn the now popular cooking question has taken, I should use the word "Foods," because, while the actual processes of cooking are now everywhere receiving attention, I cannot see that there is any provision made for instruction on food selection. After such a course as I have sketched out, a young person would be in a position to understand how to select duly nourishing foods, and how, if circumstances compelled it, to fall back on a diet that would prevent starvation, and they would have knowledge to secure as much variation as possible.

This letter was brought under the notice of the health section of the Social Science Congress, at the Brighton meeting, in 1875,* and the following resolution was passed :—" That the council be requested to communicate with the authorities of the Science and Art Department of the Privy Council, suggesting the desirability of making foods, their uses and preparation, the subject of examination."

It is, of course, a very easy thing to get a resolution passed at a congress, but it is not so easy to prevent it being entirely forgotten the next day. Nothing came of the resolution ; but I have never heard whether that arose from its being considered worthless, premature, or meddlesome, or from its being forgotten.

Since that time another machinery has been called into existence for the spread of information connected with foods. Cooking is now made a subject of teaching in schools connected with the School Boards; and a suggestion I wish to offer is, that the teaching should not be confined to instruction in the processes of cooking and receipts, but should also include some of the information the food collection of the Science and Art Department is intended to teach. And a question I wish to raise for discussion among those who are in a position to form an opinion is, whether this teaching may not be given in a perfectly intelligible form to the young girls who are being taught cooking. They are found quite capable of taking their own notes of receipts from the "demonstration lesson" they attend, and they are found capable of using scales, and making the various dishes, and cakes, and puddings, &c., from their receipts. Now, if they can understand ounces and quarter ounces of sugar, spice, &c,, why should they not be able to understand ounces and quarter ounces of carbon and nitrogen, of fibrin and albumen. Of course the first is that they should be familiarised with the things themselves. To most minds the words nitrogen, albumen, &c., convey a hazy idea about things they have never seen. What is wanted is to make the things familiar realities instead of mere words. And this can easily be done in all schools at a very small cost. The amount of chemical knowledge that is required for this purpose is of far less range than is given in most elementary text-books. See the tables p. 654.

[In this table the gases are printed by hollow letters, and the dark lines represent by their length the amount of each element and compound in the body, the scale being quarter of an inch to a pound. The weights are in accordance with Professor Church's calculations.]

I have alluded to these books issued by Messrs. Macmillan—"Chemistry," by Professor Roscoe, "Physiology," by Professor Foster, "Physics," by Professor Balfour Stewart, and "Cookery," by Mr. Tegetmeier; the amount of information they contain has been carefully sifted, and as far as I am able to judge, for the purpose we are now discussing, not a half of each would be all that is wanted, so that, I think, the suggestion that this subject should be taught in schools, that the girls who are to be the future mothers should learn that it is not sufficient simply to give children food to keep them quiet, but that they need proper material to build up their bodies, might be practically carried out.

I said just now that one of the first steps would be to get the words fibrin, albumen, nitrogen, and so on converted into absolute actualities in the children's mind. They ought to be familiarised with these things and to recognise them. As regards the solids, that would be tolerably easy, and in the case of the gases, it would be no difficult matter in school to show their nature and properties. On the table is a set of the apparatus required for use in Professor Roscoe's hand-book, which is supplied by two or three firms, and at a very moderate price—easily within the reach of any school—especially if the portion required for the decomposition of water be left out. By the aid of such an apparatus children might be familiarised with all these different things which enter into their bodies the same as they know the gold of half-a-sovereign, the silver of a shilling, and the bronze of a penny. It only requires them to be frequently in contact with these things for them to be familiarised with them. The great drawback up to the present time has been the teaching by books, instead of by actual contact with the things themselves. But now cooking is being taught practically, and the same kind of teaching which is required for filling up the lessons in cookery seem to me what is necessary with regard to selecting the most useful kinds of food.

We must not forget that there are some people who cannot be taught. With regard to them, I would again quote from the *Times* :—

> "People who do not know how for themselves to make use of the tables want the facts put before them in some form, as Dr. E. Smith gave it in the Privy Council reports already mentioned. He divided the needed daily amount of carbon and nitrogen into three meals, and then gave a series of examples for breakfasts, dinners, and teas at different prices. The amounts of the foods he mentions were expressed in pounds and ounces or pints of each, and then he give in grains what is the amount of nitrogen and carbon in the meal. For examplo (table 176), he gives a breakfast, calculated for a family at 1¼d. a head, consisting of skimmed milk, oatmeal, water, bread and fat, which gives to each ration, if equally divided, carbon 1,478 grains, nitrogen 80 grains. Another breakfast, at the same price (table 177), somewhat different, and including bacon, gives carbon 1,564, nitrogen 69 ; and another (table 182), also at the same price, carbon 1,190, nitrogen 56. For dinner at 2d. a head (table 187) gives carbon 1,616, nitrogen 71 ; (table 190) gives for the same price, carbon 1,513, nitrogen 140 ; (table 199), also at the same price, carbon 2,144. We quote, also, three tables for tea at 1d. a head (table 198), carbon 670, nitrogen 29 ; (table 201) carbon 1,034, nitrogen 61 ; (table 202) carbon 1,250, nitrogen 43. There are also other examples at slightly different cost. This is, however, sufficient to show that the cost of a meal has no relation to its value as nutriment."

How to bring this home to the people seemed a matter of great difficulty. They had their pre-

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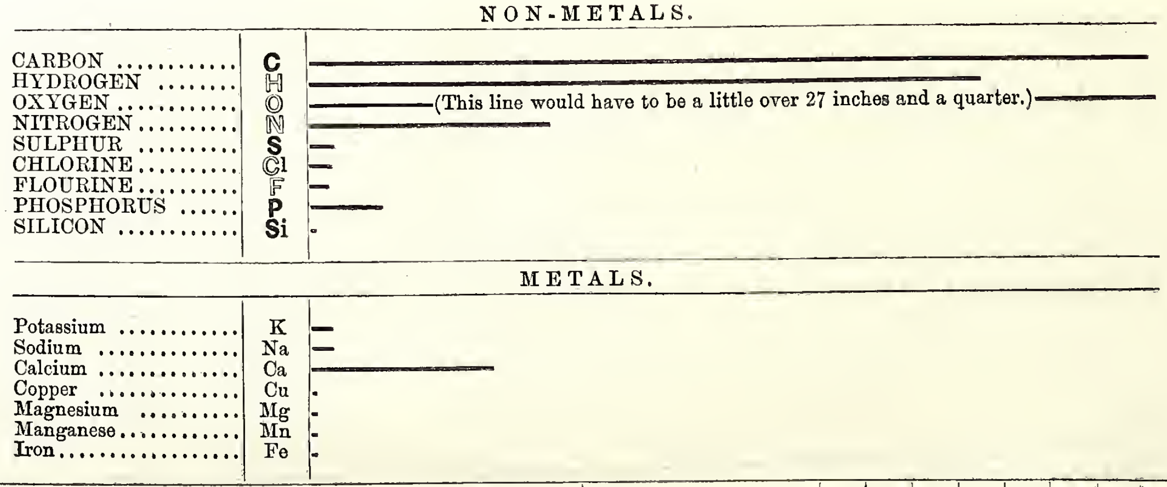
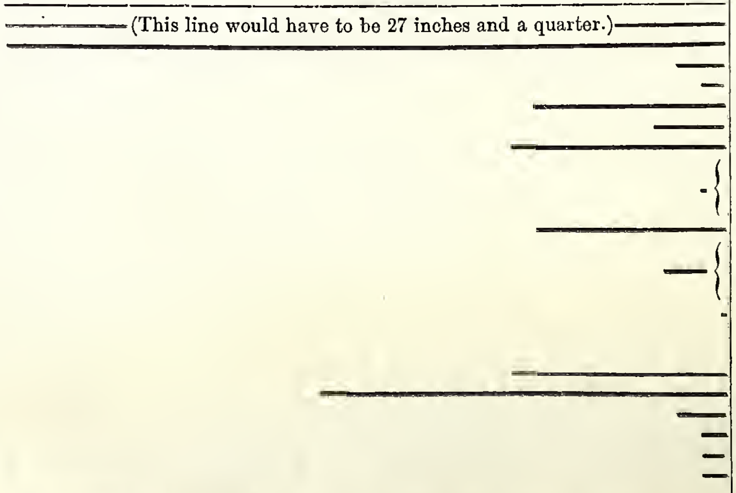
* At the same meeting the medical officer for Salford stated that half the children there died from want of proper nourishment.





	C	H	O	N	S	Cl	F	P	Si	
WATER		—	—							
FIBRIN	—	—	—	—	—					
ALBUMIN	—	—	—	—	—					
OSSEIN	—	—	—	—	—					
KERATIN	—	—	—	—	—					
CARTILAGIN	—	—	—	—	—					
FAT	—	—	—							
CHOLESTERIN	—	—	—							
INOSITE	—	—	—							
GLYCOGEN	—	—	—							
KREATIN	—	—	—	—						
CEREBRIN	—	—	—	—						
KEPHALIN	—	—	—	—				—		
MYELIN	—	—	—	—				—		
SILICA			—						—	
HÆMOGLOBIN	—	—	—	—	—					and Fe
Phosphate of Lime			—					—		Ca
Carbonate of Lime	—		—							Ca
Fluoride of Calcium							—			Ca
Phosphate of Magnesia			—				—			Mg
Chloride of Sodium						—				and Na

judices. It was all very well to say we will give you a table which shall give you a certain amount of fat and other things, but they would turn round and say, "It is not nice; you do not eat fat, and why should we?" I have said in this paper nothing about other things concerning health, such as fresh air, water, &c.; those matters are receiving attention from the Health Society and others; but, as far as I am able to judge, the question of selecting that food which is most fitted for the nourishment of the body does not receive that attention which it ought to. The great difficulty is to bring scientific knowledge home to the people in a way in which they could make use of it, and there are probably even more difficulties surrounding it than many people are aware of. Miss Matthews, who has been appointed instructor of cooking in the Board schools, told me that she felt that was one of the great difficulties which had to be faced; and I hope somebody will face it. If there is only one woman's heart sufficiently warm on the subject to lead her to make herself master of it, and so study it that she can solve the problem of bridging over the great gap existing between the knowledge of scientific men and the wants of the people, I am sure that her name will go down to posterity as a benefactress of her country.

DISCUSSION.

The Chairman, in inviting discussion, said though it seemed absurd to talk about carbon and nitrogen in English villages, or to think of teaching such subjects in schools, it was not necessary that every one should study these things, because if one or two acquired the necessary information it would soon spread. It might look hopeless at first sight, but, he remembered when the teaching of geology was frowned on and laughed at in Oxford by all the Dons, who said that Dean Buckland was teaching the undergraduates nonsense. Yet geology was now taught everywhere, and he had no doubt that the time was near when people would study cooking, and the different ingredients of their food. The great difference in the amount and quality of food required at different ages had not been noticed, but this was of great importance. It did not matter if one or two persons in a village only were instructed, the knowledge would spread from one to another, and the people would be glad to adopt any dish which was found to be nutritious and nice. Of course there would be prejudice, as happened in Lancashire during the cotton famine, when a man came from Scotland and gave a lecture on the use of oatmeal; the people threw their clogs at his head, and said they were not going back to oatmeal, but as knowledge increased such foolish feelings passed away.

Mr. P. L. Simmonds said that having had a good deal to do with the Food Collection, he had been much interested in this paper, which contained many valuable suggestions. The Food Collection had been before the public for many years; the scientific men who had arranged it had of course done so on scientific principles, and had not had the opportunity perhaps of making it exactly suitable to the district in which it was now located, but he believed it was originally the intention of the Department to have lectures delivered to illustrate it. Dr. Playfair had given some, and it was also proposed that lectures should be given at Bethnal-green, but there were too many difficulties in the way. That the collection had proved useful was shown by its having been copied by several other nations; he (the speaker) had sent out a similar collection to Japan, and Russia and Prussia had also followed the same idea. He saw great difficulties in the way of bringing this kind of knowledge home to the labouring classes, though something might be done by the School Boards. Scientific names must always be scientific, which rendered it difficult to popularise such subjects, but something might be done, and he might remark that there had lately been a great deal of discussion in the agricultural papers on the different classes of food. Not only the lower but the middle classes were very ignorant on this subject, and in a country where so much food had to be imported it was a matter of vital importance that the principles should be taught.

Mr. Lucraft said he was in favour of teaching as much of this subject as possible to girls at school, but something more than that would be necessary, because most of them left school at 11, 12, or 13, and went into some occupation where they would soon forget nearly all they had learned. One difficulty in the way of utilising the Food Collection was that it only formed a portion of a large museum, and a man and his wife who could only visit it perhaps once or twice a year wanted to see everything that was there, and roamed all over it. They consequently carried away little or no information of any value. He should like to see popular evening lectures given in some of the Board schools, which would form a centre of a large district, to which the parents of children should be invited, and he would recommend that the subject should be treated rather from the standpoint of what was most useful than of what was the cheapest, and it should not be put forth too prominently as being specially addressed to the poor, but as being a subject which affected the welfare of the whole people. He must take exception to one statement which he understood Mr. Mitchell to have made, viz., that when a large family came difficulties arose, but the bread-winner looked after himself first. Now, being a working man himself, and knowing a good deal of the class, he must say that that was not the general rule, but that where there was want, the man shared it with his wife and family.

Mr. Bain said he had studied this matter a good deal, and had visited the Food Collection several times; but he had always found the technical terms a great difficulty, especially in the case of children, and, consequently, it did not do so much good as it otherwise might. He thought the best means of diffusing information on this subject would be the delivery of popular lectures, such as were given some years ago by Prof. Johnson, on "The Chemistry of Common Life."

Mr. W. Botly remarked that any one who was acquainted with the agricultural statistics of this country, and knew the vast importations of food-stuffs constantly taking place, must admit the vast importance of this subject. The Government was now paying increased attention to this question of agricultural statistics, and he had been informed that, in consequence of a paper he had himself read before the British Association, they would be prepared earlier than they had been hitherto.

Dr. Mann said he had paid a great deal of attention to this subject, and had come to almost the same conclusions as Mr. Mitchell. One great difficulty in bringing the scientific facts bearing on the question home to the public mind, was the want of some more simple mode of teaching the main principles which lay at the root of the matter. He had recently been looking over a large series of volumes which were being produced as class-books for the teaching of these subjects, and the misfortune was that they all contained a vast deal more matter than was at all necessary, and nine-tenths of the information was not correct. It was, in fact, astonishing what egregious blunders were made. In one book, which no doubt would have a large circulation, it was stated that water was composed of oxygen and nitrogen, and in another the action of a cupping-glass was explained by the statement that when the air in the glass cooled it shrank up and left a vacuum into which the blood could flow. On looking through the whole series he found there was scarcely an idea attached to the simple words oxygen, hydrogen, carbon, nitrogen, which could be taken in by an ordinary child. He was now engaged in an endeavour to meet this difficulty, and to give reality and personality to these ideas. Another great difficulty was the fact that every form of physiological teaching was repulsive to the masses. In a large manufactory at Battersea, where there were a number of intelligent people, he was informed that although other classes were fairly attended, including even the mathematical class, neither the boys nor girls could be found to take the smallest interest in physiology. In order to test the matter, he undertook to give a course of lectures one winter, but, though he made the subject as simple and attractive as possible, he found there was a great repugnance to any kind of physiological knowledge. He did not say that this was an insuperable difficulty, but it was one which they must recognise, and try to get round in some way or other.

Professor H. G. Seeley said he was not very sanguine as to the success of the proposals brought forward by Mr. Mitchell, on account of the generally backward state of public information on these subjects. It was necessary, first, to appeal to the natural instincts and emotions of mankind before much good could be expected from such an effort. The labouring classes of this country did not attain to anything like the average age of those who were employed in a more intellectual manner, and this was, no doubt, due in a large measure to the deficient quantity and quality of the food which they consumed. If it could be made intelligible to mothers that the prolongation of a child's life depended very much on the kind of food supplied to it, or to a man that the years he would live depended on the sort of nutriment he took, the subject would be at once invested with an interest which it did not possess when looked at merely from a scientific point of view. It seemed to him desirable that, before they taught children in schools what it was necessary to take in order to have the best chemical food, it was very important to teach them what things to avoid. There were many kinds of food commonly taken which were known to be extremely exhausting to the digestive organs, and which gave very little energy either to the nervous or muscular system. This information could be easily diffused, and would pave the way for further physiological knowledge, which it was the object of the paper to popularise. But until by some such means the general mass of the public were convinced that these questions underlay our national prosperity and the happiness of the people, they could not look for much success. He doubted very much the advisability of teaching anything so abstruse as chemical ideas to children at present, for after some experience in investigating the residuum of school teaching left in mature years, he found the amount of it was very small indeed, the only real result being the mental training which such teaching involved. It was quite possible to convey whatever was worth knowing with regard to food without dwelling upon these abstract matters of chemical constitution or physiological action. The main thing to consider was how the body could be made to do its work and the man to enjoy his life, and if this were more dwelt upon immense good would ensue.

Mr. Pearsall thought one of the first steps in educating the people on these questions was to show them clearly what were the effects of spirituous liquors, tea, and coffee, on the body, and the evils of adulteration in butter and such like articles. There were, however, many places where lectures could advantageously be given, as for instance in factories where a large number of men and women took their meals. To show what could be done by one energetic individual, he might mention the case of Count Rumford who went to Bavaria in the time of the great war, and undertook for a ridiculously small sum to organise, feed, and keep in health the army, and also all the paupers, and did it so successfully that to this day the Bavarians were noted for their fine physique and sturdy qualities. The evils of monotony of diet were well shown in the case of invalids, who were most carefully watched in this respect, and their necessities properly attended to, but who were remarkably glad to return to ordinary food when they recovered. The importanee of a good diet was remarkably shown in the case of the invasion of Mexico by the United States. The former country was conquered with remarkable ease, simply because the United State soldiers were supplied with a nutritious and portable food consisting of meat biscuit, which they were allowed to eat at their discretion; and, being thus provided, they decoyed the enemy into districts where no supplies of food were attainable. He did not see that Mr. Mitchell had alluded, in his tables, to the influence of good tea; but he was convinced that its effects were something marvellous. He believed that, if the facts were properly put before the public, there were a great number who would appreciate them, and see that the question was really one of national importance.

Mr. McComber said there was one very important article of food, much used in America, which was hardly touched in this country, viz., Indian corn, and buckwheat was another. If the Society could draw attention to any article of food, such as these which was both cheap and healthy, it would be a great public benefit.

Mr. Steet thought there should be popular lectures given on this subject if the masses were to be reached, but he did not believe in trying to bring down science to ordinary capacities, but rather in elevating a man's capacity up to science. This could only be done by practical teaching, which would convey definite ideas in connection with the words which were used. The Food Collection might be utilised by means of such lectures, and the knowledge would soon spread. Judge Payne told a story of a ragged boy who was permitted to wash his face and hands, and when he went home he was so much admired that the whole court followed his example. The same thing would take place in workshops. If one man went to a lecture and learned how to make good nutritious dishes, the whole workshop would be equally instructed. There was an enormous quantity of food wasted in this country by bad cooking, and much more so amongst the poor than amongst the rich.

Mr. Mitchell expressed his disappointment with the result of the discussion, which had turned very little on the point he had specially brought forward, viz., the possibility and desirability of introducing this subject into schools under the control of the Science and Art Department, and into Board schools. He hoped the paper, when printed, would be sent to the mistresses of those schools, in order to ascertain from them whether they thought it possible that the plan could be carried out. He was by no means in favour of doing away with scientific terms, but the amount of science required was really very small; and, by familiarising young people with the terms and the things themselves, they would be able to follow any changes in the opinions of scientific men, if such took place. Another advantage of teaching science with the usual terms used by men of science was, if they came across books more advanced, they would find the same terms employed, and that there was really no impassable gulf between the little knowledge they had attained, and that which they went on to. Professor Seeley referred to the very small residuum of scientific knowledge possessed in after years by those who had learned it at school; but this seemed to him just one of those cases in which the knowledge acquired being brought into practical use would not be forgotten. It would not lead to the introduction of monotony of diet, but to put the information before people in such a way that if they did not get a sufficient amount of carbon in one form of food they would know how to obtain it in another. It was quite possible to draw out a long series of tables showing a very varied dietary, with each meal containing the required food constituents. The point was to give the people such information as would enable them to make out their own dietary. One point he had not alluded to was the decrease in the average stature of the people, which might be observed in manufacturing districts and the east of London and which had led to a reduction in the military standard. He did not suggest that this was entirely owing to improper diet, but he believed it was considerably influenced by it.

The Chairman said he did not consider it necessary that this scientific information should be conveyed to all in order to be generally useful. Every day they knew that vessels were safely navigated through the most intricate channels by men who knew nothing whatever of the methods by which Laurie's tables were calculated, but who simply knew how to use them, and in the same way if a few were instructed in this subject the result of their knowledge would soon spread from house to house. He concluded by moving a vote of thanks to Mr. Mitchell, which was carried unanimously.

CORRESPONDENCE.

PHOSPHOR BRONZE AND ITS APPLICATIONS.

With reference to my paper on "Phosphor Bronze and its Applications," which appeared in your issue of the 4th inst., I beg to point out one or two errors of some importance, as they will mislead your readers.

In the two tables of tests made by Mr. Kirkaldy, the pulling stress and resistance in pounds per square inch is stated in every instance with decimal points, which is quite incorrect; thus, for example, the pulling stress per quare inch of phosphor-bronze wire, which should be 159,515 lbs., reads 159·515 lbs.

Owing to the position of the two tables referred to having been reversed, the paragraph which has reference to the experiments made with cast phosphor-bronze by the Royal Academy of Industry in Berlin seems somewhat confusing after reading the tests made with drawn metal, the breaking strain of which is of course much greater than of cast metal.

In the twelfth paragraph of the discussion, on page 555, the word "tons" is substituted for "pounds," as I stated that the same samples of phosphor-bronze wire had resisted a strain of 159,000 lbs. (not tons) to the square inch. ALEXANDER DICK.

110, Cannon-street, E.C., May 14th, 1877.

THE ARTESIAN SYSTEM OF THE THAMES BASIN.

Referring to what I am reported to have said in last week's *Journal*, after the reading of Mr. Lucas's paper, namely, that subterranean water obtained from chalk strata situated beneath a covering of London clay, contains from 40 to 50 grains of soda-salts per gallon, while subterranean water derived from chalk strata where the chalk forms the surface of the country, and is not covered by London clay . . . . . . does not contain "more than 18 to 22 grains." The 18 to 22 grains is a mistake, and should have been only "2 to 3 grains." In water obtained from the chalk strata situated beneath a large area of London clay, varying from 150 to 250 feet in thickness, the total mineral matter in solution is often found to be as much as 50 to 60 grains per gallon, of which 43 to 52 grains consist of soda-salts, and 3 to 6 grains lime-salts; while, in water obtained from chalk strata not covered by London clay, the total mineral matter in solution is frequently found to be from 20 to 24 grains per gallon, of which only 2 to 3 grains consist of soda salts, and 14 to 18 grains lime salts.

This will be apparent from an examination of the analysis of the following six samples of water, three of which were taken from chalk strata, situated below the clay on which London stands, and the other three from chalk strata not covered with clay.

TABLE OF ANALYSES IN GRAINS PER GALLON.

Substances found in the Waters.	Waters from Wells in Chalk not covered with Clay.			Water from Wells in Chalk covered with Clay.		
	Caterham Water-supply, Surrey.	Chiltern-hills Water-supply, Herts.	Canterbury Water-supply, Kent.	Trafalgar-square. Orange-street Well.	Combe and Delafield's Well, Long-acre.	De Keyser's Well, Victoria Embankment.
Carbonate of soda	...	...	...	10·58	11·60	14·67
Sulphate of soda	1·10	2·00	...	21 34	24·25	15·90
Chloride of sodium	1·55	1·17	3·00	19·04	12·70	13·18
Chloride of potassium	1·96	1·20	0 45	1·05	a trace	2·51
Carbonate of lime	13·00	12·96	15·96	2·74	6·18	1·15
Sulphate of lime	1·21	a trace	0·08	...	...	1·60
Nitrate of lime	...	a trace	2·06	...	...	0·07
Magnesia (probably as silicate)	0·46	0·37	0·29	...	...	...
Carbonate of magnesia ...	...	...	...	2·07	1·08	2·16
Silica	1·04	1·44	0·96	0·40	0·44	0·88
Oxide of iron	0·80	0·30	0·16	...		0·04
Phosphate of iron and lime.	...	...	...	0·97	0·43	a trace
Volatilised matter	0·80	0·72	0·96	0·66	0 12	0·16
Total............	21·92	20·16	23·92	58·85	56·80	52·32

The above analyses were all made by Mr. Dugald Campbell, the well-known analytical chemist, and may be taken as representative of other waters obtained from similar strata.

By referring to the discussion on the paper read before the Society of Arts on the 31st of January, 1855—22 years since—"The Chalk Strata considered as a Source for the Supply of Water to the Metropolis," it will be seen that the late Dr. Clark then also forcibly alluded to the great chemical difference that is found to exist in the quality of water derived from chalk strata protected by a large area and thick covering of London clay, compared with that of water derived from chalk strata, whose surface is now, and has been for ages past, exposed to alternate rain, sunshine, and change of weather.

S. C. HOMERSHAM.

19, Buckingham-street, Adelphi, May 16, 1877.

CONTINUOUS BREAKS.

As the notice of my few remarks during the discussion on Captain Tyler's paper on "Continuous Breaks" does not quite convey my meaning on one or two points, I shall feel much obliged by your kindly inserting the following corrections in your next *Journal*. In protesting against the advocate of the vacuum breaks so cavalierly, dismissing friction breaks as out of the competition (an opinion, the value of which is best judged by the fact of the most important railway in the whole world having, amongst others, adopted them, after carefully trying and rejecting fluid-pressure breaks), I was anxious to point out that the first point to be decided by a railway engineer before selecting any special break, was the question whether frictional force, derived from the momentum of the vehicles themselves, or fluid pressure, created by some pump or other appliance on the engine, and necessitating continuous tubing on every vehicle, is the most advantageous principle for actuating breaks. That point once decided, then would come the remaining points for decision, namely, whether Heberlein's or Clark and Webb's, or whether Westinghouse's or Smith's, Steel-McInnes's, or Saunders's, Barker's, or Clark's, or any other of the fluid-pressure break fulfils best the required conditions.

With regard to the erroneous opinions relative to friction breaks prevalent in this country, they have arisen from their being hitherto worked for the whole train by means of one long continuous chain, being thus open to the objection named by Mr. Brudenell Carter, as the possible fracture of one link would destroy their whole efficiency. By dividing, however, as Mr. Heberlein was the first to do, the break power into sections of two or three vehicles, and reducing to its utmost limits, by means of rods and couplings, the amount of chain required, this risk is practically removed, as any rupture only affects the break-power of the one carriage where it occurs, and then only after it has, before breaking, produced its chief effects.

With reference to actuating the break-applying apparatus by means of a cord, I desired to point out that with a well selected and strong line, especially fitted for that purpose, and led along the centre line of the train, the application of the breaks by the guard and driver (and in cases of rupture of couplings, &c., by the automatic action) is as easily and as safely effected as with any other form of break, whilst the rapidity of action and power is unsurpassed, one revolution of the wheels sufficing to bring every break block into hard contact. The proverbially inefficient contrivance known in this country as the communication cord is utterly unfit to be trusted to control the breaks, upon which the safety of the whole of the passengers chiefly depends. Led along on small rollers at the sides of the carriages, the present cord of communication is disturbed by all the curve movements, and consequently requires the compensating wheel I mentioned.

The expression I am reported as having used as to the driver giving his break a kick, needs a little explanation, which is easy to give when the facts are understood. The handle of the Heberlein engine break rests on a catch at the driver's stand, from which, when urgently required, it can be instantly thrown off by the driver or the fireman, whichever first sees the danger a-head, and the break then applies itself instantaneously to both tender and engine. I purposely abstained from attempting any invidious distinction between the Heberlein break and that known here as the Clark and Webb, as, although differing in one or two most important points, their principle and effects are practically the same, as far as the train breaks are concerned; and the remarks of both Mr. Clark and Mr. Wilkin as to efficiency and cheapness apply equally to the Heberlein break. I feel it, however, my duty to point out here that the priority of invention belongs unquestionably to Mr. Heberlein, as he patented in this country a system of friction breaks in the year 1856, six years before any other inventor presented himself with breaks actuated by frictional force derived from the running axles.

Charles Fairholme.

9, Victoria-chambers, Westminster,
16th May, 1877.

OBITUARY.

J. Russell Reeves, F.R.S.—In the person of Mr Reeves, the Society has lost one of its oldest members, for he joined in 1824, since which up to the present time, he has continued a subscribing member. Mr. Reeves began life as a tea inspector in the Honourable East India Company's service, in Canton; but when the company's trade with China ceased he went into business on his own account. Eventually he became a partner in the firm of Dent, Palmer, and Co., with which he remained associated till his death. His natural history studies, when in China, gained him the Fellowship of the Royal Society in 1834, he having sent home and described several new animals, birds, and flowers. In 1826 he communicated to the Society of Arts a description of the manufacture of rice-paper in China, an account of which will be found in vol. xlvi. of the Society's Transactions.

NOTICES.

PROCEEDINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday evenings, at 8 o'clock. The following arrangements have been made:—

May 23. — "The Measurement and Settlement of Musical Pitch," by A. J. Ellis, Esq., F.R.S., F.S.A.

MEETINGS FOR THE ENSUING WEEK.

Mon.... Asiatic, 22, Albemarle-street, W., 3 p.m. Annual Meeting.

Tues....Conference on Spelling Reform (at the House of the Society of Arts), 3 p.m. At 7 30 p m. Public Meeting.
Royal Institution, Albemarle-street, W., 3 p.m. Prof. James Dewar, "The Chemical Philosophy of Sir Humphrey Davy." (Lecture I.)
Medical and Chirurgical, 53, Berners-street, Oxford-street, W., 8½ p.m.
Anthropological Institute, 4, St. Martin's-place, W.C., 8 p m. 1. Professor Boyd Dawkins, "The Evidence Afforded by the Caves of Great Britain." 2 Professor McKenny Hughes, "The Evidence Afforded by the Gravels and Brick Earth." 3. Mr. R. H. Tiddeman, "The Hyæna Bed in the Victoria Cave."

Wed.... **SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. Mr. A. J. Ellis, "The Measurement and Settlement of Musical Pitch."
National Health Society (at the House of the Society of Arts), 4.30 p m. Dr. Arthur Ransome, "How to Prevent the Spread of Epidemics."
Geological, Burlington House, W., 8 p m.
Royal Society of Literature, 4, St. Martin's-place, W.C., 8 p.m. Rev. A. Castle Cleary, "The Syllabic Bases of Words, for an Improved Form of Dictionary."

Thur....Linnean, Burlington House, W., 3 p m. Anniversary Meeting; Election of Council, Officers, &c., and the President's Annual Address. Subject:—"Recent Researches among some of the more simple Sarcode Organisms."
Society for the Encouragement of the Fine Arts, 9, Conduit-street, W., 8 p.m. The Third Conversazione, with Music.
Royal Institution, Albemarle-street, W., 3 p.m. Prof. Tyndall, "Heat." (Lecture VII.)
Inventors' Institute, 4, St. Martin's-place, W.C., 8 p.m.
Zoological, 11, Hanover-square, W., 5 p.m. (Davis Lectures) Mr. P. L. Sclater, "The Lion-house and its Inhabitants."
Civil and Mechanical Engineers, 7, Westminster-chambers, S.W., 7 p.m. Mr. C. H. Rew, "Llandudno Promenade Pier."

Fri.......Royal United Service Institution, Whitehall-yard, 3 p.m. Captain J. C. Colomb, "Russian Development, and our Naval and Military Position in the North Pacific."
Royal Institution, Albemarle-street, W., 8 p.m., Weekly Meeting. 9 p.m. Mr. G. J. Romanes, "Evolution of Nerves and Nervo-Systems."
Quekett Microscopical Club, University College, W.C., 8 p.m.
Clinical, 53, Berners-street, W., 8½ p.m.

Sat.......Physical Science Schools, South Kensington, S.W., 3 p m. 1. Profs. J. Perry and Ayrton, "The Friction of Water and Other Liquids," and "Ice, as an Electrolyte." 2. Lieut.-Col. Campbell, "Spectroscopy."
Royal Botanic, Inner Circle, Regent's-park, N.W., 4 p.m. Professor Bentley, "Plants, with Reference to their Life and their Organs of Reproduction." (Part I.) Lecture III. "Exhalation of Watery Vapour by Leaves. Exhalation of Gases by Leaves or Respiration. Wardian Cases. Assimilation. Secretions of Plants."
Royal Institution, Albemarle-street, W., 3 p.m. Mr. W. H. Pollock, "Modern French Poetry." (Lecture III.)

JOURNAL OF THE SOCIETY OF ARTS

No. 1,279. Vol. XXV.

FRIDAY, MAY 25, 1877.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

HEALTH AND SEWAGE OF TOWNS.

The following papers, dealing with various systems of treating sewage, were brought before the Conference* :—

TREATMENT OF SEWAGE SLUDGE.

By J. H. Kidd.

In the treatment of sewage sludge, I think that too little care has hitherto been taken, so as to allow Nature to perform her share of the work. How can it be expected that such material can dry when it is simply thrown out of the depositing tank, and no provision made for its reception, to prevent the first wet day from undoing the work of the previous fine weather. The following plan is now being carried out at the Hafod-y-Wern Farm, Wrexham, where sludge is manufactured into a dry and perfectly pulverised manure, containing from 1½ to 2 per cent. of ammonia, which meets with a ready sale at 10s. per ton, an amount rather under than over one-half of its chemical value. The following analysis, made by Prof. Voelcker, shows that this dried manure is theoretically worth 30s. per ton. Great attention is paid to the "draining tank," which consists of a gravelly bottom, and is made to slope in all directions to one point. Below the bottom of this tank narrow channels, from 6 in. to 9 in. in depth, are cut longitudinally and transversely, so as to allow the water a further chance of escaping from the bottom of the sludge, in the act of drying. When the tank is full, and the supply cut off, it should be allowed a few days' time for the water to drain away, and then the flood-gate, or overflow, should be raised, until it becomes level with the tank, so as to give the water a further chance of escaping by the channels above alluded to. When sufficiently dry for the use of the spade, roads are cut through it in both directions, so as to leave square or oblong blocks of sludge for the atmosphere to act upon. All these operations should be conducted under an open shed, so as to prevent the rain from again mixing with the sludge. If this plan were more generally adopted, nature would perform one-half of the work, and any sum of money so laid out would well repay the owners in the saving of after labour. When brought into the mixing-room, the sludge receives an addition of, say, 20 per cent. of any drying materials, such as road-scrapings (collected in dry weather), fine calcined ash, &c., which will enable it to pass through a pug-mill, breaking-rollers, or similar preparatory machine, from which it will emerge in a subdivided and friable condition, ready to pass into my drying machine, which in a few minutes converts it into a dry and pulverised manure, ready for immediate use, and of so light a nature that the least wind will blow it away in the act of loading into the farmer's cart. In this manner, I see no practical difficulty in dealing with any amount of sludge, so as to prevent its being sent out to sea, and its fertilising properties lost to the land in its immediate vicinity. If it were given away, the cost of so manufacturing would not, with a suitable provision of buildings and machinery, exceed that of the collection of fæcal matter and refuse in our large towns, *i.e.*, about 6s. per ton.

Moisture	4·19
Organic matter*	46·26
Carbon	....
Oxide of iron and alumina	7·03
Phosphoric acid†	1·05
Carbonate of lime	9·45
Magnesia and alkaline salts	2·62
Insoluble siliceous matter	29·40
	100·00

In the treatment of the excreta and house refuse, where the pail system is in use, all that is required is to reduce the pail contents by evaporation, and then to add a small quantity of fine calcined ash obtained by riddling the refuse matter, and pass it through the drying machine, from which it will emerge in a few minutes as a fine powdered manure, containing (according to the degree of evaporation practised) as much as from 5 to 10 per cent. of ammonia. The difficulty in getting rid of house refuse is, in my opinion, only to be obviated by a compulsory separation of all fæcal matter therefrom. By general observation, I consider that a ton weight of refuse would consist of, say, 4 cwt. of fine calcined ash and vegetable matters which can be burnt, 4 cwt. of large and small cinders, sufficient for all the requirements of heat in manufacturing, and 12 cwt. of mineral and metallic matter. So that, at least 19½ cwt. out of every ton weight could (after separation of any saleable or useful materials) be used for the purposes of road-making, or tipped into the nearest hole, the residue of fine ash alone being used for admixture with the evaporated pail contents.

FINANCIAL REPORT UPON BEDDINGTON SEWAGE FARM, FOR THE YEAR ENDING MARCH 25th, 1877.

By Alfred Carpenter, M.D.

It will assist the Conference if I follow up the report which was presented to the last Conference, with a return of the receipt and expenditure upon the Beddington sewage farm during the past year. The difficulty of management by an irresponsible committee continues to prevent the returns being as large as they ought to be, whilst the expenses are greater then would be the case if those in charge suffered by mismanagement. During the past year the farm manager has been changed, Mr. Horsley having been appointed to a more lucrative post. This change was effected at Michaelmas. About one month before it happened, the manager, by permission, was much away from the farm; as a sequence to that absence the farm suffered in various ways, both as regards cultivation and crops. The former was neglected, and the latter arrived late in the market. It was some time before a new manager was secured, not, indeed, until shortly before Christmas, and during the interregnum much mischief resulted. The mangolds, which showed well, were not clamped early enough, so that they suffered from the severe frosts which prevailed so early last year, and nearly 300 tons were destroyed. Mr. Parrott, the present manager, has done much to restore the mischief, and the farm is in a more satisfactory

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* A report of the discussion will be issued in subsequent numbers of the *Journal*. For the convenience of those wishing to have the account of the proceedings in a more compact form, the same will also be published as a pamphlet, which can be had (as soon as ready) on application at the Society's House. Price 3s.

* Equal to nitrogen, 1·81; equal to ammonia, 2·19.

† Equal to phosphate of lime, 2·29.

BEDDINGTON FARM.

STATEMENT OF RECEIPTS AND PAYMENTS FOR YEAR ENDING 25TH MARCH, 1877.

RECEIPTS.

	£.	s.	d.	£.	s.	d.
Sale of:—						
Greens	299	3	10			
Parsley	5	10	8			
Broccoli	33	5	9			
Sage	50	18	4			
Cabbage	692	14	1			
Potatoes	438	1	3			
Rhubarb	114	11	8			
Leeks	0	11	6			
Celery	1	10	0			
Spinach	2	15	6			
Wallflowers	34	15	3			
Walnuts	0	8	0			
Willows	1	1	0			
				1,675	6	10
Milk	1,144	7	8			
Grass	2,467	17	3			
Mangold	513	4	0			
Hay	46	13	3			
„ cartage of	2	5	0			
Swedes	25	4	6			
Cows, Horse, &c.	833	14	10			
Calves	35	17	6			
Oats	31	1	0			
Wheat	5	5	0			
				5,105	10	0
Horse Hire	5	16	0			
Sewage Manure	16	5	0			
Stock Keep	211	5	6			
Miscellaneous	8	3	0			
				241	9	6
Rents:—						
Moody	100	0	0			
Leeks	20	0	0			
Shaw	20	0	0			
				140	0	0
Balance (Loss)				2,227	6	10
				£9,389	13	2

PAYMENTS.

	£	s.	d.	£	s.	d.
Wages:—						
General labour	891	9	4			
Milk	170	8	4			
Grass	252	6	7			
Fencing and Roads	41	3	7			
Market Garden	656	1	2			
New Carriers	7	16	2			
Mangold	166	12	1			
Hay	74	10	0			
Swedes	13	8	2			
Oats	41	1	9			
				2,315	7	2
Salaries				210	16	8
Printing and advertising				21	10	2
Coals				9	4	2
Buildings				145	7	7
Gas				19	6	6
Forage				396	18	11
Seeds				220	12	5
Waggons Repairs				78	3	10
Manager's Cart				24	0	0
Tools and Implements				57	13	6
Veterinary Charges				31	1	6
Rates, Taxes, Tithes, &c.				514	12	3
Insurance				16	8	5
Valuations (2)				63	0	0
Repairs				40	18	3
Harness				25	9	0
Horse Hire				21	12	0
Threshing				34	0	0
Purchase of Cows				150	0	0
Willow Sets				27	0	0
Fencing				30	16	2
Stop Boards, Rods, &c.				16	10	0
Pipes, Bricks, Cement				54	17	6
Land Drains—Pipes	30	0	0			
„ Wages	26	6	7			
				56	6	7
Open Carrier Waddon Marsh:—						
„ Materials	45	19	9			
„ Wages	33	17	8			
				79	17	5
Expenses Mangold Sale				16	4	11
Miscellaneous				19	4	3
Rents:—						
Mr. Quilter	1,977	1	8			
Beddington	1,739	6	8			
Dr. Shorthouse	395	8	4			
Local Board	500	0	0			
				4,611	16	8
Commission on Sale of Vegetables				80	7	4
				£9,389	13	2

state as regard cleanliness than it has been for some years. The receipts compare very favourably with the statement which was made last year. It will be noted that the sale of grass was much exceeded, £2,467 being taken in actual cash on this head alone. Much less hay was made for that reason, and a much smaller amount appears as receipt from the sale of it. The sale of milk has also advanced from £826, in 1875-6, to £1,144, in 1876-7. It will be observed that considerable sums have been spent in unexhausted improvements, amounting altogether to £336 9s. 1d., and some back bills have also been included in the account. The charge of rent, rates, and tithes reaches the enormous sum of £5,126 8s. 11d., a charge which no farm of 466 acres could be expected to clear. In that amount, however, there is included the sum of £500, which goes into the Local Board account as rental for the freehold land belonging to the Board, and the loss of £2,227 6s. 10d. may fairly be reduced by a portion of that amount; if to that we also add the sum which fairly represents the unexhausted improvements, the charge upon the rates of the parish for the year ending Lady-day last may be put a small something above one penny in the pound. The loss upon the mangolds has made an increase to the deficit. The valuation has been made this spring by Messrs. Fuller and Moon, and may be taken as correct. The valuation which I published last year was made by the then manager, as it had not been the custom of the Board to have a valuation made at Lady-day; that amount was £5,450 2s. 7d.

Valuation of Beddington Sewage Farm, made Lady-day, 1877.

	£	s.	d.
Horses	410	0	0
Neat stock	1,476	0	0
Dead stock, &c.	649	11	0
Cultivation, crops, hay, corn, manures	2,615	17	6
	£5,151	8	6

It will scarcely be fair to compare this valuation with that made by the late manager, but it will be a safe starting-point for future balance-sheets.

I may also state that the stock on the farm has continued perfectly healthy during the past year, and we hope that, in the hands of our new manager, several matters which have been hitherto unsatisfactory will continue to improve.

It will be seen that the estimate which I ventured to make as to the cost of the farm three years since, when many gentlemen interested in the subject honoured me with their presence to luncheon on the farm, viz., one penny in the pound in each rate, has not been exceeded, and the whole expense to the parish has been less than 1¾d. in the pound per annum.

WREXHAM SEWAGE FARM.

By Lieut.-Col. Alfred Jones.

In continuation of "Notes on Wrexham Sewage Farm," page 27 of the Sewage Conference, 1876, a balance-sheet is appended, showing the profit and loss balances of ledger accounts for the several crops cultivated during the fifth year of our farming, which was completed on the 1st February, 1877.

It will be observed that 5 per cent. interest on all capital, together with an additional 5 per cent. on so much thereof has as been laid out on permanent works (such as levelling carriers' road, &c.) has been deducted before striking a balance for the year's profit; and it may be added that the charge of £5 per acre for the 84 acres held from the Corporation, and £3 per acre for 20 acres which he has added to that farm, has been made for rent, taxes, &c., against each crop in the several ledger accounts.

The amounts paid for wages have been as follows:—

No.	£	s.	d.
1.—1872-3	620	3	5½
2.—1873-4	474	7	0½
3.—1874-5	530	16	3
*4.—1875-6	463	17	6
5.—1876-7	447	19	11

For permanent works as well as for farm cultivation, &c., two horses, with the occasional assistance of a third, have generally sufficed for all purposes.

The farm cash book shows receipts and payments for the five years as follows:—

	Receipts.			Payments.		
No.	£	s.	d.	£	s.	d.
1.—1872-3	462	1	6	1599	0	6½
2.—1873-4	1456	13	6	1798	1	10½
3.—1874-5	1797	10	7½	1603	17	4½
*4.—1875-6	2136	11	7	1099	18	8
5.—1876-7	1392	5	8	1327	9	10
	£7,245	2	10½	£7,428	8	3½

The valuation of live and dead stock, taken 1st February, 1877, amounted to £877 3s. 2d., and the present value of permanent works to £786 6s. 5d.; consequently, by adding these two sums to the total receipts of the five years—

£	s.	d.		£	s.	d.		£	s.	d.
7,245	2	10½	+	877	3	2	+	786	6	5

We have the gross produce of the farm for the period, £8,908 12s. 5½d., and deducting the gross payments as per cash-book, £7,428 8s. 3½d., the remainder, £1,480 4s. 2d., represents the actual profit for the five years, subject only to any possible failure to realise the estimated value of stock and permanent works.

This profit gives an average of £296 0s. 10d. per annum, being about 21½ per cent. per annum, on the average amount of capital embarked in the concerns, or at the rate of £3 4s. 4¼d. per acre per annum on the average extent of land occupied, viz., 92 acres.

I have been at some pains to record these accounts, with a view to my own education in sewage farming, and having published them through the medium of the Society of Arts, I shall be happy to produce the whole of the farm books, for examination by any agricultural accountant whom the Council may be pleased to appoint, if they think it desirable to have the facts verified for the satisfaction of those interested in the subject.

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* The dairy stock was handed over by valuation, 15th May of this year, to Mr. George Jackson, who purchases fodder for his stock from the farm.

5th ANNUAL BALANCE-SHEET.—PROFIT AND LOSS ACCOUNT, 1876-77.

1877.	Dr.	£	s.	d.	£	s.	d.
Feb. 2.	To balance of Couch Field turnips (6 acres) ... (Above level of tanks, manured with sludge.)				0	0	9
	To balance of loss on 1875 crops account				3	0	1½
	,, ,, ,, tank sludge				1	0	2
	,, ,, horse labour				23	3	6
	,, ,, sundries and implements				24	4	0
	To interest at 5 per cent on £1,600 ...	80	0	0			
	To payment to sinking fund; 5 per cent. on £700	35	0	0			
					115	0	0
	(To pay off cost of permanent improvement during term of lease.)						
	To balance profit on the year's farming				392	19	0½
					£559	7	7

1877.	Cr.	Acres.		£	s.	d.
Feb. 2.	By balance Italian rye grass account	17	...	229	2	11
	,, ,, mangolds ,,	6½	...	56	6	11½
	,, ,, market garden ,,	5	...	52	2	3
	,, ,, permanent pasture ,,	52	...	52	2	7½
	,, ,, wheat crop ,,	5	...	55	6	6
	,, ,, oat ,, ,,	4	...	22	6	4
	,, ,, potato ,, ,,	4	...	20	4	0
	,, ,, dairy ,,	0	...	38	15	8
	,, ,, rent ,,	1½	...	33	0	4
	Total acres ...	95				
				£559	7	7

HURSTPIERPOINT (SUSSEX) SEWAGE,

By Charlton Wollaston, C.E., &c.

I would preface the few remarks I have to make upon the sewage of Hurstpierpoint, by stating that at the date of the Conference last year, the rule excluding discussion upon methods of sewage treatment not then in public use precluded the mention of the system which has since been adopted at Hurst, with results clearly indicating that with a proper use of well-known and inexpensive chemicals, followed by artificial filtration, a sewage effluent may be secured free from any tendency to after decomposition, and of sufficient purity to be discharged into any water-course. Population of Hurst, about 3,000. Sewage does not contain manufacturing refuse. Sewage increased during winter to at least three times its volume by subsoil water. No provision is made for removal of storm water. Summer flow 60,000 to 70,000 gallons per day. Sewer outfall situated too low for irrigation without pumping, and the land very ill-suited to that purpose, being heavy wet clay, with much subsoil water.

For three or four years previous to the adoption of the present process, the sewage of Hurst had been treated by a method patented by a Mr. Leopard, which method was nothing more than a very partial straining through straw and heather, with a subsequent slight aëration by an exposure upon a series of four steps or stages, each of 12 feet by 60; the sewage after straining being caused to flow in a thin film over each step successively, and then to run direct into a brook-course, which in summer without the supply of sewage would, for several months, be entirely dry. Under these circumstances the natural result followed—the sewage, deprived only of a very coarse matter, set up a speedy decomposition, and the brook before joining a mill-stream about two miles below the outfall became nothing more or less than an open sewer. In consequence of the complaints of riparian owners and threats of injunction, negotiations were opened between the Local Board of Health and the Sanitary Carbon Company, ultimately resulting in the sewage works being handed over to the Company. The alterations required to transform the steps or stages abovementioned into depositing tanks were at once carried out, and the sewage, now treated with a small quantity of lime in the form of milk of lime, combined with chloride and chloride of magnesium, and the alumina contained in the ash of Kimmeridge shale, is allowed to flow through four tanks, each 11 feet by 60 feet, and from the tanks is conveyed to two filter beds, either together or separately used, of 25 feet by 12 feet area, prepared as follows:—

1. A layer of sea-beach shingle, about three inches.
2. 15 to 18 inches of sanitary carbon, broken to pass through a half-inch sieve.
3. The carbon coarsely broken.
4. A top layer of shingle in order to prevent the displacement of the carbon.

My object in forwarding this paper to the Conference is not to puff any system at the expense of any other, but to direct attention to a place of sewage purification, which from its simplicity will commend itself to many, and its practical results is proved at a very small outlay to secure an effluent in every respect equal to that obtained by land filtration.

SEWAGE OF COVENTRY.

By J. C. Melliss, Associate Institute Civil Engineers.

Having contributed for the Conference held last year, some account of the treatment of the sewage of Coventry, I would now add the experience of another year to the information then given. The mode adopted for the purification of sewage there has continued to afford satisfactory results, both to the riparian owners in the neighbourhood and to the Corporation of Coventry. The Town Council having occasion, towards the end of 1876, to consider the advisability or not of continuing the process, came to the following conclusion:—

> "That the system for treating the sewage of this city by precipitation, having been in use since the 30th of April, 1874 (a period of nearly three years), this council is well satisfied with its success, and that the same be certified under the common seal, and given to the Rivers Purification Association (Limited), with a statement appended thereto, that this council have entered into a contract with them to continue to carry on the said system of purifying the sewage of this city, in consideration of an adequate annual subsidy to the said association."

The association here referred to has been formed for the purpose of carrying out the requirements of the Rivers Pollution Act by the best known methods. They have acquired the recent and original patents for the Coventry system. These works have also, during the past year, been under the investigation of the committee appointed by the Local Government Board in 1875, to inquire into the various modes of treating town sewage, and at page 46 of their report, a full account of the works and process is given. In addition to the information hitherto published, the following cost of the process at Coventry may prove of value.

The chemicals used per day are as follows:—

	tons.	cwts.	qrs.	lbs.
Crude sulphate of alumina manufactured on the works[*]	2	0	0	0
Lime	0	10	0	0

The cost of these ingredients is £3 8s.; or 34s. for one million gallons of sewage. The sewage of Coventry containing a great amount of dye, requires a larger proportion of materials to purify it than would be wanted in cases where manufacturing refuse is absent. The cost in these cases would be considerably reduced, according to the quality of the sewage, and the quantity of land available as an auxiliary to the process. The cost of the whole undertaking, inclusive of rent of land, interest on capital expended on works, management, labour and materials, for the months of August, September, October, 1876, as taken from the books kept at the works, is as follows:—

	£	s.	d.
Coal	115	9	10
Sulphate of alumina	218	12	6
Lime	27	9	8
Labour on works and filter beds	218	16	6
Incidental expenses, repairs, &c.	68	5	1
Rent of land for works and filter beds	13	0	0
Interest at 5 per cent. on £12,000, cost of works	150	0	0
Cost of management	50	0	0
Total for three months	861	13	7

From this it appears that the entire annual cost, exclusive of any proceeds from sale of manure, is £3,446 14s. 4d., or £4 14s. per million gallons, or 1s. 8½d.[†] per head of the population. This cost it has been ascertained would be much less where no manufacturing sewage is dealt with. If the market value of the manure (as fixed by Dr. Voelcker, in the recent report of the Local Government Board, pages lx. to lxiii.) is realised, the cost would be reduced as follows:—

	£	s.	d.
Annual cost	3,446	0	0
Receipts from manure	832	0	0
Loss per annum	2,614	0	0

Various methods of dealing with the sludge have been tried at Coventry works, and at Nuneaton, during the last five years. Drying it upon kiln floors was found to give off offensive odours when it became over dry and burnt. Mixing it with various absorbent materials, such as dry ashes, plaster of Paris, lime, &c., were tried. It was, however, proved that the enormous bulk of material, and the heavy cost of labour required for such a purpose on a large scale, rendered these methods impracticable. Trials of various methods of pressing and straining proved that the sludge required to be manipulated in such small quantities at a time that no plan of this kind was successful. Straining it through flannel and sugar bags was tried to a considerable extent, but was found to be too costly for employment on a large scale. It was converted into fuel by the admixture of slack coal. The odours, however, arising from the combustion of the fuel so produced were objectionable. It was converted into gas, and at one time a portion of the Coventry works was lighted with it; but, although its heating power was considerable, its illuminating power was weak. After these and various other experiments, the best mode of dealing with the sludge was ultimately proved to be as follows:—

The daily amount of sludge being about 25 tons, containing 85 per cent. of mixture, is reduced to about seven tons, containing about 60 per cent. of mixture; when reduced to a portable condition it is disposed of in three ways:—1. In a dry powdered state as a manure, the theoretical value of which is about 35s. per ton according to Dr. Voelcker's analysis. 2. After drying, by the admixture of phosphate of lime and other fertilising agents, so as to form an artificial or fortified sewage manure at an average chemical value of £4 to £5 per ton. 3. In a semi-dry condition for manuring grass and arable lands.

In this latter condition a farmer is the gainer in purchasing it instead of farm-yard manure, as in comparison with that article it is worth slightly more, and is not quite so bulky to carry. This is shown by Dr. Voelcker in his report for the Committee of the Local Government Board in 1876.

The sale of a manure of so low a value as that from water-carried sewage, will, however, be slow and uncertain, and in the first instance but little consideration should be bestowed upon it as a source of revenue or profit.

It may be interesting to record that treatment of the sewage of Coventry by lime alone has been tried upon the present works, and that the results were sufficient to show that for sewage of such a quality simple lime treatment is not sufficient. From the lime treatment, the sludge increased in quantity and was offensive in character. The effluent water also caused the filter beds to become offensive, which plainly indicated that the addition of some other chemical for the defecation of the sewage is necessary. I think, after considerable experience, that the real value of an efficient chemical process for treatment of sewage is for use in combination with a small area of land whereby the sewage is first defecated and then filtered. It, in fact, assists the land difficulty, by rendering a smaller area sufficient than is required for irrigation *per se*, the extent to which chemical treatment is carried being governed by the amount of land which is available as an auxiliary for filtering the effluent water.

TWENTY-FOURTH ORDINARY MEETING.

Wednesday, May 23rd, 1877; WILLIAM POLE, F.R.S., Mus. Doc. Oxon., in the chair.

The following candidates were proposed for election as members of the Society:—

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[*] This is dissolved in water, the solution only being allowed to pass into the sewage, the solid residuum to the extent of two-fifths of the weight being removed by subsidence.

[†] Care should be taken in using these figures for other places, as they include cost of works, and cost of management, neither of which increase or decrease in direct proportion, and also include cost of chemicals necessary to deal with manufacturing refuse, where nine acres of land only are employed for filtration.

Alford, Henry William, 2, Southampton-buildings, Chancery-lane, W C.
Howard, James, Bedford.
Insole, James Harvey, Ely-court, Llandaff.
McNaught, James Aldren, Worcester.
Shirley, Lionel H., F.R.G.S., 2, Storey's-gate, Westminster, S.W.
Smith, George Belk, 11, Melbourne-place, Bradford, Yorkshire.

The following candidates were balloted for, and duly elected members of the Society:—

Bromley, Massey, Great Eastern Railway Company, Stratford, E.
Emery, F. J., Burslem, Staffordshire.
Stroudley, William, London, Brighton, and South Coast Railway Company, Brighton.

The paper read was—

ON THE MEASUREMENT AND SETTLEMENT OF MUSICAL PITCH.

By Alexander J. Ellis, B.A., F.R.S.

I.—*Work of the Society of Arts on Musical Pitch.*

The question of musical pitch has engaged a large share of the attention of the Society of Arts. After the French Commission had been appointed on 17th July, 1858, and its report, in favour of a lowered pitch, had been followed by an Imperial decree, dated 16th Feb., 1859, for adopting the pitch recommended,* the Society of Arts took the important step of calling together a large committee of musicians, instrument makers, men of science, and amateurs, on 3rd June, 1859, to consider the state of musical pitch in England. This committee issued a report, printed in the *Journal of the Society of Arts*, for 8th June, 1860, recommending a pitch slightly higher than that of the French Commission. This report was adopted, after much discussion at a special meeting of the Society, and a fork was ordered to be prepared representing that pitch. Of the forks issued by the French Commission and the Society of Arts I shall have to speak fully hereafter. In the *Journal of the Society of Arts*, for 23rd November, 1860, there is a declaration signed by 45 musicians, singers, physicists, and amateurs, pledging themselves to use the fork issued by the Society.

On the 21st January, 1869, the Society of Arts, through its secretary, applied to the Secretary of State for Foreign Affairs to obtain information respecting the musical pitch used on the Continent, and sent three queries with a list of places from which it was thought desirable to obtain information. The consequence was, a series of reports from the English consuls or ministers, or the Foreign authorities, at Copenhagen, Leipzic, Munich, Dresden, Stuttgart, Vienna, Baden, Berlin, Cologne, Florence, Bologna, Milan, Venice, Stockholm, and Brussels, which were printed in October, 1869. These reports were in several instances accompanied by forks. The Society of Arts kindly placed at my disposal for examination and measurement the forks thus obtained, including one from St. Petersburg, without any report, and also the two forks made for the Society by the late Mr. J. H. Griesbach. I thought it, therefore, incumbent upon me to make a report to the Society upon these forks, and considered it advisable, in doing so, to take up the whole subject of the measurement and settlement of musical pitch, and to embody in my report such information and results as I had already obtained. Such is the origin of the present paper, and the reason why it has been laid before the Society of Arts.

II.—*The Principal Physical Properties of Musical Tones on which Measurement of Pitch depends.*

In order to understand the precise bearings of the question, it is necessary to recall a few points of physical and physiological acoustics, which are important for the measurement of pitch.

Nature of Musical Tones.—Sound is a sensation created by the vibration of the air, which, striking the drumskin of the ear, is conveyed by means of the little bones within the drum itself, known from their shapes as the hammer, anvil, and stirrup, to a membrane which covers what is known as the "oval window" of the internal ear, and thence to the watery fluid contained in it, and to the terminations of the auditory nerve, which are immersed in that fluid. When such a vibration is periodic, the effect is musical. But in that case the vibration may be of two kinds, first, simple or pendular, so called because it precisely resembles the motion of a clock pendulum, and second, compound, so called because every such form of vibration may be mathematically represented as the sum of a series of simple vibrations. Now Helmholtz showed, in 1862, that to each kind of vibration belonged a different kind of musical tone, distinguished as simple and compound. The simple tone is heard when a tuning fork is held over a proper resonance chamber. The compound tone, or musical note, is any ordinary musical note, which the ear analyses into the separate simple tones due to the simple pendular vibrations out of which the compound vibration is composed, to which the musical note is due. The component simple tones are called "partials" of the original note, and must be distinguished from harmonics, which are not simple tones. To their various degrees of loudness is due the sensation of quality of tone.

Sensation and Expression of Pitch.—The number of compound vibrations in a second, which cause the sensation of a musical note, is the same as that of its lowest partial tone, and it is most convenient to call this number the "pitch" of the note, because the sensation of sharpening or flattening is found to be due to an increase or decrease of this number. In counting a pendulum we generally count each swing to and fro separately, because they are perfectly uniform and are made in the same time. But in a compound vibration the motion one way is very different both in time and character from the motion the other way, although the whole motion to and fro is always made in the same time. Hence it is best to follow the old English custom of counting double vibrations, or the motions to and fro, in one second, and I shall henceforth uniformly mean by the pitch of any particular note, the number of double vibrations in a second to which it is due. In France, however, it is customary to count single vibrations, and hence their numbers are the doubles of ours. Thus, the French Commission recommended, and the Imperial decree settled that the "pitch" of the A of the open violin string should be 870, meaning single vibrations. Such a pitch will always be called A 435 in this paper, meaning the note called A and produced by 435 double vibrations. But it will be seen that the French Commission did not succeed in making such a fork, but that the French normal is A 439. (See note 16.)

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* (1) See translation of the report and decree in the *Journal of the Society of Arts*, for 3rd June, 1859.

It should be remembered, however, that though we speak of pitch as an absolute number, the sensation of sameness or difference of pitch, when two notes are struck in rapid succession, does not depend solely upon the pitch numbers, but is also influenced by relative loudness and duration, and especially by quality of tone. All these being the same, however, no ear can detect a difference of pitch amounting to one vibration in five seconds at any high or low pitch, and at very high and low pitches the best powers of discrimination are often much more widely at fault. Again, since the memory for pitch is very weak except in rare cases (see note 20), and since the power of determining whether two notes struck in succession are the same or different, and which is the sharper, also materially depends on the length of time elapsing between the hearing of the two notes, it becomes extremely important to have a means of fixing pitch.

Mode of Fixing Pitch.—The mechanical conditions for strict fixity of pitch are difficult to fulfil. No string, tuned up, will maintain its pitch for long, even if left untouched, owing to differences of temperature (see note 2), and every time it is plucked, or bowed, or struck, the pitch slightly alters. An harmonium reed is also variable according to the force of the wind, so that a uniform blast is required. For a long while past the tuning-fork has been adopted, and if its temperature is kept uniform, so that it is not fingered or carried next the body, or if so, is allowed to cool before trying, and if it is not struck too violently and so on, it answers its purpose as a record very well (see note 5). It is easily brought into tolerable unison with a given note, unless the quality of tone be very different, but care must be taken to compare any copy with the original fork after the lapse of a week, if possible, because the filing necessary to tune the copy so much alters the temperature and disturbs the molecular condition of the fork, that it "sets" to a somewhat different pitch.

Sensation and Expression of Interval.—The sensation of interval between two notes is not due to the difference, but to the ratio, of their pitches. It is best measured by a fraction of which the numerator is the higher or larger pitch, and the denominator the lower or small; or else by an expression in the form of a ratio with the lower pitch placed first. Thus if the two pitches be A 439. C 522, then the interval is 439 : 522, or else $\frac{522}{439}$. As, however, it is difficult to see the relative sharpness of such fractions, they should be reduced to a decimal form with at least four decimal places. For accurate purposes six decimal places are necessary. Thus the last interval is 1·1891 or 1·189066. But such numbers have to be multiplied when we feel that we are only adding the sensation of one pitch to that of another, and divided when we feel that we have only subtracted the sensations. For this purpose another mode of representing pitch is necessary. The pianoforte shows us an octave divided sensibly into twelve equal parts, called equal semitones. It is easy to calculate what the pitch of each of these must be if the pitch of the lowest is taken to be one vibration in a small fraction of a second. And then the pitch of the hundredth part of this may be calculated. The reduction of an interval expressed as a fraction to the form of a number of semitones and hundredths of a given semitone, and conversely, is rendered easy by Table III. in the Appendix. The interval may be expressed with tolerable correctness, even when the absolute numbers of vibrations are unknown, by means of a monochord. It was long known that the rapidity of vibration of a string under constant tension was inversely proportional to the length of the string; that is to say, that if we halved the length of the string, we doubled the number of its vibrations, when the stretching power remained the same. To this we owe all power of playing on the violin, and also all knowledge of the relative pitch of the notes in the Greek and Arabic scales, for which the corresponding relative lengths of the string were given by Euclid, the mathematician, in the fourth century, B.C., and Abdul Kadir, the Persian theorist of the fourteenth century, A.D. Even now a far better notion of the interval between two tones can be obtained by the monochord than by the common vague estimation of ear. I find that musicians are apt to call all intervals less than a semitone, a quarter tone. This confuses everything. Suppose that by a moveable bridge we limited the vibrating length of a string till, on being plucked, it produced a tone sensibly the same as a given tone. Say that the length of the string were 1,256 hundredths of an inch, as nearly as could be measured. Then determine 1,200 hundredths of an inch as the length of the same string when in unison with another fork. The interval between the forks will be $\frac{1256}{1200} = 1{\cdot}0467$, which gives ·79 equal semitones, that is more than $\frac{3}{4}$ semitone. (See Table III.) Of course there would be many sources of error. The sharp "twang" of the string, and gentle "coo" of the fork, are qualities of tone so different, that the ear has great difficulty in deciding on the identity of their pitch. The distance of the hundredth of an inch is difficult to measure. As the string or wire bends over a bridge it is difficult to determine the exact boundaries of the vibrating parts of the string, and the parts of the string beyond the bridge necessarily also vibrate, and though they do not produce a sensible tone, they affect the vibrations of the freely vibrating portions. The process also requires a well-educated musical ear.* Yet this is the readiest way to approximate to an interval, as a piece of thin twine stretched between two nails, and limited by a rude bridge, might be used for the purpose. Also if the absolute pitch of one fork were known, a very decent approximation to the pitch of the other could be obtained. Thus, in the example quoted, the 1,256 hundredths of an inch gave a note which has been otherwise determined to have 522 vibrations. Then the proportion 1,200 : 1,256 = 522 : 522 × 1,256 ÷ 1,200 or 546·4, gives the approximate number of vibrations of the higher fork. (See a series of such determinations by Mr. Hipkins in note 3.)

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* (2.) Scheibler in his "Tonmesser" (pp. 1-3) sums up his long experience with a monochord, thus:—"Had it been possible to obtain exact results with a monochord, I could not but have succeeded, during the many years that I devoted to it, in tuning the forks of my scale correctly, as deduced immediately from A. My ear, and those of all others, were satisfied with the purity of the notes on instruments tuned by my monochord forks. But my mind would not be satisfied, because my results were not constant. When, for example, one monochord showed me that a certain fork was one stroke of the pendulum [not necessarily a seconds pendulum] too sharp, another monochord gave it as too flat. That was not what I had been seeking for years. I became convinced that a mathematical monochord could not be constructed. I had also discovered

Nature and Laws of Beats.—Another very important physical fact must be noticed. When two simple tones do not differ widely from each other, they "beat;" that is, the musical tone splits up into a series of sharp distinct sounds separated by silences, and when these beats do not exceed six in a second, they can be counted with tolerable ease. Now the number of beats in a second is precisely equal to the difference of the pitch of the two notes, as can be established by physical reasoning. Thus if the two forks vibrated 522 and 546·4 times in a second, they would beat 24·4 times in a second. This produces a strong rattle which cannot be counted; but if five other forks were tuned, having intermediate pitches, and beating about four times in a second with their neighbours on either side, the beats could be counted to about 1 in 10 seconds, and then by adding all together, we could obtain the whole number of beats between the extremes.

Beats of Compound Tones.—The beats I have hitherto spoken of are those of simple tones, in which case alone the beats are separated by silences. Now suppose two notes or compound tones to beat together with all their partials. The lowest partials beating suppose four times in a second, the next partials will beat eight, the next nine, the next ten times in a second, and so on. The beats will, therefore, all corroborate each other at every fourth part of a second, but between them there will be a running fire of beats, destroying the effect of the silence, as may be seen by the following arrangement, where 1 represents the beat of the first or lowest partial occurring once every quarter of a second, and 2, 3, 4, represents the beats of the 2nd, 3rd, and 4th partials occurring every 8th, 12th, and 16th part of a second. It must be recollected that the beats of the 2nd, 3rd, and 4th partials diminish much in intensity, so that the reinforced beats are much the most conspicuous.

1 1 1
2 2 2 2 2
3 3 3 3 3 3 3
4 4 4 4 4 4 4 4 4

If the interval between two beats is considerable, many of their partials will not beat, and others will. If the intervals are those known as $\frac{2}{1}$ the octave, $\frac{3}{2}$ the Fifth, $\frac{4}{3}$ the Fourth, $\frac{5}{4}$ the major Third, $\frac{6}{5}$ the minor Third, $\frac{5}{3}$ the major Sixth, $\frac{8}{5}$ the minor Sixth, there are no beats slow enough to be counted. But if one of the tones be slightly altered, slow beats immediately arise, showing mechanically that the interval is imperfect. These are called "dissident beats," and are of great value in Appunn's method of obtaining absolute pitch, as explained hereafter.

III.—*Musical Notation gives only Relative Pitch which has to be determined absolutely by Systems of Tuning and a Standard Pitch.*

The importance of ascertaining absolute pitch depends upon the fact that the human voice of any class, and any artificial instrument, at any time, is capable of producing tones within a certain limited interval only, of which the extremes are bounded by an absolute pitch in every individual case. But the written notes of music indicate only relative pitch, or interval, and not absolute pitch at all. What the relative pitch may be depends upon the style of tuning used, of which it is necessary to consider only three, the just, the old or meantone, and the new or equal tuning or temperament. The just is used at present only by unaccompanied singers, and is characterised by producing all the intervals recently named in accordance with the fractions written against them. The old tuning and the new both alter some or all of these intervals, but in different ways, in order to facilitate performances on the organ, pianoforte, and harmonium, but they thereby produce dissident beats, which are sometimes very offensive. For the purposes of tuning, and of calculating pitch, it is necessary to know the relations which are intended to be produced throughout the scale. These relations are given in Table I. of Appendix, for each note of of the major scale in the just, old and new tuning, supposing C to be 10,000. Pianoforte and organ tuners generally tune from C, but violinists. and many conductors of orchestras, use A. Dr. Robert Smith, master of Trinity College, Cambridge, 1759, and author of a celebrated treatise on "Harmonics," tuned from D. Calling these the C, A, and D "standards," respectively, the problems before us are to determine, first what was and is the standard pitch of these notes at different times and places, and secondly, what should guide us at any time in the section of such a standard pitch.

From Table I. we see that if we attempt to derive one standard from another, by calculation, we must be particularly careful as to the tuning which we select, and must on no account select the just tuning, which is not at present in use for organs and pianofortes. For example:—

A 440 gives just C 528, old C 526·3, new C 523·25.
C 264 gives just A 440, old A 441·4, new A 444.

These results differ by a large number of vibrations. Now, in the report of the committee appointed by the Society of Arts, already mentioned, it was inadvertently assumed that just tuning was generally adopted, and hence that A 440 would give C 528. Partly in consequence of that view, the pitch C 528 was recommended for adoption. But in 1869, when the report was issued, the new tuning was generally adopted in England, and hence A 440 and C 528 were incompatible numbers, and the Society of Arts, in adopting C 528,

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that the string could not be protected from the warmth radiated from the observer's body, even when it was so thoroughly covered with slides that there was only just space enough left for striking it. The string of a monochord, from this cause, does not remain for 30 seconds at the same pitch, but varies constantly by one-tenth to one-half of a double vibration." And on p. 25, he says of Sarty's measurement to the St. Petersburgh pitch:—"His investigation was based on the monochord, which is not to be trusted to 5 (double) vibrations." Dr. W. H. Stone has shown that by passing an electric current through the string of a monochord its pitch can be lowered by at least an octave. I had an opportunity of seeing this experiment.

actually adopted A 444, a pitch considerably sharper than they intended. Scheibler himself used the new tuning, and in his own work ("Der Tonmesser," 1834) makes A 440 give C 523¼. It so happened that the forks actually constructed for the Society were very much sharper still, giving C 539·4 and A 449·6, so that, instead of adopting a mean between the arithmetical pitch C 512 and the French, taken as C 522, the Society's pitch is one of the sharpest in Europe (see Table IV.) Again, in presuming that the French pitch was C 522, the report quite unconsciously hit upon the exact number, for the real French pitch is A 439, which on the new tuning gives C 522. Whereas in the report the theoretical number A 435 was taken, and the C 522 was calculated as in the just tuning; the new tuning giving C 517·3.

The new tuning was proposed for English use (it had long been known theoretically) by Mr. James Shudi Broadwood, in the *Monthly Magazine* in 1811, and stated to be used by himself. Dr. Crotch, in the appendix to his "Elements of Composition" in 1812 (p. 134), said that that tuning "will upon the whole be least offensive to the ear," adding a table by which it could be tuned from a monochord, showing its precise nature, but not stating that he used it himself. Possibly several tuners during the next 30 years aimed at producing it with more or less success—generally with very ill success—but most of them tuned "flattering scales," that is, did not tune equally, but favoured certain keys, and came on the whole nearest to the old tuning. And this old tuning was used exclusively by Messrs. Broadwood and Sons, in their pianofortes, down to 1840. In 1841, the new tuning was partially, and from 1844 to 1846 universally, introduced into their manufactory, and since 1846 this new tuning has been consistently used for all their pianofortes. In the Great Exhibition of 1851, only one organ, a German organ by Schulze, was tuned on the new plan, all the others were in the old tuning. I am indebted for these interesting facts to Mr. Hipkins, of Messrs. Broadwood and Son's establishment, who himself introduced the new tuning universally, under the direction of the firm, and who himself, with M. Fétis, examined the organs of 1851. Hence we may assume that in England the old tuning should be used for all calculations up to the year 1840, and the new tuning afterwards, but that abroad the new tuning probably prevailed much earlier, say in 1820, although it was partially used 50 to 100 years earlier. All our old music, however, especially our older ecclesiastical music, was due to the old tuning exclusively. Handel never heard any other. It is doubtful whether even John Sebastian Bach, to whom the idea is attributed on account of his book of preludes, published in 1799, long after his death, ever really used it; certainly his organ maker, Silbermann, used the old tuning exclusively. It is quite within the memory of living men that all church organs were so tuned. Even now the old tuning is in use at St. George's Chapel, Windsor, and Turvey Abbey (according to Mr. Bosanquet, in his work on "Temperament"), and Norwich Cathedral (according to a letter written in 1877, by Dr. Buck to Mr. Hipkins). Hampton-court organ was altered only about six years ago, and St. George's-hall, Liverpool, did not adopt the new tuning till 1867.

IV—*Modes of Measuring Musical Pitch.*

Measurement of Pitch by Beats and a Monochord.—The following method is, so far as I know, explained here for the first time. Suppose we had two notes of unknown pitch—which we will call x and y—which were 24·4 beats apart, counted by means of intermediate forks as already suggested (so that $y = x + 24{\cdot}4$), and which corresponded to the lengths 1,200 and 1,256 hundredths of an inch, so that $x : x + 24{\cdot}4 = 1{,}200 : 1{,}256$. Then we easily find that $x = 1{,}200 \times 24{\cdot}4 \div 56$; that is, that the lower pitch is the number of beats, multiplied by the smaller length of string and divided by the difference of the lengths of the string. This would make $x = 522{\cdot}9$. But, supposing that the number of beats had been 24·36, which is ·04 less than before, then we should have found that $1{,}200 \times 24{\cdot}36 \div 56$ would give 522; so that a difference of ·04, or 1 beat in 25 seconds, in the determination of the number of beats, which is far less than any probable error that would be made, would make a difference of ·9 vibration, or nearly 1 vibration, in the measured pitch. Such results, joined to the difficulties of measuring the string and determining the unisons between the string and the forks, suffice to make this method quite impracticable, although it is theoretically perfect, and its principles can be conveniently applied in the verification of Appunn's tonometer.

Direct Physical Method of Measurement.—The direct physical method is subject to inconveniences of a similar nature. It consists in tuning a string to a given note, or some octave of it, and determining its vibrations from knowing the stretching weight, the weight of the wire as stretched, and the vibrating length of the string. The formula usually adopted is the following:—

Let V = pitch, or number of double vibrations in 1 sec.
W = number of grains in the stretching weight.
S = number of grains in one inch length of the vibrating string when stretched.
L = number of inches in the vibrating string.
SL therefore = the weight of the vibrating string, and if it is cut off, weighed and measured, L, SL, and thence S are determined.
π = ratio of circumference to diameter of circle = 3·14159 . . .
P = number of inches in the seconds pendulum at the place of observation = 39·1393 at Greenwich.

$$\text{Then } V = \frac{\pi}{2} \sqrt{\left\{\frac{W}{SL} \times \frac{P}{L}\right\}}$$

or in the two most convenient forms for calculation.

$$2 \log V = 1{\cdot}984\,8528 + \log W - (\log SL + \log L)$$
$$\text{and } \log V = {\cdot}992\,4264 + \tfrac{1}{2}(\log W - \log S) - \log L.$$

In using the first of these forms, the string or wire should be suspended, the upper part being wrapped round the violin peg, and the lower end lapped round the handle of a weight. The string is brought into sensible unison with the note by shortening or lengthening the wire by turning the peg. Then the wire is cut opposite to the centre of the peg, and of the ring of the weight. The cut wire is carefully measured for L to ·01 inch, and weighed for SL to ·1 grain, and the weight attached together with the part of the wire left wrapped round the weight for W. In Dr. Smith's case L = 35·55, SL = 31, W = 49000, whence log V

$= 1·8164238$, $V = 65·527$. He had tuned his wire by ear to give a note two octaves below the D pipe of the organ of Trinity College, Cambridge, about A.D. 1755, in the month of September, with the thermometer at temperate. Multiplying by 4, this gives 262·108, or as Dr. Smith (who uses a smaller value for the length of the pendulum) takes it, D 262, giving mean-tone C 468·7, obtained by Table I. This is more than a whole tone below the usual pitch now used. But observe the great number of chances of error, in measuring and weighing, which must be done very accurately indeed, and in estimating the agreement of a note as low as that of the lowest string of a violoncello, with another two octaves above it, while, at the same time, every error was increased fourfold. Thus if the weight of the string had been 30 grains in place of 31, the pitch would have been 266·44 in place of 262·1.

When the tension has been unaltered for many trials, and the length of a horizontal string is limited by a movable bridge, the second form for V is most convenient, but this mode of experimenting is very liable to error, from the difficulty of ascertaining the real stretching weight, the weight of the stretched wire per inch, and exact length of the vibrating portions, and estimating the effect of friction and the action of the vibrations of the parts beyond the bridges. In a series of cases which I calculated out, I found my results very good when 36¾ inches of stretched wire were assumed to be 83 grains, the weight of a measured yard of unstretched wire of the same kind as that of which the monochord had been made. But Dr. Pole, who had calculated these cases also, got results differing by seven vibrations from mine, apparently by weighing the 36¾ inches of wire as 85¼ grains. The formula, therefore, must be considered merely as a first rude approximation. If however, we really know the pitch of one fork accurately, = H, and the length of the string in unison with it = K, then the formula gives $V L = H K$, and V can be found with a very fair amount of correctness.[*] But the great difficulty is to find a single absolute pitch with perfect accuracy. And many mistakes have arisen from considering the French normal to be A 435, as it was intended to be, instead of A 439, as it really is. (See note 16.)

Griesbach's Method of Measurement by Perforations.—Mr. J. H. Griesbach invented a recording system. A very thick gut-string stretched on a double bass body, was tuned to two octaves below the fork to be measured, by stopping off the harmonic of the string. Then a fine point being attached to one part of the string, a slip of paper of considerable length was passed over it, at a certain measured length and at a uniform velocity, and in passing was pricked by the point at every double vibration of the string. Then the holes were counted, and thus the number per second discovered, and on multiplying the result by four, the pitch of the original fork was approximately determined. It appears that Mr. Griesbach's system gave results too small by about ten vibrations per second, but considering the large number of sources of error, we can only be surprised at the accuracy of the results he obtained. It had however the effect of making the fork of the Society of Arts more than 11 vibrations, or 37 hundredths of a semitone too sharp, because it measured the actual vibrations too little by that amount. The whole machine was elaborate, required careful manipulation, and a good musical ear, and was hence defective in the mechanical elements.

Measurement by the Siren.—The Siren, invented in 1819 by Cagniard de la Tour, was hoped to be a complete success. In this, air is driven from bellows through a fixed plate, pierced with a circle of 12 holes cut obliquely, over which revolves a loose plate containing also 12 holes cut obliquely, but in the opposite direction. Hence, the wind passing through the first holes into the second, causes the upper plate to revolve rapidly, while, the under holes being closed as the unperforated parts of the upper plate pass over them, the air passes in a series of separate puffs, 12 for each revolution of the disk. By increasing the pressure of the wind, as many as 50 or 60 rotations in a second can be produced, giving 600 to 720 puffs, each of which institutes a vibration and a consequent wave, reaching the ear as a very compound musical note. We have, therefore, a series of notes gradually increasing in pitch from very low to higher than any known standard pitch. A note being sounded, the pitch of the siren is increased till it is apparently in unison with the note, then the wind is cut off by a special valve, but the upper disk continues to revolve uniformly, and by an attached counter the number of revolutions in a minute is read off. The siren is subject to numerous errors. In the first place the quality of tone is so peculiar that it is very difficult to determine whether it is in unison with any other note. This difficulty is increased by the rapid, uniform, but continuous sharpening of the pitch, which does not leave the ear sufficient time to make the comparison. Then as each revolution of the disc reckons as 12 vibrations, an error of one revolution in a second, which is easily made, vitiates the result by 12 vibrations, or ·4 semitone at the pitch of C, which is a large amount. Practically, a siren cannot be depended on within 10 vibrations. Thus, Mr. Hullah's fork intended to be C 512, was really 529·3, but was counted as 512 by the siren, the error being 17·3 vibrations or ·58 semitones.

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[*] (3.) These numbers may be worth preserving. In the following table, the column headed fork gives the names of the forks as referred to in the table to the appendix. The column headed inches, gives the inches and hundredths of an inch in the length of the monochord in unison with the fork, as determined by Mr. Hipkins. The column French, gives the corresponding pitches on the assumption that No. 5 gave C 522, corresponding to the French Normal A 439. The column physical, gives the pitch as obtained from the physical formula, taking the weight of 36¾ inches of stretched wire (No. 17·5) at 83 grains, and the stretching weight at 143·6 lbs. The column Pole, gives the pitch determined by Dr. Pole, which agrees with the supposition that 36¾ inches of stretched wire weighed 85¼ grains. The column Appunn gives the pitches as measured by Mr. Hipkins and myself with Appunn's tonometer.

No.	Fork.	Inches.	French	Physical.	Pole.	Appunn.
1	Covent-garden Opera .	12·00	546·4	546·2	539	fork lost
2	Broadwood's Philh., 1859	12·06	543·5	643·5		542·5
3	Society of Arts (Hipkins)	12·20	537·4	537·3		537·5
4	Broadwood's Medium	12·28	533·9	533·8		534·9
5	French Normal	12·56	522	521·9	515	522·06
6	Broadwood's Vocal ...	12·59	520·8	520·7		521·2
7	Peppercorn's Philh., 1813	12·82	511·4	511·3		510·8
8	Father Schmidt's	13·68	479·3	479·3		478·8

Scheibler's Tuning Fork Tonometer.—The first person who seems to have hit upon a practical method of obtaining exact measurement was Heinrich Scheibler, a silk manufacturer, at Crefeld, near Düsseldorf, who devoted many years of his life to the invention of methods for tuning properly.[*] The method pursued amounted to the following, although Scheibler himself did not so conceive it. If we strike a tuning fork and its octave together, and hold them both over their own proper resonance chambers, we shall hear no beat, even if they are out of tune. But if they are applied to a sounding-board, a beat may be heard between the second partial of the lower fork, and the lowest partial of the upper fork. And if both forks be held over the resonance chamber of the upper fork, the beat is heard more distinctly. Counting the number of beats in a second, they give the difference between the number of vibrations of the upper fork, and double the number of the second. Suppose the forks P, Q, of which Q is nearly an octave above P, when sounded together, beat n times in a second, where n is less than 4, then n will be the difference between the number of vibrations in Q, and twice those in P. But the beats do not tell us whether Q is too sharp or too flat. To discover this, tune a third fork R sharper than Q and making 4 beats in a second with it. Try the beats of P and R. If they are $n + 4$, then Q was too flat; but, if they are $4 - n$, then Q was too sharp. Using P, Q, R to represent the pitches of these notes, we have, when Q is too flat, $2P = Q + n$, and, when Q is too sharp, $2P = Q - n$. Then interpose between P and Q (which I will suppose to be too flat) so many tuning-forks that each beats with its neighbour, or with P or Q, either four times in a second or less. Suppose the sum of those beats to be m. Then $Q = P + m$, and, since $2P = Q + n$, we have $P = m + n$; so that the number of vibrations is the sum of all the beats heard, including those with the imperfect octave. But, when P is known, the pitch of all the intermediate forks is also known. In Scheibler's case, he tuned Q so as to make no beats with 2P; so that $Q = 2P$, $n = 0$, and $P = m$. He then constructed 52 forks, and found $P = 219\frac{2}{3}$, $Q = 439\frac{1}{3}$, and the pitch of the intermediate forks was regulated so as to include the complete equally-tempered scale. In this case P was A on the second ledger-line below the treble staff, and Q was the usual A of the open string of a violin. Scheibler subsequently adopted 440 in place of $439\frac{1}{3}$, for his A. So accurately did he work that he states that, on the 12 last countings of the beats throughout an octave, the results did not differ by one-eighth of a vibration in a second. Having this scale complete, he had only to sound another fork beside these in turn, to determine, by counting the beats, between which two it lay, and by how many vibrations it was sharper than one and flatter than the other, the exact pitch of each of which was known. The solution was very complete, very simple, and easily applicable. But the workmanship had to be extremely accurate[*]; and the difficulty of proving the work was very great, because as tuning-forks scarcely admit of the determination of beats, except in unisons and octaves, it was necessary to count all the beats in the octave. His results are probably the best which have been obtained, and all his measurements will be included in Table IV. of the Appendix to this paper. But his instrument was unwieldy, difficult to maintain in order, and very expensive.[†] It had however, several advantages as a standard to measure other forks by. I find it very convenient to have a set of C forks and A forks, differing by four vibrations in a second, even when not made with such painful accuracy as Scheibler's. They enable me to obtain, in a minute or two, a more accurate notion of the pitch of any standard fork than was possible lately by the most refined instruments. The error will generally be less than half a vibration. They are cheap, being merely ordinary forks retuned, and the whole 20 forks are easily carried in the pocket, ready for use at any moment. They were made for me by Mr. Greaves, of 76, Milton-street, Sheffield, and I commend them to the attention of all who are interested in this subject.* But, in order to make them, Mr. Greaves had to get a standard fork. This he accomplished by means of the following beautiful instrument.

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[*] (4.) See his book entitled, "Der physikalische und musikalische Tonmesser. welcher durch den Pendel, dem Auge sichtbar, die absoluten Vibrationen der Töne, der Haupt-Gattungen von Combinations-Tönen, so wie die schärfste genauigkeit gleichschwebender und mathematischer Accorde beweist." Essen, 1834, pp. 80 and 4 lithographic plates. (The physical and musical tonometer, which shows visibly to the eye, by means of the pendulum, the absolute vibrations of tones, and of the chief kinds of combinational tones, together with the most perfect exactness of equally-tempered and just chords.)

[*] (5.) The following extracts from his book are interesting and useful:—"The best tuning-forks are made of Hundsmann's English cast-steel. Forks of six lines (about half an inch) square, sound the best. The prongs must be parallel and equal; when they open out or contract they are bad, because they alter in pitch while sounding. The bend at the bottom must be wide enough to admit a file. They should be well polished, to avoid rusting, which injures the tone. A fork is bad and scarcely usable if it does not sound for 30 seconds, good ones sound for 50 to 80 seconds, and tolerable ones for 40. Each fork should be provided with a wooden handle, to avoid touching it with the hand; putting on a new handle slightly puts it out of tune. The stem must not be too thin, as this injures the tone; it should be cut with a screw to fit into handle, and a small projecting end should have a very correct screw to fit into the holder. The forks must not be flattened by making them thick at the point. The bend must not be filed away too deep or the tone will be injured. It is better to file a little above the bend. One stroke of the file at the bend will flatten more than four strokes at the tip will sharpen. Both prongs should not be fastened at once in the filing vice, for if the prongs are wrenched all tone is lost. The forks are not anealed. When filed out of the rough the tuner may help himself by dipping them in mercury. When they are very nearly right, make two or three strokes of the file at most, and wait three or four days before examining their correctness. Forks must not be struck too hard, because that destroys the uniformity of tone. The warmth of the hand will flatten a fork by half a (double) vibration. Strike the forks with a woollen pad rolled round and stitched to a piece of whalebone 18 inches long. A tonometer must not be made in a small or a heated room. The space should be large and the thermometer should stand at 68 degs to 72 degs. F, without fire. Low forks do best on a sounding board, high forks on a heavy piece of pine wood. The holder is furnished with a piece of copper, into which the forks can be screwed. When tuning the piano a small hole is bored into the bridge, which rests on the sounding board, and the end of holder inserted. The least touch then makes the fork sound for some time, and the piano will not be injured.'—"Tonmesser." pp. 46-49.

The safest and easiest way to try two tuning-forks is to hold them steadily over the mouth of a nearly cylindrical glass jar, which has been tuned to reinforce the tone of one of them to the utmost extent by pouring in a little water. The tones are then perfectly simple, and the beats clear and distinctly separated by silences. The same jar suits forks which differ by two commas, or even much more. If forks, especially high forks, be sounded in the usual way by having their handles pressed on a table, the beats cannot be nearly so well observed because the tones are no longer simple. If they are placed on the body of a violin, they give a good loud tone, but are much affected by the resonance of the air within, which is not in tune with them.

[†] (6.) Kaemmerling, a clock-maker and mechanician in Crefeld, in an advertisement dated October, 1833, at the end of Scheibler's "Tonmesser" (p. 80), professed to make a set at one dollar each, about £9 the set, but these, no doubt, were very much smaller forks, and made with very much less accuracy. Twelve years ago, I failed to obtain any forks from Kaemmerling's representatives Koenig, of Paris (30 Rue Hautefeuille), in his catalogue of 1865, offers a "Tonomètre,' d'après Scheibler ou série fondamentale de 65 diapasons échelonnés de 8 en 8 vibrations [simple vibrations are to be understood throughout] entre ut_3 = 512 vs. et ut_4 = 1,024 vs. Chaque diapason est monté sur sa caisse de résonnance et vibre assez long temps qu'on puisse compter les battements pendant une minute et demie. Pour compléter la gamme, on a dû ajouter encore le fa_3 et le la_3, qui tombent chacun entre deux termes de la série, ce qui porte à 67 le nombre des diapasons de la collection, 2000*fr.* [£80.]" With such an instrument, Koenig ought to furnish absolutely trustworthy forks. But, on measuring four of his five forks belonging to the Royal Institution, and marked "Ut_3 512VS. Mi_3 640VS. Sol_3 768VS. Ut 4 + 4 VD, 1032VS.," meaning C256, E320, G384, C516 in my notation, they were found to be C258·4, E323·1, G387·6, C521·1. The probable cause of these errors will be shown in note 16 on the correction of the French pitch. But they would have been impossible if the forks had been derived from a trustworthy tonometer of the nature described in his catalogue. (See also note 7.)

Appunn's Reed Tonometer.—Herr Georg Appunn, of Hanau, near Franckfurt-on-the-Main, Germany, exhibited his tonometer in the Loan Exhibition of Scientific Apparatus at South Kensington, last year, and I am happy to say that the South Kensington Museum has purchased it, and that another copy has been obtained, by means of Sir Charles Wheatstone's bequest, for the physical laboratory of King's College. Herr Appunn had the happy notion of substituting harmonium reeds for Scheibler's forks. These, although the springs of the reeds themselves are affected by temperature, yet, by a compensatory action, differ very slightly in the pitch of the note, even when exposed to air passing through freezing or boiling water, as has been well shown by Dr. W. H. Stone. For all ordinary temperatures the variation is imperceptible. The reed tone is peculiarly rich in upper partials, producing a strong, hard, and somewhat harsh sound, which is of a great service scientifically, because it perfectly discriminates all the consonances, allowing the slight error to be immediately detected by dissident beats. With tuning forks the only known method of determining consonances other than the octave, is an optical arrangement, by the so-called Lissajous figures, which were not known in Scheibler's time, and which require special arrangements and apparatus to obtain and observe. The arrangement of Appunn's instrument is as follows:—

Sixty-five reeds are arranged in a long rectangular box, and are excited by wind blown from bellows, to which a horizontal reservoir is attached, compressible by a spring, whence the air is driven into the upper part of the box containing the reeds, and enters another reservoir compressible by the weight of the lid of the box. By this means, after the lower reservoir has been filled, a steady blast, lasting about half-a-minute, is produced to excite the reed. It is absolutely necessary in these experiments that a constant blast should be used, and hence no observations should be made while pumping up wind, as otherwise there is a constant variation of pitch shown immediately by a variation of beat. The reeds each act in a separate hole, controlled by a "pull" (like a door bell-pull, consisting of an iron wire with a knob at the end), which opens a valve fully, or to any smaller amount. The reeds are tuned to give the note due to a complete opening of the valve, corresponding to drawing out the pull to its greatest extent. By pushing in the pull the note is flattened up to about $2\frac{1}{2}$ vibrations in a second; beyond this, the note become dull and unusable, or inaudible from lack of wind. The reeds are so tuned that each beats exactly four times in a second with either of the adjacent reeds. In the particular instrument shown at South Kensington, I verified this by careful counting with a chronometer through 20 seconds for each pair. The lowest reed is numbered 0, and the highest 64. Consequently, the highest is four times 64, or 256 vibrations sharper than the lowest. On sounding the lowest and highest reeds together, they were found to make a perfect octave. On flattening either the higher or lower reed separately, by partially pushing in either one of the pulls, dissident beats instantly arose, which would be made to disappear by partially pushing in the other reed. Hence the upper reed was the precise Octave above the lower, and made twice as many vibrations in a second. The difference of the numbers of vibrations being 256, as already shown, it followed that the lowest reed made 256 and the highest 512 vibrations in a second. This gave also the pitch of every one of the intermediate reeds. The result is, that the 65 reeds give the 64th to the 128th harmonic of an imaginary note making 4 vibrations in a second. I call it "imaginary," because less than 15 pendular vibrations in a second do not strike the ear as a simple tone. These numbers 64 to 128 enable us to form many examples of each of the ratios of the pitches of two tones, which it is interesting to examine, and, therefore, are very valuable in the investigation of consonance. The importance of this fact for the purposes of measuring pitch is, that it enables us, by sounding the two notes together, and determining the accuracy of the consonance (by the absence of dissident beats, and the immediate production of dissident beats by flattening either note separately, followed by their disappearance on flattening the other, as already explained for the octave), and then counting the sum of the beats between the intermediate reeds, to determine the absolute pitch of the two consonant notes. Thus, for example, finding that reeds 8 and 26 are an exact major Third, if the pitch of the lower be x, the pitch of the higher is $\frac{5}{4}x$. But the difference of 8 and 26 is 18, and hence the sum of the number of beats between them is $4 \times 18 = 72$, so that the higher pitch is $x + 72$, which, therefore, $= \frac{5}{4}x$, and this gives $x = 4 \times 72 = 288$, agreeing with its determination from the octave. I found that the upper partials were so distinct on these reeds that the sixteenth partial could be made effective in giving dissident beats, and hence in determining ratios. On calculating out the ratios furnished by the instrument, I found that there were 1 Octave, $\frac{2}{1}$; 11 Fifths, $\frac{3}{2}$; 11 Fourths, $\frac{4}{3}$; 10 major Thirds, $\frac{5}{4}$; 9 minor Thirds. $\frac{6}{5}$; 4 major Sixths, $\frac{5}{3}$; 4 minor Sixths, $\frac{8}{5}$; 7 major Tones, $\frac{9}{8}$; 5 minor Tones, $\frac{10}{9}$; 1 major Sevenths, $\frac{15}{8}$; 4 diatomic Semi-tones, $\frac{16}{15}$; 6 sub-minor Fifths, $\frac{7}{5}$; 4 super-major Thirds, $\frac{9}{7}$; 8 sub-minor Thirds, $\frac{7}{6}$; 1 super-major Sixth, $\frac{12}{7}$; 2 sub-minor Sixths. $\frac{14}{9}$; 3 sub-minor Sevenths, $\frac{7}{4}$; 7 super-Seconds, $\frac{8}{7}$; with other intervals not involving more than the 16th partial. Almost every one of the above intervals, and many more depending on the the primes 11, 13, 17, 19, I have tried, and in all cases found the interval correct.

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* (7) Mr. Greaves charged me at the rate of 1s. 6d a fork, or 15s. per each set of ten in a box I have a arranged with Mr Valentine (Mr. Greaves's successor) to make a set of larger forks with still greater care, and fit for scientific use at a cost of 3s. a fork He will also make a complete Scheibler series at the same rate. But for determining pitch it should be continued 9 steps higher, or up to C.548, making 74 forks in all.

On examination it will be found that these verify the pitch of almost every reed on the instrument. In fact, on confining attention to Octaves, Fifths, Fourths, major and minor Thirds, which are the easiest intervals to examine, only 20 reeds out of the 65 remain unverified.[*] But, curiously enough, disturbed consonances on this instrument enable us to verify the pitch for the two reeds on each side of those which make a consonance. For, if anyone of the consonances $\frac{2}{1}$, $\frac{3}{2}$, $\frac{4}{3}$ $\frac{5}{4}$ $\frac{6}{5}$, are disturbed by adding or subtracting four vibrations to each of the two notes making the consonance, we obtain a disturbed consonance which beats four times in a second. Thus, 256 and 384 are a perfect fifth, and do not beat; but 260 and 388, or 252 and 380, are disturbed Fifths, each of which beats four times. This can be made to give the pitch of the extremes by counting the intermediate beats.[†] This facilitates the preliminary examination of the instrument, necessary before making any precise measurements, to discover whether any of the reeds are out of order. The observer has merely to try each one of these intervals by sounding them, observing the absence of dissident beats, their appearance by flattening one note, and disappearance by flattening the other, and also the pairs of notes below and above each. If there is any fault he knows that one of two reeds is out of tune, and then he has to count the beats between those, and determine the absolute pitch of the extreme and intermediate reeds, as already shown. These newly determined pitches must then be employed in measurements of pitch, in place of those previously determined. The instrument is, therefore, perfectly verifiable and usable, even if out of tune. This is a most important peculiarity of this arrangement.

The exact pitch of every reed having been thus discovered from the instrument itself (see note 10), we proceed to use it thus. A given tuning fork, which we will suppose at first not to exceed the pitch 512, is sounded. Then different reeds are sounded, till it is found to beat not more than four times in a second with one. The ear readily becomes attuned to the rhythm of 4 in a second, but at first observe when the beats appear to begin to be numerable. Above 6 in a second they cannot be sufficiently counted, and below 1 they are unsafe to count. I am supposing that the observer has no "musical ear," that is, that he is not at all sensitive to musical intervals, but that he is able to hear and count beats. To count the beats with quite sufficient accuracy for the present purpose, a good watch with a seconds hand is sufficient. The reservoirs are filled with wind, and the beats are produced. No pumping must go on while the beats are counted. The first thing necessary is for the ear to get accustomed to their rhythm, without looking at the watch. Then attempt to strike down the finger at every fourth of the quick beats, and every second, or one, of the slower beats. As pupils learn to count time let the observer say mentally, not audibly, or he will fail, one-y, two-y, one-y, two-y, &c. Then, having started the beats well, look at the watch, and begin when the hand is on a long mark of the seconds, to place down a finger at each one, or each one-y, or each one-y two-y. This counts the number of these mechanically, the first figure representing 1, the middle finger 2, the next 3, the little finger 4, the straight thumb 5, the thumb and first finger 6, thumb and middle finger 7, &c., till the thumb comes again as 10, when it had better be well stretched apart from the other fingers, and for 15 be bent under the hand. This mechanical counting will be found very convenient, but the counter can also say one-y, lah-y, two-y, lah-y, three-y, lah-y, and so on, if he prefers it. Stop counting at the beginning of the 6th, 11th, 16th, or 21st second, according to the length of time that the fork will sound, so that the number of sets of beats in 5, 10, 15, or 20 seconds can be noted, of which 10 and 20 are the most convenient. The difficulties arise from beginning inaccurately and estimating the number of beats in an incomplete set at the end. But, after a little practice, these errors are not likely to exceed two beats on the whole. Other precautions to observe are to keep the ear perfectly steady while the beats are listened to. A slight motion of the head easily creates beats. Also, it is necessary to hold the fork to be measured very steadily, tight down against a good resonance board, or, as is best, over the mouth of a resonance jar. I have myself found it most convenient to have one person to manage the fork and the instrument, and another to count the beats, and have derived the greatest advantage from the kind assistance of Mr. Hipkins in this respect. It is necessary also to be careful not to hold the tuning fork too long in the hand. It should be laid down to cool as often as possible. I have found a difference of ·2 vibrations to be caused this way. The themometer should be noted if much under or over 60, or measurements will apparently differ. Also no tuning fork should be measured immediately after taking of it from the waistcoat pocket, as it will be sure to be ·2 to ·4 vibration flat. I generally excite the forks by striking them on a piece of lead, on to which some wash-leather has been glued. This prevents all tingling or injury to the fork. When all these matters are attended to, the number of beats divided by the number of seconds gives the number of vibrations in a second by which the fork is sharper or flatter than the reed. Hence, if we take two beats as a probable error, the probable error in determining pitch will, on the whole, be ·4, ·2, ·15, or ·1 vibration, according as the beats are counted through 5, 10, 15, or 20 seconds. For all musical purposes the three last may be disregarded, for it has been shown by Dr. Preyer[*] that in successive notes the best ears cannot distinguish a difference of one-fifth of a vibration.

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[*] (8) For the convenience of those who wish to use the instrument at South Kensington, I here note the numbers of the reeds which produce these intervals:—Octave, 0—65; Fifths, 0—32, 2—35, 4—38 6—41, 8—44, 10—47, 12—50, 14—53, 16—56, 18—59, 20-62; Fourths, 2—24, 5—28, 8—32, 11—36, 14—40, 17—44, 20—48, 23—52 26—56, 29—60, 32—64; major Thirds, 0—16, 4—21, 8—26, 12 31, 16—36, 20—41 24—46, 28—51, 32—56, 36—61; minor Thirds, 1 14, 6—20, 11—26, 16—32, 21—38, 26—44, 31—50, 36—56, 41—62. The 20 reeds not verified by these intervals are, 3, 7, 9, 13, 15, 19, 22, 25, 33, 37, 39, 42, 43, 45, 49, 54, 57, 58, 63.

[†] (8a) Thus, if the pitch of the lower note be x, and the intermediate beats 128, the upper note will be $x + 128$; and also, as it beats flat four times with the lower, will be $\frac{3}{2}x - 4$; and this gives $x = 2$ $128 + 4 = 260$. I was able to count the beats easily except for $\frac{9}{8}$. This completes the verification.

[*] (9.) *Ueber die Grenze der Tonwahrnehmung*—(On the Limits of the Perception of Musical Tone) Jena, 1876, the results of which are given in my paper "On the Sensitiveness of the Ear to Pitch and Change of Pitch in Music," in the Proceedings of the Musical Association, 1876-7, p. 1-29.

But how are we to discover mechanically whether the fork is sharper or flatter than the reed? In two ways. First, flatten the reed, by pushing in the pull gradually, and observe whether the beats become more or less rapid. If more rapid, the reed was flatter, and if slower, the reed was sharper. In the former case flattening made it more, and in the latter case less out of tune with the fork. Secondly, draw out the next sharper reed. If the beats are now more than 4 in a second, the first reed was sharper; if less, it was flatter than the fork. Next, draw out the next flatter reed, and observe in the same way; if the beats increase, the reed was flatter; if they decrease, it was sharper than the fork. In fact, we can always find two reeds, with each of which the fork beats no more than 4 in a second, and between which the fork lies. Never attempt to observe a unison, or a beat less than 1 in a second, because it is too indistinct. Take an adjacent reed with which the fork beats less than 4, or even one with which it beats between 4 and 5 a second, and count those beats.

The beats and vibrations of pitch (sharper or flatter) being ascertained, the number of the beats, if sharper, is added to the pitch of the reed (already known),* and if flatter subtracted from it, and the result is the pitch of the fork. The work should always be checked by counting the beats with both a sharper and a flatter reed, and noting that the sum of the beats with both is equal to the beats they make together.

Next, suppose the fork is sharper than 512. If not more than four vibrations sharper it can be measured as before, but not checked by a sharper pitch. But if still higher it must be made to beat with the second partial or Octave of a reed very nearly an Octave below the fork. This is an important case, because, as the greater number of C forks are sharper than 512, it is the most frequent in practice. Suppose we had a fork C 533 to measure. We should find that if we sounded the fork with reed 0, 1, 2 and 3, having the pitches 256, 260, 264, 268, it would beat very fast with the two first, more than four in a second with the third, and less than four in a second with the fourth. In this case it is not the prime or lowest partial of the reeds which beats at all. This goes on undisturbed all the time, and, being loud and powerful, tends to confuse the ear at first, till it becomes used to the drone and learns to disregard it. The real beats are between the fork, and the second partials or Octaves of the reeds, that is, between the fork and the pitches 512, 520, 528, 536. In this case I find it decidedly easier to count the beats when the fork is held över a resonance jar or box, whereby the fork is reduced to a perfectly simple tone, which attacks the simple tone forming the second partial of the reed, and leaves the lowest and all the higher partials untouched. The reed selected must be always one in which the beats do not exceed four in a second. Then another reed must be selected with which it beats evidently less than eight in a second. The pitch of the fork lies between the octaves of the two reeds, and is sharper than the lower and flatter than the upper octave. In the case supposed the fork would beat 5 sharp with reed 2, and 3 flat with reed 3. Then the pitch is double that of reed 2 (that is 528), increased by 5 (giving 533), or double that of reed 3 (that is 536), diminished by 3 (giving 533 as before.) But it will be found difficult to count the quicker beats correctly. Thence they should only be used to show between which pair of reeds the fork lies.

I have been thus lengthy in describing this mode of measuring pitch, because the instrument is decidedly the most convenient and cheapest for the purpose,* because two copies are accessible in London, and because all the pitches to which I shall have occasion to direct your attention were determined with its help, or by means of forks already measured by it, wherever the original forks themselves were accessible. But, for ordinary practical purposes, it is most convenient, as I have already mentioned, to have a pocket set of ten A and ten C forks, which have been carefully made by a good maker, and compared with the original tonometer.

For all purposes of the determination of musical pitch, Appunn's tonometer is sufficient and satisfactory, and I am not certain whether there is any other instrument by which equally good results can be obtained, or which is self-verifying to the same extent. It is in the verifications, by means of the many upper partials of the reeds, that the great superiority of this instrument over Scheibler's consists. Two beautiful arrangements, however, have lately been invented, one of which is extremely delicate, but the other is still incomplete.

Mayer's Electrical Tonometer.—Professor Alfred Mayer, of Stevens's Institute of Technology, Hoboken, New Jersey, U.S., read a paper before the National (American) Academy of Sciences at Washington, in April, 1876, just one year ago, in which he described his apparatus, and the results of very extended researches made by its means. This paper has not yet been printed, and I am indebted to the kindness of Prof. Mayer for being able to give the following account of his instrument and results, which were communicated to me in a letter dated 24th April, 1877, for the purpose of this paper. The seconds pendulum of a clock has a wedge of platinum foil attached to its lower extremity, which, at every swing, passes through a globule of mercury, placed vertically under it in the cup of an iron binding screw, which is connected with one wire of a small and constant battery, of which the other wire is connected with

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* (10.) It is best to tabulate these pitches, which for convenience are given below, the first number representing the number of the reed and the second its pitch.

Reed.	Pitch.	Reed.	Pitch	Reed.	Pitch.	Reed	Pitch.
0 ...	256	17 ...	324	33 ...	388	49 ...	452
1 ..	260	18 ...	328	34 ...	392	50 ...	456
2 ...	264	19 ...	332	35 ...	396	51 ...	460
3 ...	268	20 ...	336	36 ...	400	52 ...	464
4 ...	272	21 ...	310	37 ...	404	53 ...	468
5 ...	276	22 ...	344	38 ...	408	54 ...	472
6 ...	280	23 ...	348	39 ...	412	55 ...	476
7 ...	284	24 ...	352	40 ...	416	56 ...	480
8 ...	288	25 ...	356	41 ...	420	57 ...	484
9 ...	292	26 ...	360	42 ...	424	58 ...	488
10 ...	296	27 ...	364	43 ...	428	59 ...	492
11 ...	300	28 ...	368	44 ...	432	60 ...	496
12 ...	304	29 ...	372	45 ...	436	61 ...	500
13 ...	308	30 ...	376	46 ...	440	62 ...	504
14 ...	312	31 ...	380	47 ...	444	63 ...	508
15 ...	316	32 ...	384	48 ...	448	64 ...	512
16 ...	320						

* (11.) The tonometer itself, containing 65 reeds, costs £18; the table and bellows supplying the wind, which can be made useful for many other instruments, costs £7. It should be mentioned that I have only a scientific interest in this instrument.

the primary coil of a large inductorium (these relations of small and large are important), whence a wire also passes to the top of the pendulum. By two other wires the secondary coil of the inductorium is connected with a tuning-fork and a revolving cylinder. The tuning-fork carries a delicate wedge of foil, permanently attached, which, on the fork being excited by a violin bow, will, as the cylinder revolves, sweep out a delicate wave-curve on its camphor-smoked surface. Every time the pendulum leaves the mercury globule a single[*] spark is projected from the foil of the fork, which pierces the covering of the cylinder, and marks the beginning and end of the second, but as the mercury globule may not have truly vertically under the point of suspension of the pendulum, the length of every two seconds only is used, the possible error one way correcting the error the other way. The number of sinuosities of the curve between the pairs of spark holes, divided by 2, gives the pitch of the fork. Professor Mayer estimates the probable error of this determination to be only the 25,600th part of a vibration. The foil attached to the fork is excessively light, and its influence in lengthening the vibratory period, if it has any, is determined by ascertaining if the piece of foil alters the number of beats which the fork experimented on makes with another fork kept as a standard of reference. It would, therefore, be necessary to time another fork within beating distance of the first before the foil was affixed. A difference of amplitude of the vibration of the fork from 2½ to ½ a millimetre (one-tenth to one-fiftieth of an inch), made no difference in the vibratory period. The pressure of the point of foil attached to the fork also made no change in the vibratory period.[†] An increase or diminution of 1 deg. Fahr. in temperature lengthens or shortens the fork by one-twenty-two thousandth part. The co-efficient of the effect of temperature is therefore ·00004545. Thus, if a fork at 60° Fahr. had the pitch 256, and its temperature were raised to 90° (that of the human body) by holding it sufficiently long under the arm, it would lose ·00004545 × 30 × 256, or ·35 vibrations, while a fork of 512 under the same circumstances would lose ·7 vibrations, both sufficient to cause an evident alteration in the rate of heating.[‡]

McLeod and Clarke's Cycloscope.—Professor H. McLeod, of Cooper's-hill College, and Lieutenant G. S. Clarke, R.E., have invented an optical method of determining the velocity of rotation by means of tuning forks, which conversely serves to determine the pitch of tuning forks from a known velocity of notation. The difficulty of obtaining a rapid and uniform velocity of rotation has hitherto prevented their obtaining such accurate results as by Herr Appunn's and Professor Mayer's methods. A fork which they had measured as C 540, proved to be very nearly C 537. This is better than the determination of the French normal A (439 in place of 435), and the method will no doubt be improved so as to obtain still better results. The instrument is called the cycloscope, and a paper upon it was read by the inventors before the Royal Society on 19th April, 1877. The principle of the machine is as follows:—If a series of white dots at equal distances on a revolving drum of a dark colour be viewed through a narrow slit, while the drum rotates they will appear as lines, and, if near enough, as one continuous line. If now the small slit be attached to a tuning fork in vibration, and be made to vibrate right and left while the dots on the cylinder have a vertical motion, this line will appear as a sinuous curve, and often as a complicated collection of sinuous curves interlaced, which appears to move forwards or backwards according to the comparative rate of the vibration of the fork and revolution of the cylinder. If a complete vibration of the fork takes place in the time of the passing of two dots, a double sinuous curve is produced, something like a collection of figures of 8 piled one above another, and this figure will appear quite stationary. Now, to find this relation, the inventors hit on the happy idea of drawing lines on the cylinder as follows:—A piece of paper of the required size and colour had lines ruled on it radiating from a point. Out of these an oblong was cut of the length of the cylinder and width of its circumference, and this was pasted round the cylinder, forming a graduated scale of lines, which the narrow slit optically cut into dots, having every intermediate distance from that at one end of the cylinder to that at the other. The number of dots in a circumference, as seen through a slit at a given distance from the extremity, is then easily found; and as equal distances along a drum correspond to equal differences of velocity of rotation, a scale may be laid down with ease, giving the velocity of rotation in relation to that of the fork, at any point where the figures of 8 are seen stationary through the slit.* The machine is very beautiful and easy to work. Its original intention, as the name implies, was to measure velocities of rotation when the pitch of a fork was known.

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[*] (12.) With a large cell of the battery and small induction coil, one may obtain as many as 30, 50, or even 100 separate sparks at the moment of breaking the primary circuit. See my paper on the nature of the electric discharge in the *Philosophical Magazine*, Jan. 1875 Professor Mayer's letter. The spark hole is reduced to its minute size by properly adjusting the resistance between the battery and inductorium.

[†] (13.) In order to contrast Professor Mayer's measurement with Appunn's, I asked him what he made Koenig's Ut_3 and he said it C 256·31 at 65 deg. F. This is considerably different from the C 258·4, which I obtained from another of Koenig's forks. I also sent him an exact duplicate of a fork, which I measured on 6th May, as C 517 [illegible], which he kindly promised to measure for me and he informs me that he makes it C 5[illegible]3·045 with the foil attached. The fork, which was formerly in precise unison with it, is now 8 or 9 vibrations sharp. This would make the loaded fork to be C 517 or C 516·9. When the loaded fork is tried with Koenig's C 516·8 (see note 16) it is difficult to detect any beat at all. This, and the difference in the estimation of Koenig's C 258·4, would point to a retardation of about 77 per cent., due perhaps to the scrape of the attached foil on the smoked paper, which was not supposed to produce any effect at all. The sinuosities are very minute, but quite numerable under a glass, and the spark holes also very small, but distinct, on the smoked paper actually used in the experiment, and kindly sent me from America by Prof. Mayer.

[‡] (14.) This co-efficient of temperature was obtained by calculation from two sets of eight of Koenig's forks, one exposed in a room with an open window during four days of cold weather, temperature noted, and the other in a room heated to 70° by steam-pipes. After being left a day, the door between the rooms was slightly opened (by a crack), and the similar forks were sounded together, the beats being noted by a stop chronometer. Before and after the experiments, then two sets were maintained sometime at the same temperature, and their pitch noted by beats. Dr. Stone and Professor McLeod determined the co-efficient to be ·000125 for 1° Centigrade, which is ·00007 for 1° Fahr., or not quite twice as large as Professor Mayer's. General Perronet Thompson says (Just Intonation, § 127 and note), "A tuning-fork is made flattor by heat at the rate of a hundredth of a comma for every three degrees of Centigrade (5⅖ of Fahrenheit) and the contraries." Now, a comma is 81 ÷ 80, or 1·0125 and 100th root of this is 1·0001242, so that the coefficient would be ·0001242 ÷ 5·4, or ·000023, which would be about half of Professor Mayer's. Scheibler ("Tonmesser," p. 60), gives as the result of his own observations on tuning-sorks, what is equivalent to ·0000673 at 440 vibrations, and ·0000505 at 220 vibrations, as the alteration of pitch per vibration per degree Fahrenheit, and draws the conclusion that, after handling a fork, it should be left a whole day to cool down.

V.—*Variations of Standard Pitch.*

Authentic Records of Pitch.—Tuning forks and principal pipes of organs are perhaps our most authentic records of musical pitch. Mere estimation of ear is quite insufficient, even in reference to a standard fork. Measurements of forks have hitherto proved untrustworthy, but by means of Appunn's tonometer we have now a cheap and practical method by which the pitch of any fork may be obtained, within a limit of one-fifth to one-half of a vibration, according to the accuracy of the observer. Hence it becomes necessary to compare all the authentic forks that can be obtained, by measuring them directly by means of this tonometer. Now, I have been very fortunate in obtaining numerous interesting forks to measure. As already mentioned, the Society of Arts has lent me twelve valuable forks. Mr. Driffield, the rector of Bow, brought me Handel's own fork to measure. To Dr. Stainer I owe a very interesting old fork of a low pitch, used at the Plymouth theatre 80 years ago. To Dr. Stone I am indebted for several modern forks of a very high pitch. To Mr. Keatley Moore I owe copies of two forks which he kindly made for me. But I have received the most assistance from Mr. Hipkins, of the celebrated pianoforte manufactory of Messrs. Broadwood and Sons. Mr. Hipkins has paid great attention to the subject for many years, and has at different times attempted to ascertain the actual pitch used in England. Through him I was able to measure the normal French A given by the French Commission of 1859 to Messrs. Broadwood, and another given by the Commission of the Paris Great Exhibition in 1867, to the same. Through him also I obtained the pitches used now and at other times in Messrs Broadwood's factory, the older forks of Sir George Smart, the authentic old Philharmonic pitch, the mean of the Philharmonic pitch for 30 years, ending July, 1874 (which he had ascertained with a great amount of patient observation), the Philharmonic pitch of February, 1877, and that of St. Paul's organ at Easter, 1877. He also lent me a fork tuned to the C pipe of old Father Schmidt's old organ at Hampton Court, before it was retuned and re-arranged to suit modern views, about six years ago, besides a variety of other forks. These, added to Scheibler's measurements in 1834, and Dr. Smith's old ascertainment of the pitch of Trinity College organ, and the data of the French Commission, corrected as explained below,† enable me to lay before the Society of Arts the most complete conspectus of standard pitch, actually taken from tuning forks by trustworthy processes, that has ever been brought together, and I trust that it will do much in settling our conceptions respecting the pitch that ought to be adopted. In the Appendix I give the most accurate measurement in a tabular form, and add notes, detailing the history of each fork, so far as is known to me, in order that

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* (15.) The whole theory is explained in the Proceedings of the Royal Society for April, 1877. The slit is a very fine vertical line cut in a thin piece of black paper, attached to one of the prongs of the fork and projecting beyond it.

† (16.) After I had ascertained that the real pitch of the French normal A was 439, and not 435, as was usually supposed, it occurred to me that the other pitches observed by M. Lissajous, and given in the Appendix in the French Report, might be flat to the same amount; that is, 4 vibrations for A, and 4·8 for C, as would certainly be the case for those counted from the French normal by beats. But it was necessary to verify this hypothesis by re-measuring some other forks referred to by the French Commission. This I was enabled to do for the three forks marked London, No. 1, No. 2, and No. 3, which were, in fact, very accurate copies of Broadwood's vocal pitch, Broadwood's medium pitch, and Broadwood's high pitch, as I was informed by Mr. Hipkins, who supplied them to the French Commission, and afterwards placed them at my disposal. The French Commission report these as A 868, 905, and 910·4 simple vibrations. Dividing by 2 and adding 4, these numbers give A 438, 456·5, 459·2, to which correspond C 520·87, 542·88, 546·09. The real pitches of these forks, as found by measurement, are C 521·2. 534·9, 542·5. The second and third were clearly mistakes. The others give 4 vibrations as the limit of error, and some of this may have arisen from determining A from C. Taking an A fork, we find Leipzig (no doubt the *Gewandhaus*, or Clothing-hall, where the celebrated concerts are held), reported by the French Commission in 1859 as A 897·5 simple vibrations, which, treated in the same way, would give A 452·75. Now, a Gewandhaus fork, sent from Leipzig to the Society of Arts in 1869, gave, on measurement, A 452·3. This confirms the process of correction, which I have therefore used throughout, taking care, however, duly to mark the pitches thus deduced. This theory received an unexpected confirmation, by the measurement of Koenig's fork (as mentioned in note 6 on Scheibler's "tonometer," purporting to give C 256 E 320, G 384, C 516 (the last being 4 more than the octave of the first). If from C 256 we reckon a just A, it will be $\frac{5}{3}$ of 256, or 426⅔ and this would beat flat with A 435, exactly 8⅓ in a second. But as A 439 was used in place of A 435, the result of tuning a fork 8⅓ beats flat of the French normal A, would give A 430⅔, in place of 426⅔. Then we should obtain in just intonation. C = $\frac{3}{5}$ × 430⅔ = 258·4; E = $\frac{3}{4}$ + 430⅔ = 323; and G = $\frac{9}{10}$ + 430⅔ = 386·6; and the upper C = $\frac{6}{5}$ + 430⅔ + 4 = 520·8. Now the numbers actually found by measurement by Appunn's tonometer were C 258·4. E 323·1, G 387·6, and C 521 1, of which the second is 1 vibration, and the last 3 vibrations too large. This at once shows that in France the normal A is everywhere taken as 435, and that possibly the whole of Koenig's tonometer is vitiated by working from 258·4, as if it were 256. To establish this, however, it would be necessary to measure every fork of Koenig's by Appunn's tonometer. In comparing Appunn's determination with Koenig's, we may at first leave absolute pitch out of the question. There can be no doubt that the difference of the number of vibrations between the French normal A and Appunn's reed No. 1 (which my tests show to be C 256) is 183 vibrations, and that the difference between the French normal A and Koenig's *Ut*$_3$ 512 (meaning C 256) is 180·6 vibrations. Also that the difference between the theoretical French normal A 435 and an actual C 256 would be 179 vibrations. Hence, first Koenig's result could not have been obtained by counting the vibrations on a tonometer having the construction which he explains in his catalogue (see note 6), and cannot possibly be correct. But suppose he formed an A 430⅔ in the way just explained, and then determined the consonances optically by the Lissajous figures. for which he makes all the apparatus, and which he perfectly well understands how to manipulate, then he would certainly obtain results agreeing with the measurement of his forks by Appunn's tonometer. The whole agrees with the correctness of that instrument, and with the French normal, being A 439, one of the most important practical results of the present investigation.

Since the above was sent to press I have had an opportunity, through the kindness of Professors Tyndall and Guthrie, of examining an extensive system of Koenig's forks, with duplicates, all with Koenig's monogram, and also a set without the monogram, but believed to be his. The forks with the monogram were of beautiful workmanship and exactly true in unisons and the common chord. Those without the monogram were 4 to 7 tenths of a vibration flatter. Mr Ladds, of Beak-street, also lent me his standard fork, which is in precise unison with Koenig's. This examination fully confirms the theory explained above, as the following table will show:—

Harmonic.	Marked V. S.	Meaning D. V.	Measured by Appunn's Tonometer	Calculated Theoretically.
1	...	...	...	64·6
4	Ut$_3$ 512	C 256	258·4	258·4
5	Mi$_3$ 640	E 320	323·1	323·0
6	Sol$_3$ 768	G 384	387·6	387·6
8	Ut$_4$ 1024	C 512	516 7	516·8
10	Mi$_4$ 1280	E 640	646·0	646·0
14	7. 1792	Bfl. 896	905·0	904·4
16	Ut$_5$ 2048	C 1024	1033·6	1033·6
18	Re$_5$ 2304	D 1152	1163·3	1162·8
20	Mi$_5$ 2560	E 1280	1292·0	1292·0

their reality and authenticity may admit of no question. All the most important forks have been measured several times, at intervals of some months, and the pitch here assigned may, I believe, be accepted as correct, within one-fifth of a vibration.

The forks which I have examined extend over two periods, at one of which the old tuning, and at the other the new tuning, was prevalent. Two especial standards are used. All the old and foreign forks use A; the modern English forks for singers and pianists are usually C. The relation between A and C is very different in just, old, and new tuning, as we have already seen. For the purpose of comparison, therefore, seeing that, at the present time, whatever A is taken, the new C would be played from it, I have throughout used the new tuning of both A and C, but have subjoined the old tuning values in the annexed observations in Table IV. when it seemed necessary. I have thus been able to form a complete scale of variation of standard pitch, proceeding from Handel to the present day, with three older and much lower isolated pitches. In order to have a general view of the subject, I first present an outline list of the principal forks, with the pitch to the nearest whole number of vibrations, and divided into groups, to be shortly explained, and give precise details, with numerous additions, in Table IV. of the Appendix.

In the following outline table the groups are written in the margin; then, in the first column, is given the pitch of C; and the forks measured showed C, unless otherwise named. In the second column is given the corresponding pitch of equally tempered A, for every sixth value of the pitch of C, as a rise of six in C corresponds very closely to a rise of five in A. The cross lines divide off intervals of one-tenth of a semitone, so that the intervals between two forks can be seen at a glance. When † is prefixed to the name of the fork, it shows that it was measured by Scheibler, or by means of Appunn's tonometer, so that the results are accurate; ‡ marks pitches taken from the reports of the French Commission and Brussels Committee, corrected in the manner already explained, or from some other less certain source. Those not otherwise marked were measured by me, with the kind assistance generally of Mr. Hipkins. The forks are arranged from the highest to the lowest, but the groups are numbered in the contrary order, which was that of time.

Group I.—Ancient Low Pitch, below C 500.—The first thing that strikes us is the great flatness of the older pitches. Dr. R. Smith's D 262 in 1755, taken an Octave higher, as D 524 gives nearly the present French normal for C. Hence his pitch was almost exactly a whole tone flatter than the present French C, and a tone and a quarter flatter than Broadwood's present high pitch, which we may take to represent "concert pitch." But rejecting this as probably wrongly ascertained, for the reasons already mentioned, we have the fork tuned to Father Schmidt's C pipe at Hampton-court before the organ was reconstructed, and this is more than a semitone flatter than C 512, and seven eights of a tone flatter than "concert pitch." It follows that vocal music composed a hundred years ago ought to be transposed a whole tone, if sung at the present "concert pitch," to produce its proper effect.

Outline Table of Comparative Musical Pitch.

Group	C.	A.	
V. High Modern Pitch.	547		
	546	459	Chappell, 1877. Albert Hall for Wagner's concerts, May, 1877. ‡ Brussels Guides A, 1859.
	515	...	Broadwood high 1877. Philharmonic, July, 1874. Crystal Palace A, March, 1877.
	544	...	Philharmonic, Feb., 1877.
	543	...	Mean Philharmonic, 1852-74. Kneller-hall A, 1877.
	542	...	Army regulation A, 1877. † Mahillon, of Brussels, A.
	541		
	540	454	Society of Arts, Allen's C.
	539	...	Society of Arts, Griesbach's C, 1860. Collard, 1878. Dresden high A, 1869.
	538	...	Society of Arts, Cramer's C and A. Leipsic, Gewandhaus A, 1869.
	537		
IV. Medium Pitch.	536		
	535	...	Broadwood's Medium, 1854-77. Society of Arts, Griesbach's A, 1860.
	534	449	
	533	...	St. Paul's, March, 1877.
	532	...	Bologna A, 1869. ‡ Gotha and Brunswick A, 1859.
	531		
	530		
	529	...	Hullah, 1843. ‡ Dresden A, 1859. ‡ Paris Opera A, 1826.
	528	444	Society of Arts, theoretical, 1860 (no fork).
III. French Normal Pitch.	527		Dresden low pitch, 1869.
	526	...	Westminster Abbey, May, 1877.
	525	...	† Berlin A, 1834.
	524	...	† Vienna A, 1834. Würtemberg A, 1869.
	523	...	Scheibler A, 1834. Bavaria, Berlin, St. Petersburg A, 1869. Broadwood low, 1877.
	522	439	French normal A, 1859. Broadwood, vocal, 1877. Baden A, 1869.
	521	...	Sir George Smart's, 1826.
	520	...	Sir George Smart's Philharmonic mean A.
	519		
	518		
	517	...	French normal A, theoretical (no fork). † Gand's Paris A, 1834.
	516	434	† Petitbout's Paris A, 1834.
	515	...	
II. The Handel Pitch	514		
	513		
	512	...	‡ Berlin A, 1806-14 (Wieprecht, old C 515).
	511	...	Philharmonic, 1813.
	510	429	‡ Mozart's A (old C 513)
	509		
	508	...	Plymouth A, 1800 (old C 511).
	507	...	Handel A, 1751 (old C 510).
	506		
I. Low Ancient Pitch.	491	413	‡ Gluck's A (old C 494).
	479	400	Father Schmidt's Hampton Court organ (old A 400)
	467	393	‡ Trinity Coll. Cambridge, 1755, as measured by Dr. R. Smith (D 262, old A 383, old C 469).

Group II.—The Handel Pitch, C 500 *to* 513.—C 512, which was insisted upon so strongly by Sir John Herschel, at the meeting of the Society of Arts to consider the report of the Committee on Pitch in 1860, was in favour 50 to 100 years ago. Wieprecht gives a Berlin pitch of that amount, but the measurement may be doubted. We find, however, the fork to which Mr. Peppercorn tuned pianos for the Philharmonic Concerts, in 1815, was about 511, and, reckoning by the old tuning, a fork used at the Plymouth Theatre, about 1800, gives nearly the same, while Handel's fork, of 1751, gave C 510. We may take, then, the dawn of modern pitch to be C 512,* but that is fully a semitone flatter than the present concert pitch. Hence vocal music of Handel's time should be transposed a semitone lower than it is written when played at concert pitch. The same remark applies to the music of Mozart, and, probably, Haydn, and Beethoven.

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* (17). The value of C 512 is entirely arithmetical. It has no other particular charm, and arithmeticians can deal with any other C with equal ease if they know decimal fractions. In measuring or assigning pitch, it is never necessary to consider more than two places of decimals, and even then the last place is used only to prevent an accumulation of error. But C 512 would appear to have been aimed at about the period of this group. Although the mean tone

Group III.—French Normal Pitch, C 514 *to* 527.—About 40 years ago there was a French pitch in use almost coincident with that theoretically established at Paris in 1859, one fork from a good maker, measured by Scheibler in 1834, actually gave A 434·9, or, practically A 435 = C 517. The pitch, however, in Paris must have rapidly risen to about A 452, and the object of the French Commission was to regain this older pitch, though through an error of measurement they reached no lower than A 439. This modern version of the older fork in the Paris Opera and Conservatory was preceded in England by the almost identical but flatter pitch of Sir George Smart and Broadwood's vocal, and preceded in Germany by the very slightly sharper pitch of Schiebler, which, being chosen by him as the mean pitch of Vienna grand pianofortes, represents the Vienna pitch of the time, but from having been accepted by a congress of German physicists, who met at Stuttgardt in 1834, is commonly known in England as the Stuttgart pitch. Altogether this group, which is comprised within about a quarter of a tone, represents the group most in vogue at present on the Continent, and consequently has the greatest claims on our attention, although its highest forks are three-fifths of a semitone below our present high English concert pitch.

Group IV.—Medium Pitch C 520 *to* 536.—The interval of about an eighth of a tone between the French normal and high pitch is not well marked. We have, indeed, within this group a fork from Leipzig purporting to be the Dresden low pitch; one from Vienna, measured by Scheibler, but differing materially from the other Vienna forks; one from the Liceo Musicale, or musical school, at Bologna in 1869; the medium pitch empirically adopted by Messrs. Broadwood, and the organ of St. Paul's. There were also several foreign forks in this group. The theoretical fork of the Society of Arts, which begins it, was never really made, and Mr. Griesbach's A, like Mr. Hullah's C, was an accidental error. It would seem that the whole of this interval is not generally satisfying; it is both too sharp and too flat, and can only be regarded as a neutral medium pitch.

Group V.—Modern High Pitch, above C 536.—The last and highest group contains the moderately high pitch which the French Commission found so excessive, and the still sharper English concert and military pitch of the present day, with the high pitch of Brussels strongly advocated in an excellent report addressed to the Belgian Minister of the Interior, in 1863, of a committee he had appointed to consider the subject. Correcting the pitches given in that report by adding 4, because of the erroneous measure of the French normal, as explained and justified in note 16, we find that there was a tuning-fork in Paris, in 1826, giving A 445 = C 529·2 for the French opera, another giving A 449·5 = C 534·6 for the Italian opera, and A 452 = 537·5 for the Opéra Comique. The two first belong to the preceding group. The report says that the operas composed since 1810, for the Opéra Comique, by Méhul, Boïeldieu, Auber, Hérold, Adolph-Adam, and others, were all composed for this last pitch, which was afterwards raised to A 455 = C 541. The report mentions that when the French Commission was appointed, the French opera pitch was A 453 = C 538·7, and that Lissajous wished to lower it to A 449·5 = C 534·5, but that a contrary opinion prevailed.* Lastly, this committee says that to the present high pitch group belong "the tuning-fork of the Royal Conservatoire of Brussels, an old fork in use at the Ghent Theatre, and at the Casino in the same town 30 years ago [that is, in 1833], an old fork of the Opéra Comique of Paris in 1820, that of the Theatre Royal of Brussels, one belonging to a member of the committee (a maker of brass instruments in use all over the country, in the regiments of the army, exported to England, America, and North of France [probably Mahillon, who signs the report, and whose fork has been measured as A 456 = C 542·3], the tuning-fork of the Philharmonic Society of London [possibly meaning that of 1859, C 542·5], that of the Berlin Opera in 1861, and, lastly, that of the well-known Choral Society of Cologne." And the mean of those forks is given as A 455 = C 541·1.

Causes of Change of Standard Pitch.—No satisfactory cause has been assigned for this remarkable change of standard pitch. The French Commission throws the blame on tuning-fork makers, which is insufficient. The tuning-fork maker was in general without means of determining the pitch he used. He made a fork to suit a singer or an instrumentalist, or he made a fork which reproduced some pitch in vogue,† or of some instrument that pleased him. This was seldom done very directly, and still seldomer by beats, and differences of a comma or more would easily occur. When merely memory was trusted to, very much greater errors might occur.‡ Again, forks "set" sharper

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system of tuning was in use, musicians have always been in the habit of calculating the minor third, A to C, as just, or $\frac{6}{5}$. Of this we have already had an example taken from the report of the Committee of the Society of Arts (1860), where A 440 was supposed to give a just C 528, instead of a tempered C 523·25. Precisely in the same way Handel's A 427·7 would give just C 511·7, and the Plymouth A 427·7 would give just C 513·2. These results lead to a supposition that the makers of forks at last time worked by the physical formula to obtain C256 on a monochord, and divided the monochord for the just A. The differences are just such as would be expected from good workers under such circumstances. Peppercorn's Philharmonic C 510 8, in 1815, was also most probably derived ultimately from an attempt at C 512 obtained by means of the direct physical formula.

* (18.) This report says, that intending to lower by a quarter of a tone, the French Commission lowered really more than the third of a tone below the Opera Comique. But the interval between 453 and 439 (the real pitch) is only ·548 semitones, and hence scarcely more than a quarter of a tone. The French Commission mentions the other diminution proposed as half a quarter of a tone. Now 449·5 to 453 gives about ·14 semitones, which is much less than half a quarter of a tone, or ·25 semitones.

† (19.) When Mr Greaves began making forks, 30 years ago, he bought a fork stamped Philharmonic, of Bates, of Ludgate-hill. This he afterwards worked from It agreed with the vocal pitch by Messrs Broadwood, and proved to be C 522 2, which is almost indistinguishable from the C corresponding to the French normal A 439 But this was a pure accident; and similar accidents may have often set pitches in different places. Mr. Greaves suggested to me that, as by handling forks in tuning, they were flattened, and subsequently sharpened on cooling, a series of forks tuned from one another in succession might rise considerably in pitch.

‡ (20.) The accurate memory of pitch is a very rare gift. Dr. Stainer told me of a good tuner who, passing from one room to another to compare the pitch of a piano and harmonium, and who scouted the idea of taking a tuning-fork to help him, selected an harmonium which turned out to be so different from the piano, that

than they are tuned, and a difference of half a vibration may thus arise, which would increase with the number of forks successively tuned. Forks professing to show the same pitch seldom or ever do so.* Hence in time there might be a change from this source, but it would be gradual and irregular, whereas, so far as records go, the actual change took place by jumps at principal centres, although we find great differences existing simultaneously in the same country, as we see in the above list for England, and in the lists furnished by the French Commission for France.

The next cause which the French Commission assign is the interest of musical instrument makers, especially those of wind instruments, and of the regimental brass instruments, to raise the pitch, in order to increase the brilliancy and sonority of the tone. On the other hand, in the report of the Committee of the Society of Arts, we have Messrs. Withers and Co., in 1860, saying that the tone of violins, violoncellos, and double basses, and Messrs Rudall, Rose, Carte, and Co., saying that the tone of wood and brass instruments would be improved by a lower pitch. This is a point upon which much difference of opinion prevails, indicating that these are not generally accepted principles on which a decision should be arrived at. In all instruments, just as in the human voice, sonority fails when the pitch of the note comes too close to either extreme.† Other causes have been assigned. Wind instrument players in an orchestra are, unjustly perhaps, supposed to seek prominence by sharpening their instruments, which is easily done, and then the other instruments follow them. The tuning by Fifths in bowed instruments is supposed by Dr. Stone to have a continually sharpening effect, as the tempered Fifth is taken flat. The violinists are also said to tune a little sharp because their harmonics would be otherwise flat. In fact a whole orchestra varies so much in the pitch of its different instruments during one evening, and different classes of instruments play in such different styles of tuning, that it is difficult to say what the pitch of a band is.* Mr. Hipkins has latterly found the best criterion to be a pianoforte tuned specially for playing with the band, and observed during the performance to go well with the other instruments. A fork can be afterwards tuned to the pianoforte, and the pitch can be thus recorded. In this way he found the pitch of the Philharmonic band in February, 1877.

None of these causes seem to be sufficient to occasion the change, which bears a curious resemblance to the change of pronunciation during the last six hundred years in English, both tending to thinness of sound, and neither being thoroughly accounted for by known causes of variation. Perhaps, the caprice of some conductor, or singer, or instrumentalist, at some important centre, and the desire of other less important centres to follow the lead, may have had the most influence.

VI.—On the Settlement of Musical Pitch.

We find practically that pitch has varied in 130 years in England from C 467 to C 546, that is through 80 vibrations, or 2·6 semitones, enough to entirely change the whole meaning of musical notation. Neglecting the very low pitch of the first group, we find also that the change from Handel's time has been more than a semitone, and that every tenth part of a semitone in the whole range of this interval has found favour at different times and in different places as a standard of pitch. There can be no clearer proof that there is no inherent excellence in any particular pitch. This view is confirmed by the habit of playing in different keys, the tonics of which differ by whole tones as C, D, E, and F, G, A, or semitones as D, E flat, E, F, and G, A flat, A, B flat, B, which represent the extreme differences of pitch recorded or observed. We do not

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they could not be used together. On the other hand, he told me that Sir F. Gore Ouseley, Prof. of Music at Oxford, selected by memory one harmonium out of several, which was in perfect accord with his own piano. Tuners who flatten a piano by a comma will often say that they reduce it by a quarter to half a tone

* (21.) Secretan was maker, apparently, to the French Commission. He made the fork sent by that Commision to Messrs. Broadwood's, which I take as an authoritative French normal A 439 But the Commissioners of the Great Exhibition of 1867 got them another ·3 vib. flatter. One bought in Paris by the Society of Arts gave A 439·2, while one made for the Grand Duchy of Baden was A 438·6 All of these were made by Secretan, and from the lowest to the hightest there is a difference of ·6 vib., that is more than half a vibration. The beat is well heard. In Bavaria, according to the information dated 16th April, 1869, furnished by Prince Hohenlohe, through the Foreign Office to the Society of Arts, there is a Royal Musical Intendance for stamping and approving forks, and thereby securing the French normal. With this information a fork was sent giving A 440, or one vibration, that is, ·04 semitone sharper than the French Commission's own fork. In the information similarly furnished from Baden, the minister writes:—"It has been noticed that the tuning-forks from Paris do not agree in tone, and, therefore, they are compared to and kept in accordance with the pitch of the Grand Ducal Court Orchestra." But nothing will secure absolute correctness, because that entails enormous labour, which could not be properly remunerated.

† (22.) Acoustically, notes lose upper partials as they ascend, and hence after a certain limit, deteriorate in effect. As they descend they gain upper partials, which, after a certain limit, produce beats and roughness, well shown in the lower notes of an harmonium. The effect of a change of key in any equal temperament (not merely the new tuning, but the old, with 27 notes to the octave, or in just intonation), arises first from change of pitch, and secondly and especially from the insistance on the different pitch, due to the prominence given to the tonic in modern music. But the importance usually attached to change of key belongs to unequal tuning, in which certain keys are "flattered." On the piano A flat is meant to be a good key, and A natural a hard disagreeable key This has nothing to do with the alteration of pitch. In changing from F to G on the piano, the whole tone is sufficient, from mere change of pitch, to change the character of the music, but not nearly so much as the change of F to C. The former difference exists between the older music and our own, not the latter If, then, there be any truth in the great effect of altering the standard of pitch, the effect of all old music must be much deteriorated by raising that standard.

* (23.) Dr. W. H. Stone, in an article in the *Concordia*, "On Tuning an orchestra," has some valuable remarks on this subject. "If two notes be struck at nearly the same time, a player is almost certain to tune to the sharper of the two." "It is not uncommon to find a player [on the oboe, who generally gives the pitch to a band] give at the outset a tuning note much sharper than he afterwards plays to." "The clarinet is infinitely less easy to tune to various pitches on account of its single reed, and from the fact that a slight pulling in and out of the mouthpiece socket, which is the only method of tuning open to it, tells more upon the 'throat notes' than on other parts of its scale, and thus makes it disagree with itself." It alters almost a semitone with temperature. "I have never yet known a case where the double-basses were called to account for their pitch; and yet as a rule they tune sharp. The most ludicrous case of this kind occurred in the late futile attempt to introduce French pitch at the operas. I am not aware that any change was made in the double-basses, although an expensive and very bad set of wind instruments was procured from abroad. The basses simply slackened their ordinary thin strings, instead of putting on a full set of stouter strings in proportion to the diminished rate of vibration. Of course the bow transmitted an instinctive sense of lessened tension very unpleasant to practised players, and in a few minutes they were up to their old discarded pitch; the treble instruments, attacked as being flat, were obliged to meet the difficulty by having as many as four successive slices hacked off their new outfit. In less than a month I found the pitch as high as it had formerly been." During the change Dr. Stone observed the pitch with a tuning fork with sliding weights, and found as many as five different pitches in use at the same time. During the Wagner Concerts at the Albert-hall, this month (May, 1877). Mr. Hipkins observed that the strings and voices were as sharp as C 545·6, "but some of the wind instruments were much below it."

feel any great difference of sonority when a piece is played in one key or the other, so long as the tones used lie within the good parts of the instrument to which they are assigned. This seems to be the real question at issue. Tuning being "uniform," that is, exactly the same in all keys,* the effect of alteration of standard pitch on instruments of enormous range, such as the piano or organ, is comparatively trifling. It is only from the general necessity of making strings thinner or pipes shorter and narrower, in order to reach notes at the higher extreme, that an appreciable effect is produced. And, acoustically, all such attempts practically mean the omission of necessary lower partials, the introduction of unwelcome higher partials, and hence the general worsening of tone on the way to thinness and shrillness. But, even for a whole tone of change, the effect produced is less than can be brought about in other ways. There are, however, other instruments of comparatively limited compass, as all the orchestral instruments, and, most important of all, the human voice. To raise the pitch of a violin, the strings are thinned, and the tone necessarily injured. To raise the pitch of wind instruments, diminution of length and bore are required. Acoustically, this may, or not, be an improvement; but if the longer tube and larger bore can produce the tones well, then, probably, there is an acoustical loss in sharpening the standard pitch. But the average human voice remains of the same compass. In exceptional cases, a few notes above and below the average are produced with effect, and large sums reward the singer who can bring out a good *Ut de poitrine*. But the voices of others ought not to be fatigued by the exceptional acrobatism of the one. Composers who wish to have their music well sung, will take care to use such notes as can be produced with ease and certainty, that is, without screaming or straining, and with perfect correctness of pitch, by the average voices who will have to sing them. This must be especially the case for part music and choruses.

Here, then, comes the practical difficulty of the question of standard pitch. Each composer had in his mind the meaning of the notes he used as determined by the standard pitch to which he was accustomed, and limited his vocal and instrumental parts accordingly. When, therefore, we use another pitch, we entirely alter his intention. Thus Handel, in his Hallelujah Chorus, gives loud and sustained F sharp, G and A (above the treble staff) to his sopranos. Judging by his fork and using the old tuning, we know that he meant them for notes of the pitch 712·88, 762·76, 852·80 vib. Let these be played with the highest pitch of the Philharmonic band for July, 1874, or C 545, and in the new instead of the old tuning, and they become 770·74, 813·54, 916·58 vib. This is an enormous change. Handel's notes made extraordinary demands on the singer. But the new pitch is simply beyond the reach of the greater number of chorus voices. It is evident that no composer of an oratorio at the present day, who wished his music to be sung generally, would venture on writing a passage which would make such demands on the singer. On the other hand, Mendelssohn, of course, thought in the Leipzig Gewandhaus pitch A 452·3, only a comma lower than our concert pitch, and Costa, as we know, thinks in concert pitch itself. If we were to insist on singing their music at Handel's pitch, a semitone lower, we should quite alter their intention and miss their effects, and probably convert a fine, rich low note on which they had reckoned, into a weak, gruff, unmusical tone.

It has, therefore, come to this, that we do not know at what pitch a piece of music should be sung unless we know what pitch the composer had in his mind. For the voice, we have only to give the right pitch from a fork, and all goes well. But we cannot so alter the pitch of the accompanying instruments; we cannot have the wind and wood arranged for every tenth part of a semitone throughout a whole semitone, which would imply the necessity of having ten different sets of instruments in an orchestra. When, therefore, the committee appointed by the Society of Arts of 1860 took "as the basis of any recommendation of a definite pitch the capabilities and convenience of the human voice in singing the compositions of the great vocal writers," they forgot that "great vocal writers" have employed both a high pitch and a low pitch. The Brussels Committee of 1863, observing that the difference of pitch amounted to a semitone, at once replied, "that the only lowering of the pitch in use in Belgium should be the simple operation of transposing to an exact semitone lower for exceptional cases, or where the vocal parts are written too high, which is managed without difficulty by the good orchestras of the Conservatoire at Brussels, and by l'Association des Musiciens." But such a simple expedient is not always possible, for, neglecting the inconvenience of having to read a whole composition through all its complicated modulations, a semitone lower than it is written, such a transposition would throw immense difficulty of execution on to certain instruments, on others give frequency to notes which should be avoided, and, requiring frequently a semitone lower than can be found on the instrument of limited pitch, such as the bowed and wind instruments, would oblige the player to alter certain passages or transpose them an Octave (at sight!), completely changing the effect of the composition. It is needless to say that to require all this of players is an undue tax on their powers, and would endanger the effect of any composition which they played.

There seems to be three cases for consideration, (1). vocal music without instrumental, (2) vocal music mixed with instrumental, (3) instrumental music without vocal. The last comprises military music, symphonies, and so on. These would be played at such a pitch as would place the notes within reach of the player, and that depends entirely on the caprice of the instrument maker. The first comprises madrigals, glees, and part-songs, which should be taken at a pitch chosen by the leader in order to throw the parts within easy reach of the voice.[*] There is no reason that the entirely vocal and entirely instrumental pitches should have any connection with each other. But the middle class mixed vocal and instrumental music, that is, accompanied songs, and on a large scale, the mass, the oratorio, and especially the opera, necessitates that the voice and the instruments should have the same pitch. If the instrument is only the piano, then it is easy to procure pianos in every variety of pitch. Indeed, so great is the variety, that we read in the report of the committee of the Society of Arts, that, to meet the exigencies of pianos in a country professional tour, a concertina player (Mr. Blagrove) took thirteen concertinas, varying in pitch to the extent of a Tone and a half (a gross exaggeration, as three-quarters of a Tone is quite the limit of possibility). But if the instruments are those of an orchestra, immense difficulty is experienced. The only practical suggestion which I have seen is contained in the Dresden answer to the inquiries of the Society of Arts, in 1869. At Dresden there are two pitches, apparently A 431·5 and A 450, the first used in the Roman Catholic Church, and the second in the theatre. "As a matter of course," writes the conductor, Herr Kapellmeister Dr. Julius Reitz, "different instruments are throughout used at the musical performances in the church. These are, again, sometimes made use of in the theatre for the production of Gluck's music, and for some of Mozart's works; as in the time of Gluck, the vibrations for A were only 413, in the time of Mozart 429, and by adopting the pitch of that period, the task is much easier for the singers and does not injure the music."[†] Now there are great complaints of the expense of changing the wind instruments. The letter just cited estimates that for the Dresden Theatre alone to change from A 452 to A 439, just a quarter of a Tone, would cost something like £900. This seems a large sum of money, but it is really very little in comparison with the expenses of getting up a single opera. The instruments can be priced, can be altered, can be obtained; the voices are priceless, cannot be altered, cannot be obtained at pleasure. If the instrumentalist has to double his stock of instruments, he has only to do what he often does when he procures duplicates. But the singer can never replace a worn voice. He does not lose a few guineas, like the instrumentalist, he loses the very means of his existence. If one of the two which work together has to be altered, it is evident that the changeable must yield, and not the unchangeable.

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* (24.) It is usual to confine the term "equal" to that particular system of uniform tuning in which the Fifths and major Thirds are so altered as to cause twelve Fifths to make seven Octaves, whence it follows that three major Thirds make one Octave (C to E, E to G sharp, G sharp taken as A flat to C, or G sharp to B sharp, which is taken as C.) The reason of this is that this is the only uniform temperament which is complete with twelve notes to the Octave. As, however, it makes the major Thirds very much too sharp (by seven-elevenths of a comma) the effect of this tuning for qualities of tone which have many upper partials is very bad (for example, the harmonium, which is frightfully "gritty"). But the old tuning, which tuned the Fifths too flat by a quarter of a comma, so that four Fifths were two octaves and a just major Third, is also completely uniform if carried far enough, as, for example, to 27 tones: it was merely the habit of using only twelve Tones that produced an 'unequal' or non-uniform result. Huyghens's alteration of it made 31 Fifths to be 18 Octaves. Mr. Bosanquet's plan makes 53 Fifths to be 31 Octaves. Just intonation has no such relations between Fifths and Octaves; it is, nevertheless, properly uniform in every key, that is, the interval between any two successive notes occupying the same positions in the scale is precisely the same, whatever be the pitch of the keynote.

Now in recommending the provision of two sets of instruments, regard should be had to existing practicabilities. It happens that at the present moment two sets of instruments with very different pitches are widely manufactured. Those belonging to the French normal pitch at 439 = C 522 can be procured in Paris and in those parts of Germany where this pitch is made compulsory in court theatres, as Munich, Würtemberg, Vienna, Baden, Milan, and St. Petersburg. Instruments adapted to modern high pitch C 54 = A 458·3 can be obtained in London and Brussels. Instruments of intermediate pitches exist no doubt everywhere, but it is difficult to order and still more difficult to obtain instruments of any other pitches, but French normal and English concert. Even if a proper fork is sent, the instrument-maker disregards it. The only practical method is to have a piano carefully tuned, by a good tuner, to the required pitch, and then to select an instrument of another kind which sounds well with it when a proper piece of music is played.

The recommendations that I venture to make, then, for the settlement of pitch, are these:

First, for vocal music only, that the pitch should be carefully selected for each piece—after due trial by a competent judge, provided with measured tuning-forks—and that the pitch thus selected should be published with the music.

Secondly, for accompanied music. This requires a double treatment. (1) The French normal pitch, A 439 = C 522, corresponding to Broadwood's low pitch, is recommended for the compositions of those operatic composers who formed part of the French Commission, and are understood to have been favourable to that pitch, viz., the operatic composers, F. Halévy, Auber, Meyerbeer, Rossini, and Ambroise Thomas (Berlioz, an instrumental composer, is understood to have opposed lowering the pitch), and for all French compositions of a subsequent date, and also German compositions of a date subsequent to the introduction of the French pitch at the capital for which the composition was written. The same pitch might also be used for the music of the Handel period. For still older compositions, either especial organs must be tuned, or else transposition must be resorted to. Gluck and Gibbons would probably be too high for singers even in the French pitch. (2) The English concert pitch should be used for modern English and Belgian music, and for German compositions, such as Mendelssohn's, which were written for a high pitch.

Thirdly, as regards purely instrumental music, I do not feel called upon to make any suggestion. Certainly, when Beethoven's sonatas are played on a piano at concert pitch, we do not get the effects heard mentally by Beethoven himself; still he might not have objected to them, for he had never heard such splendid tones as can be produced on modern instruments. Military bands have quite a right to play whatever can be heard furthest in the open air, without regard to a composer's intentions. Symphonies, except the choral symphony, may be played at any pitch the composer likes to assign or can obtain. Certainly, instrumentalists, as well as singers, are inconvenienced by having one uniform pitch abroad, and another, three-quarters of a semitone higher, in England. It must be unpleasant to Joachim to change the thick strings which he uses in Berlin for the thin strings he employs in England. He must feel it as an annoyance at every stroke of the bow. But these are trifles compared to the effects on the singers, who find themselves suddenly unable to produce the effects on which their reputation has been partly founded, and endanger their whole powers by straining after these suddenly heightened pinnacles in England.[*]

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[*] (25.) For this purpose the box of ten forks, proceeding by 4 beats in a second from C 512 to C 548, would be invaluable to a conductor. The interval between these forks is only ·13 semitone, and hence the conductor would be able to try minute varieties of pitch, and record the results for future guidance by writing the pitch found best on the piece of music itself. (See note 7.)

[†] (26.) The actual pitches given in this letter are—Theatre 892, Church 855, Gluck 818, Mozart 850, simple vibrations for A. These last I have corrected, as already explained, for French pitch. The first, A 450, agrees fairly with the fork sent to the Society of Arts from Dresden, A 453·3; but the second, A 431·5, is much flatter than the other fork sent to the Society of Arts from Leipzig, and called Dresden pitch, which was A 442·8.

The suggestion of two pitches requires some preparation and determination to carry out; and if proprietors of operatic orchestras refuse to make provisions for them, they ought at least to accede to the Belgian suggestion of transposing a semitone; but in any case they should know in what pitch they are playing, and the conductors should insist on that pitch being kept to, so that such tricks as Dr. Stone reports, may be no longer possible. This leads me to a final suggestion regarding the settlement of pitch.

Fourthly, as regards the preservation and communication of pitch. Such bodies as the Society of Arts and the Philharmonic should resist, and if possible prevent, the use of their names without authority. The pitch recommended by the committee appointed by the Society of Arts was C 528, a low medium pitch; the fork made for it by Mr. Griesbach was C 539·4, a high pitch; the fork sold by Cramer, an authorised agent, is C 538, which is lower than Griesbach's; and that sold by Allen is C 540·3, which is higher; but both bear the impress of the Society of Arts, so that the public are allowed to suppose that these represent C 528, the pitch recommended by that Society. As for the Philharmonic forks, their name is legion, and I have not been able to ascertain that the Philharmonic Society ever authorised the issue of any fork, so that those generally sold are mere observations at particular times repeated at hazard. The forks I cite as Philharmonic come from a different source. In 1815, we know that Messrs. Broadwood had to supply pianos of the pitch C 510·8, for we have the fork of the tuner. In February, 1877, the piano which suited the band was of the pitch C 544·3, as we know from the fork tuned to that piano the next morning. Between these limits then of just over a semitone, any pitch might be called "Philharmonic." All this uncertainty should cease. People should know exactly what pitch they are using, and for that purpose there should be some office established under competent authority, say of the Society of Arts itself, or of the Royal Academy of Music, or the National Training School of Music, where forks can be examined and stamped with their pitch. This can be done with rapidity and certainty by means of a set of five C forks and five A forks, precisely tuned to mathematically accurate pitches.[*]

For ascertaining whether the pitch of an orchestra or organ is correct, two methods suggest themselves, since a tuning-fork gives far too weak a sound for the purpose. The first is that used at Copenhagen, where the reply to the inquiries of the Society of Arts, in 1869, says:—"The band of the Royal Theatre (Opera House) tunes, in the beginning of the performance only, from a pianoforte in the orchestra. This piano is kept at pitch from two old forks (date not precisely known) which happen nearly to agree with the new French normal diapason, giving probably three or four more vibrations per second."[†]

A piano is a very good instrument for tuning an orchestra by, as all the instruments can play with it, and the agreement can be well heard. But it is expensive, and takes up much room. Hence the second method may be preferable. This consists in having a powerful reed, with a proper resonance cup tuned to A, and blown by means of a weighted bellows, with a reservoir, so as to give a uniform blast. Such a reed would cost little, would occupy a very small space, would be quite well heard throughout an orchestra, and would give the pitch with even more certainty than a piano, and much more distinctness than an organ.

But both piano and reed must be examined for correctness on every occasion that they are used for giving the pitch, and, for this purpose, tuning-forks are necessary. Two forks should be used, one tuned by means of the tonometer or standard forks exactly to the required pitch, and the other tuned flatter so as to beat four times in a second with it. The piano may be tuned by unison from the higher fork, but should at least be tested by beats with the lower fork. The reed, however, should always be tuned by beats from the lower fork, because it is quite impossible to feel certain of a unison between a fork and a powerful reed to within half a vibration, whereas by beats accuracy to at least one-fifth of a vibration can be insured.[‡]

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[*] (26a.) Herr Hans Richter, Hofkapellmeister of Vienna, and a conductor of the Wagner concerts at the Albert-hall this month, states (through Mr Dannreuther) that "pitch at Vienna is almost a semitone lower than that used at the Albert-hall." The Vienna pitch at the Court Theatre is the French normal A 439 = C 522, according to the information sent officially to the Society of Arts in 1869 The pitch at the Albert-hall was C 545·5 = A 458 7 according to the observations of Mr. Hipkins. The difference of pitch being just over three-quarters of a semitone, the two statements confirm each other Did not this great change co-operate with our extraordinarily cold May in disabling so many of the singers?

[*] (27.) The five C forks should show 512, 520, 528, 536, 544 and the five A forks should show 424, 432, 440, 448, 456. They should be large and mounted on proper resonance boxes, and should be tuned with the most scrupulous exactness, by means of Appunn's tonometer. Mr. Appunn informs me, in answer to my inquiries, that he will furnish each set of five for £3 15s. If two such sets were in possession of a proper authority, tuning-fork makers might be permitted, for a small fee, to copy them, and thus start their forks with tolerable correctness; and finally compare them with those at the proper office, and have them officially stamped.

[†] (28.) Probably the difference was taken by beats, and hence the vibrations may be double vibrations. This would give A 442 or A 443 for the Copenhagen pitch, in 1869, which would be nearly that of Westminster Abbey organ in 1877.

[‡] (29.) We are indebted to Scheibler for showing the importance of these flat forks, *T-Gabeln*, that is *tiefe Gabeln* as he calls them (*Tonmesser*, pp. 13 and 29). I have found that when a tuning-fork was very nearly in unison with one of the reeds of the tonometer, and especially very nearly in unison with the second partial or octave of the reed (for which the ear is much plagued by the drone of the first partial), that I could not possibly bear or count the beats satisfactorily. In the first case I took the adjacent reed and counted the beats from it. In the second case this was impossible, as the beats would have been too rapid to count I then used a flatter subsidiary fork, and counted the beats that the reed and the other fork made with it, the difference determining not only the amount of the slow beat between the first fork and the reed, but its direction. Scheibler says:—"I can prove to anyone that he will not hit a unison once out of ten times This is not of so much consequence in tuning with unison-forks, because the error is not propagated, inasmuch as the next tone is not deduced from the last tuned. [He is speaking of a system of 12 forks for tuning the piano with.] But if we tune 12 strings, the second from the first, the third from the second, and so on, up to the twelfth from the first, we may feel certain that we shall not hit the right result once in a billion times." (*Ibid*, p. 45.) I understand that Appunn has an arrangement of 12 unison reeds, or 12 flat reeds, beating four in a second with the correct note, for tuning pianos or harmoniums to any fixed pitch in perfectly equal temperament, but I have not seen it in action.

The two forks may be also constantly proved by making their notes beat together.

These are the only suggestions which I feel justified in offering on this subject. They are not very revolutionary, and may be almost summed up in the advice:—"Whatever pitch you use, know what it is, and take measures to secure its retention." In accordance with this advice, the object of this paper has been to show how pitch may be ascertained and fixed, what pitches have been extensively used, what is the meaning and effect of altering the standard of pitch, and what pitch it is at present practicable and suitable to use for accompanied voices.

APPENDIX.

TABLE I.

Values of the Notes for the Major Scale of C, in the Just, Old, and New tunings for the C, A, and D standards.

C STANDARD.

Note.	Just.	Old.	New.
C	5,000	5,000	5,000
D	5,625	5,590	5,613
E	6,250	6,250	6,300
F	6,667	6,687	6,674
G	7,500	7,477	7,491
A	8,333	8,359	8,409
B	9,375	9,350	9,439
c	10,000	10,000	10,000

A STANDARD.

Note.	Just.	Old.	New.
C	6,000	5,981	5,946
D	6,750	6,669	6,698
E	7,500	7,477	7,492
F	8,000	8,000	7,937
G	9,000	8,944	8,909
A	10,000	10,000	10,000
B	11,250	11,180	11,225
c	12,000	11,962	11,892

D STANDARD.

Note.	Old.
C	8,944
D	10,000
E	11,183
F	11.963
G	13,375
A	14 613
B	16,719
c	17,889

Having selected the standard and the tuning, multiply the pitch of the standard by the numbers against the note, and divide by 10,000.

Example 1.—Standard C 545, new tuning. Then 545 × ·8409 gives 458·2905.

Example 2.—Standard A 458·29, new tuning. Then 458·29 × 1·1892 gives 544·998468, or 545.

As the determination of A from C, and C from A, in the new tuning is of frequent occurrence in investigation of pitch, the following special table is added:—

TABLE II.

To determine C from A, and A from C, in the new tuning.

C	A	C	A
500	420·45	523	439·79
501	421·29	524	440·63
502	422·13	525	441·47
503	422·97	526	442·31
504	423·81	527	443·15
505	424·65	528	444·00
506	425·49	529	444·84
507	426·32	530	445·68
508	427·18	531	446·52
509	428·02	532	447·36
510	428·86	533	448·20
511	429·70	534	449·04
512	430·54	535	449·88
513	431·38	536	450·72
514	432·22	537	451·56
515	433 06	538	452·40
516	433·90	539	453·24
517	434·74	540	454·09
518	435·58	541	454·93
519	436·42	542	455 77
520	437·27	543	456·61
521	438·11	544	457·45
522	438·95	545	458·29

A	C	A	C
420	499·46	441	524·44
421	500·65	442	525·62
422	501·84	443	526·82
423	503·03	444	528·01
424	504·22	445	529·20
425	505·41	446	530·39
426	506·66	447	531·58
427	507·79	448	532·77
428	508·98	449	533·95
429	510·17	450	525·14
430	511·36	451	536·33
431	512·55	452	537·52
432	513·74	453	538·71
433	514·95	454	539·90
434	516·12	455	541·09
435	517·31	456	542·28
436	518·50	457	543·47
437	519·69	458	544·65
438	520·87	459	545 85
439	522·06	460	547·04
440	523·25		

P. P.

C	A
·1	·08
·2	·17
·3	·25
·4	·34
·5	·42
·6	·50
·7	·59
·8	·67
·9	·76

P. P.

A	C
·1	·12
·2	·24
·3	·36
·4	·48
·5	·60
·6	·71
·7	·83
·8	·95
·9	1·07

To find A from C, look for the whole number of C under C in the first part, and the decimal under C in proportional parts P. P. Add the two corresponding values of A. Similarly for finding C from A.

Example 1.—C 517·25; C 517 gives A 434·74
C ·2 „ A ·17
C ·05 „ A ·04

Result ...... A 434·95

Example 2.—A 434·95; A 434 gives C 516·12
A ·9 „ C 1·07
A ·05 „ C ·06
Result ...... C 517·25

TABLE III.

Given an Interval, expressed as a Fraction, to find the Number of Equal Semitones which it contains, and conversely.

Sem.	Quotient.	
·00	1·0000	00
·01	1·0005	78
·02	1·0011	56
·03	1·0017	34
·04	1·0023	13
·05	1·0028	92
·06	1·0034	72
·07	1·0040	62
·08	1·0046	32
·09	1·0052	12
·10	1·0057	93
·11	1·0063	74
·12	1·0069	56
·13	1·0075	37
·14	1·0081	19
·15	1·0087	02
·16	1·0092	85
·17	1·0098	68
·18	1·0104	51
·19	1·0110	35
·20	1·0116	19
·21	1·0122	04
·22	1·0127	89
·23	1·0133	74
·24	1·0139	60
·25	1·0145	45
·26	1·0151	32
·27	1·0157	18
·28	1·0163	05
·29	1·0168	92
·30	1·0174	80
·31	1·0180	68
·32	1·0186	56
·33	1·0192	44
·34	1·0198	33
·35	1·0204	23
·36	1·0210	12
·37	1·0216	02
·38	1·0221	92
·39	1·0227	83
·40	1·0233	74
·41	1·0239	65
·42	1·0245	57
·43	1·0251	49
·44	1·0257	41
·45	1·0263	34
·46	1·0269	27
·47	1·0275	20
·48	1·0281	14
·49	1·0287	08
·50	1·0293	02
·51	1·0298	97
·52	1·0304	92
·53	1·0310	87
·54	1·0316	83
·55	1·0322	79
·56	1·0328	76
·57	1·0334	73
·58	1·0340	70
·59	1·0346	67
·60	1·0352	65
·61	1·0358	63
·62	1·0364	62
·63	1·0370	61
·64	1·0376	60
·65	1·0382	59
·66	1·0388	59
·67	1·0394	59
·68	1·0400	60
·69	1·0406	61
·70	1·0412	62
·71	1·0418	64
·72	1·0424	66
·73	1·0430	68
·74	1·0436	71
·75	1·0442	74
·76	1·0448	77
·77	1·0454	81
·78	1·0460	85
·79	1·0466	89
·80	1·0472	94
·81	1·0478	99
·82	1·0485	05
·83	1·0491	11
·84	1·0497	17
·85	1·0503	23
·86	1·0509	30
·87	1·0515	37
·88	1·0521	45
·89	1·0527	53
·90	1·0533	61
·91	1·0539	70
·92	1·0545	79
·93	1·0551	88
·94	1·0557	98
·95	1·0564	08
·96	1·0570	18
·97	1·0576	29
·98	1·0582	40
·99	1·0588	51
1·00	1·0594	62
2·00	1·1224	62
3·00	1·1892	07
4·00	1·2599	21
5·00	1·3348	40
6·00	1·4142	13
7·00	1·4983	07
8·00	1·5874	01
9·00	1·6817	93
10·00	1·7817	97
11·00	1·8877	48
12·00	2·0000	00

The interval is found as a fraction:—(1) from the theory of a method of tuning; (2) from finding two lengths of the same monochord which give the two notes; (3) from measuring two forks which give the two notes.

Take the larger number for the numerator. If it is more than double the smaller number, either divide the larger number by 2 (if even), or multiply the smaller number by 2 often enough to make the fraction greater than 1 and less than 2. Reckon 12 semitones for each such operation with 2.

(1) To obtain the result correctly to a cent., or the hundredth part of an equal semitone, which is enough for most purposes, divide the larger number by the smaller to 4 places of decimals. Thus, 4 ÷ 3 = 1·3333.

Look in the column quotient for the next least number, neglecting the two separate figures to the right (in this case 1·2599) and note the number of semitones opposite to it (in this case 4).

Divide the original quotient (1·3333) by this next least quotient, also to 4 places of decimals (1·3333 ÷ 1·2599 gives 1·0582), and look in the table for the nearest quotient (in this case 1·0582) and mark the decimal opposite (in this case ·98). This decimal (·98) added to the former whole number (4) gives the result required (4·98), when, as is usual, in investigations of pitch only the nearest *cent.*, or hundredth of an equal semitone is sought.

(2.) To obtain the interval to the nearest *mil*, or thousandth part of an equal semitone. Proceed as before but continue the division to six places of decimals. In the case of $\frac{4}{3}$ this becomes 1·3333 33. Find the next nearest number in the table including the two separate figures, in this case 1 2599 21. Divide the former quotient by this to six places, in this case 1·3333 33 ÷ 1·2599 21 = 1·0582 67. Find the next least number in the table (in this case 1·0582 40) and note the decimal (in this case ·98). Subtract the last quotient from the last but one, in this case 1·0582 75 — 1 0582 40 gives ·0000 27. Multiply this difference by 100 and add 1, giving 1·0027. Look for the next least number in the table, neglecting the two last figures (in this case 1·0028) and note the decimal (·05) which divide by 100 (giving ·0005), taking the result to the nearest third place (giving ·001) and add to the two former results (4 and ·98, giving 4·981.)

(3.) Those who know the use of logarithms may find the logarithm of the interval (which for $\frac{4}{3}$ is ·124 9387), multiply it by 12 (giving 1·499 2644), and divide by ·30103 to 5 places, all of which will be correct (in this case 4 980 45.)

(4.) To find the interval expressed decimally to 3 places. Look for the whole number and the two first places of decimals in the tables, and multiply the results to 4 places of decimals, keeping 3. Thus 4 gives 1·2599, and ·98 gives 1·0582, and 1·2599 × 1·0582 gives 1·3331, of which 3 places 1·333 are correct.

(5.) To find the logarithm of the interval, multiply the number of equal semitones by ·30103 and divide by 12. But for this purpose 4 or 5 places should have been obtained correctly. In this case 4·981 × ·30103 = 1·49943, and this divided by 12 gives ·12495, of which 4 decimal places are correct.

Auxiliary table to estimate the interval between two forks, where the difference of their vibrations is known, from the number of beats

at about	a difference of 1 vibration, corresponds to an interval of— Sem.
C	·066
C sharp	·062
D	·058
D sharp	·055
E	·052

	Sem.
F	·C49
F sharp	.046
G	·044
G sharp	·042
A	·039
A sharp	·037
B	·035
c	·033

The approximate pitch of the lower fork is determined by a piano or harmonium, because a difference of pitch amounting to a half or three-quarters of a semitone makes no perceptible difference in the estimate. According to this pitch multiply the numbers in the table by the difference of the beats, and the result gives the interval. Even if the beats, counted from auxiliary forks, amount to 10, or in the higher pitches to 20, the result will be far better than any estimate of ear. I have found this method extremely useful for the rapid estimation of interval.

Table IV.

Conspectus of Pitch.

All the pitches are expressed as C and A on the equal temperament. The pitches calculated are inclosed in a parenthesis. The others were measured. SF and SS = semitones flat and semitones sharp, meaning the number of equal semitones by which the pitch is flatter or sharper than C 512.

When no sign is prefixed to the name of a pitch, it was measured by me, and generally with the assistance of Mr. Hipkins, by means of Appunn's tonometer, or by comparison with other forks so measured.

* is prefixed to theoretical pitches for which no forks have been measured.

† prefixed to the name of the pitch, shows that it is a trustworthy measurement, but not made by myself; the name of the authority is subjoined in a parenthesis.

‡ prefixed to the name of a pitch, shows that it is not so trustworthy. The name of the authority is added. If that is Fr. Com. = French Commission of 1859, or Br. Com. = Brussels Committee of 1863, or Reitz (the Dresden conductor), the pitch has, been corrected by adding 4 to A on the principles explained in note 16, on the correction of the French pitch, and the result is probably correct within 4 vibrations. The other pitches marked ‡ may be wrong by 5 to 10 vibrations.

(*Ath.* 545·2) and similar insertions, imply that this was the pitch given in my second article on Tonometry in the *Athenæum* of 30th December, 1876, pp. 893-4, but that the pitch in the table has been deduced from a new and more careful measurement. The differences will generally be found to be very slight indeed.

The series of whole numbers for C with the corresponding A, and SF or SS, has been continued throughout for convenience of comparison with the outline table already given. The semitones for any decimal of a pitch, can then be found by multiplying the decimal of the pitch by ·033, and adding the result to the SS, or subtracting it from the SF, corresponding to the integer. The intervals between any two SS, or two SF pitches is the difference, and the interval between SS and a SF pitch is the sum of the semitones annexed.

Name of Pitch and Remarks.

Group V.—Modern High Pitch, above C 536.

C	A	SS	
547	460·97	1·145	
(546·5)	459 5	1 130	‡ Brussels Band of the Guides. 1859. (Fr. Com.)
546·3	(459·4)	1·123	Messrs. Chappell's "concert pitch," 1877, from a fork lent me by Dr. W. H. Stone.
(546·09)	459·2	1·116	‡ London No. 3 (Fr. Com. report of C 542·5, see note 16.)
546	459·13	1·113	
545·5	(458·7)	1·097	† Wagner Concerts, May, 1877 (Mr. Hipkins)
545	(458·3)	1·081	Highest Philharmonic, July, 1874, observed by Mr. Hipkins (Ath 545·2).—Copy made for me by Mr. H. Keatley Moore (of Messrs. Moore and Moore) of a fork, in the possession of Messrs. Collard, by which Sir Michael Costa tuned his piano a few years ago, date uncertain.
(544·7)	458	1·073	Crystal Palace Band, March, 1877, from a fork lent me by Dr. W. H. Stone.
544·3	(457·7)	1·060	Philharmonic February, 1877, from a fork tuned by Mr. Hipkins to a piano furnished by Messrs. Broadwood for the Philharmonic at that date, and found to be in excellent tune with the band.
544	457·5	1·050	
543·4	(457)	1·031	Copy by Mr. Allen, of Percy-street, of a fork used by Sir M. Costa at Covent-garden, date unknown, lent me by Mr. Blaikley, of Messrs. Boosey
(543)	456·6	1·018	English Government Training School of (Regimental) Music, at Kneller-hall, from a fork lent me by Dr. W. H. Stone.
(542·8)	456·5	1·012	‡ London No. 2 (Fr. Com. report of C 534·9, an accidental error).
542·5	(456·2)	1·003	Philharmonic, 1859, fork prepared by Mr. Hipkins, and put away since 1860. - Mean Philharmonic 1852-1874 from the records taken by Mr. Hipkins; tuned by Mr J Black, under Sir M. Costa's direction of the Philharmonic, 1846-54, and retained as Broadwood's highest pitch until 1874: London No. 3 in 1858, as sent to the French Commission
(542·3)	456	·996	† Copy of fork made by Mahillon, of Brussels, and measured by Mr E. Greaves, of Sheffield, by means of Appunn's tonometer. – ‡ Lille, highest French pitch in 1859. (Fr. Com.)
(542)	455·8	·986	‡ Berlin in 1859. (Fr. Com.)
(541·8)	455·6	·980	British Army Regulation Pitch in 1877, from a fork lent me by Dr. W. H. Stone.
(541·7)	455·5	·977	‡ St. Petersburg in 1859. (Fr. Com.)
541	454·9	·954	
540·3	(454·3)	·932	Copy by Mr Allen, of Percy-st., of the Society of Arts fork meant for C 528.
540	454·1	·922	
(539·7)	453·8	·913	‡ Prague in 1859. (Fr Com.)
539·4	453·6	·903	Fork made by the late Mr. J. H. Griesbach in 1860, to represent the C 528, from the original lent me by the Society of Arts, for which it was made as a representative of the pitch recommended by their Committee. The box containing this fork has the following note, signed by Mr. Griesbach in 1860:—"The Pitch of the Fork producing the note C [this was in musical notation] 528 vibrations in a second was obtained by my apparatus for registering and printing the vibrations of strings, shown at the Exhibition of the Society of Arts, 1860."
(539·1)	453·3	·893	Dresden high pitch in 1869, according to a fork sent officially to the Society of Arts in that year, and lent to me by the Society.
539	452·2	·890	Copy made for me by Mr. H. Keatley Moore (of Messrs Moore and Moore) of the standard fork used by Messrs. Collard in 1876, intended for C 528.
(538·4)	452·8	·871	‡ Leipzig in 1859 (Fr. Com
538	(452·4)	·858	Fork sold by Messrs. Cramer, stamped—"Society of Arts, C 528 vib. per sec."
(537·9)	452·3	·855	Leipzig *Gewandhaus* fork sent officially, in 1869, to the Society of Arts, and lent to me by the Society
(537·5)	452	·842	Fork sold by Messrs Cramer, stamped—"Society of Arts, A eq. tempt. to C 528 vib. per sec."—Copy made by Mr. Hipkins of a C fork shown to him at the house of the Society of Arts as the standard, but different from Mr Griesbach's original fork (Ath. 538). – ‡ Paris in 1859 (Fr. Com.)
537	451·6	·825	
(536·3)	451	·803	‡ Marseilles in 1859 (Fr. Com.).

Group IV.—Medium Pitch, from C 528 to C 536.

C	A	SS	
536	450·7	·793	
(535·1)	450	·764	‡ The Hague in 1859 (Fr. Com.).—‡ Pesth in 1859 (Fr. Com). - ‡ Dresden Theatre in 1869 (official report of Kapellmeister Reitz sent to the Society of Arts).
535	449·9	·761	
534·9	(449·8)	·758	Broadwood's medium pitch, adopted in 1849–54, and still adhered to by them for tuning pianofortes not sent to concerts. Measured from the original fork, which was chosen quite empirically (Ath. 535, which is the best number perhaps); London No. 2 in 1858, as sent to Fr. Com., see note 16.
(534·7)	449·6	·751	Fork made by the late Mr. J H. Griesbach in 1870, to represent the equally tempered A corresponding to his intended C 528, see C 539·4, in the possession of the Society of Arts, by which it was lent to me. The box containing this and the other fork, C 539·4, has the following note by Mr. Griesbach:—"The Pitch of the Fork producing the note A [in musical notation] derived from the above-named *C*, was obtained by a monochord, the length of its string 20 Inches, tuned to the note *C* [in musical notation, the octave below the above named C] from the *C* 528 vibrations in a second, the whole length of string being equal to 1000, the tempered *A* is produced by 594 thousandths" This is an error; it should be ·5916036, that is, more nearly 595 thousandths. With so short a wire tuned by ear to the octave below, we cannot be surprised at his not having hit the tempered A to his C correctly.
(534·6)	449·5	·748	‡ Paris Italian Opera in 1826 (Br. Com.).
534·5	(449·4)	·745	Broadwood's medium pitch, as measured by a fork prepared in 1860, and put by ever since. See C 534·9.
534	·449	·728	
(533·6)	448·8	·715	‡ Turin in 1859 (Fr. Com.).—‡ Würtemberg in 1859 (Fr. Com.).—‡ Weimar in 1859 (Fr. Com).
533·2	(448·4)	·703	St. Paul's organ, when the Passion Music was performed, March, 1877, from the fork to which the piano was tuned to play with the organ. The organ and piano were observed by Dr. Stainer, the organist, to go well together.
533	448·2	·696	
(532 2)	447·5	·670	‡ Brunswick in 1859 (Fr. Com.).
532	447·4	·663	
531	446·52	·631	
(530·99)	446 5	·630	‡ Toulouse Theatre in 1859 (Fr. Com.).
(531·9)	447 2	·661	Fork of the Liceo Musicale di Bologna, sent officially to the Society of Arts in 1869 and lent to me by the Society. The report sent with it gave the pitch as 887·77 simple vib. = 443·89 vib., and was stated to have been obtained by "the graphic method" and by the siren. It is stated to be rather lower than the pitch of the S. Carlo Theatre at Naples, and much lower than La Scala Theatre at Milan.
(531·6)	447	·650	‡ Bordeaux in 1859 (Fr. Com.)—‡ Stuttgart in 1859 (Fr. Com.).
530	(445·7)	·598	Fork used by Mr. Proudman, one of the conductors of the large Tonic Sol-fa Vocal Concerts, at the Crystal Palace, in 1877. Measured rather hastily by a fork made for me by Mr. E. Greaves. It is possibly only another copy of Mr. Hullah's fork (C 529·3).
529·3	(445·1)	·574	Fork stamped "Do, 512 vib. per sec. C.; J. W. Parker, West Strand," being one of the forks issued by Mr. Hullah about 1843, and bought by me at the time. Another copy of the same date, in the possession of Mr. de Pontigny, gave within ·2 vib. of the same result In the report of the Committee of the Society of Arts in 1860, one of these forks is said to have been measured by Mr. J. H. Griesbach, as C 521·6, and the original pitch to have been determined by the siren. These measurements are therefore useful in showing the probable errors of such methods.
(529·2)	445	·571	‡ Dresden in 1859 (Fr. Com.)—‡ Paris Opera in 1826 (Br. Com.).
(529·1)	444·9	·568	† Vienna in 1834, Scheibler's No. VI., measured and called by him an Auswuchs, or excrescence, from being so much sharper than the other Vienna forks.
529	444·8	·565	
528	(444)	·533	* Society of Arts, theoretical pitch, see C 540·3, 539·4, 539, 538, 537·5, 534·7.

Group. III.—French Normal Pitch, C513 to C527.

C	A	SS	
527	443·1	·500	
(526·6)	442·8	·487	Dresden low pitch, sent officially in 1869 as the Dresden pitch from Leipzig to the Society of Arts, by which it was lent to me.
526	442·3	·467	
(525·6)	442	·454	† Principal stop of the Westminster organ in May, 1877 measured by Dr. W. H. Stone by means of beats with a Koenig's copy of the French normal, subsequently measured by me by means of a fork previously compared with Appunn's tonometer.
(525·2)	441·6	·441	† Berlin in 1834 (Scheibler considered this his only trustworthy Berlin fork). Scheibler says:—"I am convinced that the Berlin A varies by three or four simple v b. [1·5 to 2 vib.], and this suffices to render a singer capable or incapable of performing his or her part."—("Tonmesser," p. 53.)
525	441·5	·434	
(524·4)	441	·414	‡ Toulouse Conservatory of Music in 1859 (Fr. Com. the lowest French pitch recorded at that date).
(524·3)	410·9	·410	† Vienna in 1834 (Scheibler's No. V., given him by Prof. Blahetka as a trustworthy Vienna orchestral A, and esteemed by him the best of those he possessed).
(524·1)	440·7	·404	† French Conservatory concerts, and Italian opera in 1834 (Scheibler's No. 4. not thought by him so good as Gand's C 517·3).
(524)	440·6	·401	Fork sent officially, in 1869, to the Society of Arts from Stuttgart, to represent the pitch usually adopted in Würtemberg, and lent to me by the Society. The French normal is also stated to be commonly in use in Würtemberg.
(523·3)	440·1	·378	† Vienna, in 1834 (Scheibler's No. IV).
(523·25)	440	·376	† Scheibler' own pitch, selected by him a "the mean of the limits within which the grand pianofortes at Vienna rise or fall by temperature," said to be 1·5 simple vibration = ·75 vib. ("Tonmesser," p. 53). As this pitch was proposed to and accepted by a congress of physicists (incorrectly called "musicians" in the report of the committee appointed by the Society of Arts), which met at Stuttgart in 1834, it is known in England as the "Stuttgart pitch." although it does not appear to be known by that name in Germany. It so happens that the just major scale of C 528 can be expressed in whole numbers, and will give 440 for A. This had nothing to do with Scheibler's intentions in proposing it, and he gives the tempered scale correctly in his book. But the committee overlooked the fact that we do not play in just intonation, and proposed C 528 as the standard, meaning A 440. See C 528 for further references.—Fork sent officially, in 1889, to the Society of Arts, from Munich, as representing the French normal A, which is prescribed by authority, an office for stamping forks being appointed to secure uniformity. The fork sent is stamped with a crown at the end of each prong, but it is 1 vib. sharper than the French

C	A	SS	
			normal A lent to me by the Society of Arts.
523	(439·8)	·368	Broadwood's low pitch, meant to be C equally tempered to the French normal A, and hence should be C 522.—St. Petersburg fork with the Government stamp, sent officially, in 1869, to the Society of Arts, and lent to me by the Society.
(522·7)	439·5	·356	Fork sent officially, in 1869, from Cologne to the Society of Arts as representing the French normal there adopted, and lent to me by the Society.
(522·3)	439·2	·345	French normal A, by Secretan, of Paris, a fork with the official stamp, bought in Paris by the Society of Arts, and lent to me by the Society.
(522·24)	439·15	·343	† Vienna in 1834 (Scheibler's No. III.)
522·2	(439·12)	·342	Mr. Hipkins' vocal pitch, made by Mr. E. Greaves from one he bought in 1846 from Bates, organ maker, then of Ludgate hill, stamped "Philharmonic." It has not been retuned, and hence represents one of the pitches then in favour.
(522·18)	439·1	·341	French normal A, by Koenig, belonging to Dr. W. H. Stone, measured against a fork A 440, which had been tried with Appunn's tonometer.
(522·12)	439·05	·339	French normal A, by Secretan, belonging to Dr. W. H. Stone, measured with a fork, A 440, tried with Appunn's tonometer
(522·06)	439	·337	French normal A, by Secretan, officially stamped, given by the French Commission of 1859 to Messrs. Broadwood, and hence taken by me to be the official representative of the French normal until the prototype preserved in the French Conservatory has been compared.—‡ Carlsruhe, in 1859 (Fr. Com.)
522	(438·95)	·335	Fork representing that used by Sir George Smart in 1840, and approved by him in 1859.—Fork, by Lancelot, exhibited in the Loan Collection of Scientific Apparatus at South Kensington in 1876, and marked 1,032 simple vibrations, intended for C 516, whereas Koenig's fork so marked was C 521·1.
(521·7)	438·7	·325	French normal A, given to Messrs. Broadwood by the Commissioners of the French Great Exhibition of 1867.
(521·6)	438·6	·322	Fork sent officially in 1869 to the Society of Arts from Baden, as representing the French normal A there adopted; it is made by Secretan, and officially stamped. Lent to me by the Society.
521·2	(438·3)	·309	Sir George Smart's fork, about 1826 (*Ath.* 521).
(520·87)	438	·301	‡ London, No. 1, in 1851 (Fr. Com., believed to refer to C 522·28. See note 16.)
520	437·3	·268	
(519·7)	437	·256	Sir George Smart's Philharmonic, the mean tone C would be 522·74, and Sir G. S. considered it to correspond with his C 522. (*Ath.* C 519·93, the error of ·23 vib. in the pitch of C, was due to Mr. Hipkins having forgotten that he had measured the fork by the lower of his two French normals: the original fork was subsequently measured by Appunn's tonometer.)
519	436·4	·235	
(518·9)	436·3	·232	† Vienna in 1834 (Scheibler's No. II.)
(518·5)	436	·219	‡ St. Petersburg on 19th October, 1796, by means of the beats of two organ pipes, a metronome, and a seconds pendulum, but the method is very uncertain in its results See Scheibler's "Tonmesser," p. 60 and p. 52.
518	(435·6)	·202	Lancelot's C 512, in the Loan Exhibition for Scientific Apparatus at South Kensington in 1876.
(517·8)	(435·4)	·194	Mr. Curwen's attempt to obtain C 512 by means of the siren and Koenig's forks (it is only 1 vib. sharper than Koenig), used as the Tonic Sol-Fa standard. (*Ath.* 517.)
(517·4)	435·1	·181	† An older fork of the French Conservatory, measured in 1834 by Scheibler.
(517·3)	435	·178	* Theoretical French Normal.
(517·25)	434·9	·177	† Fork of the French Conservatory, made by Gand, luthier du Conservatoire de Music (rue Croix des Petits-champs), measured in 1834 by Scheibler (No 3), and most esteemed by him of the three Conservatory forks in his possession, because he knew that Gand understood his business ("Tonmesser," p. 52).
517	(434·74)	·168	† Mr. J. H. Griesbach's attempt to get C 512, exhibited in the Loan Exhibition for Scientific Apparatus at South Kensington, in 1876.
516·8	(434·57)	·161	Koenig's attempt to get C 512. See explanation of this discrepancy in note 16, on the correction of French pitch.
516	433·9	·135	
(515·8)	433·8	·127	† Fork of the Paris Académie de Musique, made by Petitbout, luthier de l'Opéra, measured by Scheibler in 1834, and more esteemed by him than his other fork of the French Opera, because he knew that Petitbout understood his business ("Tonmesser," p. 52).
(515·7)	433·7	·124	† Vienna in 1834. (Scheibler's No. I.)
514	432·22	·067	
513	431·38	·034	

Group II.—The Handel Pitch, from C 500 to C 512.

C	A	SF	
(512)	430·5	·000	‡ Berlin, 1806-14. (Wieprecht, as reported by the Fr. Com.). Mean tone, C 514·37, just C 516·1.
511	429·7	·034	
510·8	(429·5)	·041	Original Philharmonic, 1813. The late Mr. Peppercorn, once a tuner at Messrs. Broadwoods, preserved a fork of this pitch, which he stated to have been the concert pitch when the Philharmonic Concerts began in 1813, and to have been adhered to for fifteen years after. The original fork is lost, but a copy put away in 1860, was found and measured
(510·17)	429	·074	‡ Mozart (official report of Kapellmeister Reitz, of Dresden, to the Society of Arts), mean-tone, C 513·1; just, C 514·8.
510	428·9	·068	
509	428	·102	
(508·5)	427·6	·119	Old fork used at the Plymouth Theatre about 1800, lent me by Dr. Stainer, mean-tone, C 511·1; just, C 513·1.
508	427·2	·136	
(507·54)	426·75	·152	† Fork of the Paris Opera (Académie), measured by Scheibler in 1834. Mean-tone, C 510·47; just, C 512·1.
(507·4)	426·4	·165	Handel's own fork, the property of the Rev. G. T. Driffield, rector of Bow, Middlesex, who brought it to me to measure, with the help of Mr. Hipkins. The box containing this fork has the following note inside:—"This Pitchfork was the property of the Immortal Handel, and left by him at the Foundling Hospital, when the Messiah was performed in 1751: Ancient concert, whole tone higher; Abbey half-tone higher; Temple and St. Paul's organs exactly with this pitch Presented to Rd. Clark by I: Brownlow, the D: Sec: 1835.—Invented by M. Shore, Serj. Trumpeter, time of H. Purcell." It was bought together with another old fork (measuring A 213, or an exact octave flatter, as far as its imperfect construction would allow of measurement) at the sale of the effects of Mr. Clark, who probably wrote the above note, and was "a gentleman of the Chapel Royal and Westminster Abbey." The estimation of comparative pitch in this note is of course grossly exaggerated, and only the identities can be reasonably trusted. Handel, it is known, gave an organ of 16 notes to the octave, to the Foundling Hospital (long since rebuilt and retuned to equal temperament), and as he used the mean-tone temperament, the value of the notes are shown by this fork to have been:—

C	A	SF	
			C 255·05 Efl 305·11 Gsh 398·51 Csh 266·50 E 318·81 Afl 408·07 Dfl 272·90 F 341·12 A 426·40 D 285·15 Fsh 356·44 Ash 445·55 Dsh 297·96 G 381·38 Bfl 456·24 B 476·73 giving upper mean-tone C 510·10, just C 511·7.

Group I.—Ancient Low Pitch, below C 500.

C	A	SF	
(491·13)	413	·720	‡ Gluck, 1714–87 (official report of Kapellmeister Reitz, of Dresden, to the Society of Arts). Mean-tone C 494·03, just 495·6.
(480·4)	404	1·103	‡ Paris Opera in 1699 (Sauveur, extremely uncertain), mean-tone, C 483·26.
478·8	(402·6)	1·152	Fork, tuned to a C organ pipe of Father Schmidt's; probable date 1680. "This pipe," notes Mr. Hipkins, "was formerly in Hampton Court organ, and being lately tried at Messrs. Bevington's, proved to be a whole tone below their Paris organ. Hampton Court organ, as other of Father Schmidt's organs that had not been altered, was reputed a sharp organ. This pipe would make it very flat. May it not be B flat or B, incorrectly marked C. 'C 15' are incised upon it, and the vibrating length for the column of air is exactly 12 inches, an English foot, which would be C. But, again, did Father Schmidt use an English foot for his scale? Durham organ, one of Schmidt's, which I heard in 1872, was up to our medium, C 535." If it were meant for B, then we must add a mean semitone, or 1·171 SS, and the sharpness of C would be ·059 SS, giving about C 513·7. If it were meant for B flat, then we must add a mean-tone, or 1·932 SS, and the sharpness of C would be ·784 SS, giving about C 535·7, which is, as nearly as may be, Messrs. Broadwood's medium, or C 534·7. But, low as the pitch is for C, it is not the lowest on record.
(467)	(392·7)	1·530	‡ Trinity College, Cambridge, Nov., 1755, measured by Dr. R. Smith as D 262·1, giving mean-tone C 468·7, mean-tone A 383.

DISCUSSION.

The Chairman said Mr. Ellis had given an immense amount of information and most valuable statistics, very difficult to obtain.

Mr. Hipkins desired to emphasise the importance of having some standard of pitch and means of fixing it.

Prof. Macfarren said the facts and statistics which Mr. Ellis had accumulated would be most valuable in any speculations and experiments on this important subject. One thing, however, must never be forgotten, viz., that however desirable it was to fix and certify the pitch, the variations, not only of the seasons, but also of temperature during an evening, materially affected the pitch of musical instruments in the same room. Thus, an organ recently erected in the concert-room of the Royal Academy of Music, was found to rise so vexatiously in the course of the evening as to make it all but useless. It was found that the pipes were affected by the gas-burners, which hung from the ceilings, and when the mode of lighting was altered, and the burners placed close to the roof, it stood very well in tune, but, still, if the room were very crowded, the heat thus occasioned considerably raised the pitch by the end of the evening. In the Town-hall at Birmingham last year, great pains were taken to regulate the pitch of the organ to that of the musical instruments, and it was accordingly lowered to the standard of Sir Michael Costa's orchestra; but a succession of cold and wet weather set in, which brought down the pitch of the organ below that of the instruments, and the consequence was that there was a most painful discrepancy between the band and the organ, though every possible means was taken to remedy it by lighting all the gas in the neighbourhood of the organ pipes. Thus, however well pitch might be defined, the circumstances of climate, or of a crowded or sparse assembly, would very materially militate against the attainment of perfection by the best human efforts. The durability of pitch, as had been stated, must greatly affect musical effect, and the invariability of the human voice was beyond denial; but it must be remembered that a popular singer was almost despotic, and might insist on the transposition of a song or of a part throughout an opera; but to transpose a symphony for an entire band, or a concerto for an instrument, would be a total impossibility. The serious way in which the tone was affected by thinning the strings of bowed instruments, and diminishing the bore of others, was a very important consideration, even in comparison with the inflexibility of the vocal organs. The tone of the voice would remain the same, whether the sound were a semitone higher or lower, but the sound of an instrument was vitiated by the mechanical contrivances, such as the insertion of bars of wood to resist the extra tension of the strings, or the decrease in the bore of the pipe; and it was manifestly desirable, therefore, in the interests of music, that the pitch should be controlled and kept within reasonable limits. Another important consideration was the difficulty of representing the compositions of different eras, which had been written for different standards of pitch; but it was a marvellous fact that while the pitch was felt to be changed, the impression of the character of the keys seemed to remain with reference to the nominal key, not to the number of vibrations of each particular note. Thus the key of D at the present day represented the same effect as was produced by the same key, according to one's earliest recollections; it did not sound like the key of E flat, although it might be of the same pitch. If Mozart's symphony in C were to be played a semitone lower, to bring it to the original pitch, it would not sound at all the same. How far this result was subjective, and how far objective—how much depended on the imagination of the hearer, and how much on the physical facts—was a deep, perhaps an insoluble question; but it was one which really ought to be considered.

Dr. Stone quite agreed with what Mr. Ellis had said with regard to reeds and forks for tuning purposes, with this exception, that the reed, while undoubtedly a more variable was also a more coercive instrument than a fork. A fork was a very valuable instrument in a laboratory, but was not coercive enough in an orchestra in obliging its note to be followed, and to this he could not but attribute many of the discrepancies in organs; notably that which occurred last year at Hereford, but at the same time this discrepancy was constantly over-estimated. The difference in the case just referred to, was said by Mr. Cummings to be about a semitone, but in his belief it was not much more than a comma, for that was quite sufficient to produce a thorough disorganisation of the vocal and instrumental forces. As they had just had proof, when the tones succeeded one another, the ear over-estimated the difference, and a comma sounded almost like a semitone. Passing by the effects of heat and vapour, which he had recently treated in a lecture which would appear in some of the musical papers during the present week, he might add a word on the raising of pitch in orchestral instruments. There was, no doubt, a tendency to rise, which was still going on and seemed likely to be perpetuated, and it could hardly be supposed to be purely accidental. He attributed it in great measure to the predominance of fifths.

This interval was surrounded by dissonances, and the ear naturally tended to tune it correctly, but if it were tuned true, the octave became too large, and in orchestras and military bands the octaves were sacrificed to the primary, instinctive feeling of the true fifth. This was aided by conductors, who felt more strongly even than the performers the desire for a true fifth, and constantly turned to those who were tuning with the remark that they were too flat. If they could only be persuaded to say, "You are too sharp," a tendency in the other direction might be induced, which would do much good. Besides this, there was in human nature, especially in musical nature, a certain vulgar feeling of liking to hear oneself; and there was a small level ground on each side of consonance — at any rate in orchestral instruments—on which you might stand out a little louder than your neighbour, and yet not be sensibly dissonant. On this little platform of convenience, all wind instrument performers, at any rate, were too fond of standing, and they were not brought back to the just medium of absolute consonance, because in melodic intervals the difference was not perceptible. This could only be corrected by some absolute standard being determined, to which conformity should be required. He would not say anything about the question of brilliancy, because he considered it a mere *ignis fatuus;* but as to changing instruments, it was very difficult to get a set in perfect tune, and, when obtained, they were handed down as heirlooms. If you tried to make a new set, it took years to get them right, and then there were discords lurking in certain parts of the scale. With regard to the attempt to introduce flattened instruments into orchestral bands, he had no hesitation in saying that up to the present moment it had not been successful, no new set of instruments being in tune with one another, and hardly anyone in tune to itself. The first thing was to get the instruments in tune, which was one of Mr. Ellis's suggestions, and an attempt to secure this had been in progress for nearly a year. He had been working at it with his friend Dr. Stainer, and they hoped to establish, either at the National Training School for Music, or some similar institution, a tuning-machine, by the aid of which an instrument should be supplied to a performer, which was not only in tune with itself, but also corresponded to some definite existing pitch.

The Chairman, in proposing a vote of thanks to Mr. Ellis, said he thought he knew something of pitch, but he found his knowledge was only as a grain of sand compared with the amount of information now brought together. In a practical point of view the French did an exceedingly good thing when they fixed on one pitch, though it was not exactly the one they intended; they found the pitch getting so high that they determined on fixing it for the future, and they had practically done so, not only for France, but the Continent generally. He had the gratification some time ago of hearing Beethoven's "Sinfonia Eroica," played at a Conservatoire concert, in E flat as it should be, but he could not get rid of the idea when he heard it played at the Philharmonic concerts that it was in E natural. He had just had the honour of dining with R. Wagner, and, on speaking with him on this subject, he complained bitterly of the inconvenience his singers had been put to on account of the fact that the pitch they were obliged to sing to here, was so much higher than that which they were accustomed to. The Society of Arts had endeavoured some years ago to do the same thing as the French, and like them did not seem to have done exactly what they intended, but unfortunately their efforts had been almost ignored. Cathedral choirs had to a large extent taken the matter into their own hands, and insisted on organs being tuned lower, and he believed in the case of Westminster and St. Paul's, the intention was to adopt the French pitch, which in fact agreed with Messrs. Broadwood's vocal pitch, though they had not apparently quite succeeded. Of course when bands were in question, vocalists were obliged to adopt the pitch of the instruments. He did not see that anything could be done in the way of coercion, but by such discussions as this, public opinion might be brought to bear on the question, and the present unduly high pitch might be eventually lowered.

Mr. Ellis, in reply, said he had been led to take up this subject from having found an instrument which he could really trust, and whose results could be verified; and he desired to thank the numerous friends who had assisted him in collecting the information he had now brought forward. At the recent lecture by Dr. Stone at the College of Organists, the organist of St. Andrew's, Holborn, mentioned that his instrument, being in three different places, it frequently became almost outrageously out of tune in the course of the service, and he remarked that, when people made so much of differences of temperament, they were really straining at a gnat and swallowing a camel. It was, in fact, very difficult to keep a large organ in tune with itself, and his own opinion was that organs should be reserved for use in cathedrals, and not combined with an orchestra, because the result was so very seldom satisfactory.

MUSHROOM CULTURE IN JAPAN.

The best of the edible species of mushrooms are known as "matsutaké" and "shu-take." The difficulties attendant on preserving the former kind almost exclude them from the market for export; for not only do they decompose very rapidly, but even when they are successfully dried they are nearly tasteless, and thus useless in cookery. The shu-take species, however, have this peculiar excellence, that though they are all but tasteless in their raw state, when they are dried they have an extremely fine flavour. The quantity that grows naturally on the decayed roots or on the stumps of the shu tree is not sufficient to meet the demand felt for them, consequently much skill has been brought to bear on their cultivation, notably by cutting off the trunks of the shu and other trees, and forcing the growth of the mushroom on them. The localities in which they are thus cultivated are Yamato, Isè, Mikawa, Yotonu, Suruga, Kai, Iclzu, Hitachi, Mutsu, and Dewa Serano and Hida, Ku and Sinvo. These provinces produce the largest quantities; indeed, the quantity produced elsewhere is insignificant. Small parcels are produced in Zezo. There seems to be no great difference between the wild and cultivated varieties of the shu-take mushroom, both being in taste and appearance very much the same, with this exception, that in the wild variety the upper surface is of a purplish brown colour, while the under surface and stalk are white; in the cultivated variety the shape is uneven and irregular.

Different varieties of oak appear to be the trees most in favour with the Japanese for the cultivation of mushrooms, the tree known to natives as shu giving the best results. This tree grows abundantly in warm places having a south-easterly aspect; it attains to a height of about eighteen or nineteen feet. It has a long, narrow leaf, thin and stiff, the front surface of a deep green colour, the back of a brownish tint and glazed. The tree is an evergreen, the fruit (acorn) small, with a rough capsule. The acorns are steamed and eaten. The wood of the tree is used in the making of boats' oars; also for fuel and charcoal. Another oak, the kashinda, from which mushrooms are obtained, is also plentiful in warm localities, and attains to a height of thirty or forty feet. The leaves are used in cookery, and the wood is in great demand for divining sticks, for which it is considered the best. The donguri, another species, is to be found all over the country; it grows to about eighteen or nineteen feet, has very thick branches, and dense foliage; the leaf is slightly oval and slightly wrinkled. The fruit (acorn), after being pounded and steeped in water, is made into dumplings, and eaten in this form. The wood is much used in boat-making and also for carts.

Mushrooms are obtained from any of the above in the following manner:—About the beginning of autumn the trunk, about five or six inches in diameter, of any one of these trees, is selected and cut up into lengths of four or five feet, each piece is then split down lengthwise into four, and on the outer bark slight incisions are either made at once with a hatchet, or the cut logs are left till the following spring, and then deep wounds seven or eight inches long are incised on them. Assuming the first course to have been pursued, the logs, after having received several slight incisions, are placed in a wood or grove where they can get the full benefit of the air and heat. In about three years they will be tolerably rotten in parts. After the more rotten parts are removed, they are placed against a rack in a slanting position, and about the middle of the ensuing spring the mushrooms will come forth in abundance. They are then gathered. The logs are, however, still kept, and are submitted to the following process:—Every morning they are put in water, where they remain till afternoon, when they are taken out, laid lengthwise in the ground, and beaten with a mallet. They are then ranged on end in the same slanting position as before, and in two or three days mushrooms will again make their appearance. In Yeushin the custom is to beat the log so heavily that the wood swells, and this induces mushrooms of a more than ordinary large growth. If the logs are beaten gently, a great number of small-sized mushrooms grow up in succession. In places where there is a scarcity of water, rain-water should be kept for steeping the logs in. There is yet another plan. The cut logs are at once buried in the earth, and in a year's time are dug out and beaten in the manner above described.

The mushrooms thus grown are stored in a barn, on shelves, ranged along three sides, with braziers lighted under. Afterwards they are placed in small boxes, the bottoms of which are lined either with straw or bamboo mats. These boxes are then ranged on the shelves, and all approaches carefully closed. An even degree of warmth is thus diffused. The boxes ranged on the upper or lower tiers are constantly changed, so that the contents of each are thoroughly dried. Another mode of drying is to string the mushrooms on thin strips of bamboo, which are piled together near the brazier; the heat is well kept in by inverting a closely woven basket over them. Dried mushrooms are much esteemed in China, and they are largely consumed by Japanese, either as a dish by themselves, or as a condiment with other dishes. Dried mushrooms retain their flavour for a great length of time, and thus bear transport to any distance very well. Of other edible mushrooms in Japan, besides the shu-take, there is the kikurage, which grows in spring, summer, and autumn, on the mulberry, the willow, and other trees. It is a small, thin, soft mushroom, very much curled at the edge, and of a brownish tinge; when dried in the sun, the upper surface gets quite black, and the under surface a brownish grey. The flavour is somewhat insipid. The iwatake, which grows on rocks in thick masses. The so-take, a very delicately flavoured mushroom, to be found in precipitous crags, and consequently scarce, owing to the difficulties attendant on getting them. The kwa-take, to be found in shady spots on moorland; a funnel-shaped mushroom, with a long hollow stalk.

Consul Robertson, in addition to the above description, states the export of mushrooms from Kanayawa, amounted, for the year 1875, to 1,461 piculs, valued at 55,024 dollars; in 1874 the export was 1,603 piculs, valued at 61,656 dollars; and in 1873, 1218 piculs, valued at 34,170 dollars.

NOTICES.

MEETINGS FOR THE ENSUING WEEK.

Mon.... Royal United Service Institution, Whitehall-yard, 8½ p.m.
Institute of Surveyors, 12, Great George-street, S.W., 3 p.m. Annual Meeting.
Royal Geographical, University of London, Burlington-gardens, W., 1 p.m. Annual Meeting.
British Architects, 9, Conduit-street, W., 8 p.m. Mr. J. J. Stevenson, "Architectural Restoration—its Principles and Practice."
Social Science Association, 1, Adam-street, Adelphi, W.C. 8 p.m., Miss Shirreff, "Trained Teachers for Secondary Schools."

Tues. Conference on Spelling Reform (at the House of the Society of Arts), 3 p.m. At 7.30 p m. Public Meeting.
Royal Institution, Albemarle-street, W., 3 p.m. Prof. James Dewar, "The Chemical Philosophy of Sir Humphrey Davy." (Lecture II.)
Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. 1. Discussion on "Water-Pressure Machinery." 2. Mr. G. Haycraft, "Economical Method of Manufacturing Gunpowder-Charcoal."

Wed.... **SOCIETY OF ARTS**, John-street, Adelphi, W.C. No Meeting.

Thur.... Royal, Burlington House, W., 8½ p.m.
Antiquaries, Burlington House, W., 8½ p.m.
Civil Engineers, 9 p.m. President's Conversazione at the South Kensington Museum.
Society for the Encouragement of the Fine Arts, 9, Conduit-street, W., 8 p.m. Lecture by Dr. John S. Phené, F.S.A.
Royal Institution, Albemarle-street, W., 3 p.m. Prof. Tyndall, "Heat." (Lecture VIII.)
Zoological, 11, Hanover-square, W., 5 p.m. (Davis Lectures) Prof. Huxley, "Sea Urchins and Star Fishes."
Philosophical Club, Willis's-rooms, St. James's, S.W., 6½ p.m.

Fri....... Royal Institution, Albemarle-street, W., 8 p.m., Weekly Meeting. 9 p.m. Mr. Oscar Browning, "History of Education."
Philological, University College, W.C., 8 p.m. Paper by Dr. J. A. H. Murray, Vice-President.
Archæological Institution, 16, New Burlington-street, W. 4 p.m.
Royal Botanic, Inner Circle, Regent's-park, N.W., 4 p.m. Professor Bentley, "Plants, with Reference to their Life and their Organs of Reproduction." (Part 2.) "On the Organs of Reproduction." (Lecture IV.) "Preliminary Observations on the Reproductive Organs. Of the Bract or Floral Leaf. The Peduncle or Flower Stork. The Inflorescence."

Sat....... Artizans' Institute (at the House of the Society of Arts), 3 p.m. Annual Meeting.
Royal Institution, Albemarle-street, W., 3 p.m. Mr. Charles T. Newton (Lecture I.), "Recent Discoveries at Mycenæ."
Institute of Actuaries, The Quadrangle, King's College, 3 p.m. Annual Meeting.

Errata.—Chemical Section.—Mr. Davis's Paper.—Page 639, right hand column, line 55, for £8 8s. 6d., read £8 18s. 6d.; Discussion, page 641, left hand column, line 26, for £15, read £2 15s.; right hand column, line 9, for 275, read 175; line 71, for £12 19s., read £9 2s.

JOURNAL OF THE SOCIETY OF ARTS

No. 1,280. Vol. XXV.

FRIDAY, JUNE 1, 1877.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

NOTICE TO MEMBERS.

The Society's *Conversazione* is fixed to take place at the South Kensington Museum, on Wednesday, the 27th June. The cards of invitation will be issued shortly.

CONGRESS ON DOMESTIC ECONOMY. (BIRMINGHAM.)

The General Local Committee met on Thursday, the 24th May, at King Edward's School. There were present Alderman Baker, Mayor of Birmingham (in the chair), Alfred Baker, F.R.C.S., F. F. Barham, Mrs. C. John Bracey, Rev. Canon Bowlby, C. R. Bowling, Sir Henry Cole, K.C.B., James Deykin, Mrs. H. Edmunds, Balthazar Foster, M.D., J. D. Goodman, J. A. Longford, LL.D., Rev. E. F. M. MacCarthy, M.A., Miss A. M. Mander, Mrs. C. E. Mathews, R. H. Milward, Hon. J. S. Pakington, Rev. S. E. Pennefather, M.A., Lieut.-Col. A. Phelps, Mrs. W. L. Sargant, Rev. A. R. Vardy, M.A. P. Le Neve Foster, Secretary of the Society of Arts, attended. The Committee received returns from upwards of 150 persons approving of the Congress, and consenting to act on the General Committee.

An Executive Committee, a Finance Committee, and a Reception Committee were appointed.

Mr. J. D. Goodman accepted the office of Treasurer of the Congress.

A form of programme prepared by the Society of Arts was read, and the Meeting of the Congress was fixed for the third week in July.

All members of the Society of Arts and Delegates from the Institutions in Union are entitled to attend the meetings of the Congress free; other persons may join and attend the Congress on purchase of a ticket, price 5s., admitting one; or family tickets, price 10s., admitting four.

HEALTH AND SEWAGE OF TOWNS.

The following papers, dealing with various systems of treating sewage, were brought before the Conference* :—

PURE AIR AND PURE WATER.

Further experiences in the Lee watershed, and suggestions for Territorial Districts in the United Kingdom to prevent pollution of rivers.

By Captain L. Flower,

Sanitary Engineer, River Lee Conservancy, &c., &c.

Having again the pleasure of contributing to the Conference called by the Council of the Society of Arts to consider the Health and Sewage of Towns, I cannot do better than give personal experience on the advance of the sewage question, and endeavour to clear away the mysterious halo with which it is surrounded; in so doing, my paper may wound the susceptibilities of many an enthusiast, and many a well-meaning though misguided individual, who, if offended, must pardon me. It is only by treating a question impartially that it can be fairly considered. Last year I gave a few remarks on the question at large, in addition to a slight sketch of experience in my own watershed; the precedent is followed in this paper.

As to the discharge of untreated sewage into the sea or tidal rivers, my opinion is unaltered. Running refuse into the sea, and so hoping to get rid of it, is a weak way of looking at the question, and is unworthy of an Englishman's character. True, it is the cheapest, and undoubtedly, if as has lately been stated, it would cost two millions of money to recover one million money's worth, it is better to throw away the aforesaid million; but on what data is such a notion based, and what would it cost in works to take the sewage to outfalls where it may be discharged into the sea or a tidal river, "provided no nuisance is caused," which is the saving clause in the conclusions of the committee appointed by the Local Government Board, to inquire into several modes of treating town sewage, (page xiii.,) "such mode may be allowed and justified on the score of economy?"

Sewage, so called, has a certain amount of value; why make a nuisance of it and throw it away? To say the least of it, if properly dealt with at the outfall, it is a great question whether it might not, with advantage, be used for filling up low-lying lands, a fairly clarified effluent alone being discharged into the sea or tidal river, as the case may be. Sewage being of a different specific gravity to water, floats on the surface, and is deposited on the banks or shores, as occasion is presented. Sewage has been found on the piers of Westminster-bridge, notwithstanding the undoubtedly magnificent main-drainage works of London. Perhaps, however, this may be due to erring West Ham, and not entirely to the metropolitan outfalls. Currents are eccentric also; my former observation shall be repeated, "Once cast a thing into the sea, and who knows where it may turn up again."

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* A report of the discussion will be issued in subsequent numbers of the *Journal*. For the convenience of those wishing to have the account of the proceedings in a more compact form, the same will also be published as a pamphlet, which can be had (as soon as ready) on application at the Society's House. Price 3s.

In the Lee watershed the Goux system is about to be attempted in abating nuisance from several villages. Whatever may be the advantages or otherwise of this system for collecting and disposing of excreta, one cannot help asking what becomes of the "slops;" they are not unnaturally thrown into the surface or road drains, and so reach the river, or they are shot broadcast on the land, there to ferment and poison the air. It appears to me sewers are an absolute necessity where the village houses are close together.

Commencing again at the head of the River Lee proper, at *Luton* (population, 21,000), a better state of things is fast coming into operation. The lime process, to which the authorities were so attached, is at last abandoned, though it has taken six years to cause this advance. The sewage (about 2,000,000 gallons daily) is clarified and deodorised, and so soon as the necessary formalities have been complied with, the effluent will pass through a limited area of land, and thus be efficiently purified. The town is not completely watercloseted; nearly 2,000 houses have only common privies. However, Luton is advancing; it has recently been incorporated, and the present Town Council has manifestly the intention of making Luton one of the best and most presentable towns in the kingdom. The altered sewage arrangement will tend in this direction, as well as remove from the river one of its chief pollutions.

Hatfield (population, 4,000) remains as before.

Hertford (population, 8,000) has retrograded, and returned to lime treatment only, and its attendant nuisance. The Phosphate Sewage Company (who while in possession of the works, using it as their show place, certainly worked honourably in the right direction), has ceased to treat the sewage. I trust the time may come when this place will learn common sense, and that the effluent will be purified through land in a proper and inoffensive manner. At present the state of affairs is bad.

Ware (population, 6,000) remains as it was, and as it apparently intends to be, in the face of having a few acres of land admirably applicable, if levelled, for the purpose of absorbing a properly deodorized effluent. Last year's remarks equally apply to the present time.

Hoddesdon (population, 2,000), a very pleasant town adjoining the main road from London to Hertford, and between Ware and Broxbourne, has its sewage works in operation and here is a sewage farm, close to the New River, but as to level it is above the influence of floods, and is certainly fairly selected; the sewage of Hoddesdon, in which is included waste from a large brewery, formerly polluted the streams which lead direct to the Lee. The sewage is now disposed of, and the only fault to be found with the works is the abominable stench of the place. The people at the railway station and passengers complain very much, and say they can "cut the stink." This nuisance need not exist, and as it is close to Rye House it should not be permitted. This is, however, an air nuisance, not directly one to the water. Instances exist where sewage is bound to be deodorised before it is passed to the land; it is not necessary in all cases, but it is so undoubtedly at Hoddesdon.

Broxbourne (population 1,000) has also been sewered. The sewage is disposed of on somewhat low lying land in broad irrigation. It has not been at work long enough to note results.

Cheshunt (population 8,000) is a large straggling district where sewage pollution has to be attacked in detail, and furnishes one of the instances where irrigation with crude sewage should not be practised. An attempt was made to filter the sewage of a portion of the parish near Waltham station. The idea was that of one of the members of the Local Board, lately dead. The results were not satisfactory. Ultimately, those parts of the parish which are sewered will be disposed of by deodorisation, and then passing the effluent on the land. Much of the low lying land in this place is subject to floods.

Waltham Abbey (population 5,000) remains as it was. The condition of affairs is far from being satisfactory.

The Royal Small Arms Factory, Enfield Lock.—Here is a population of about 2,000, and a sewage farm of about 22 acres, on low lying land, and decidedly unsatisfactory; it appears to be "sewage sick," it is full of worms, and the condition of the ditches between it and Sewardstone, the adjoining village down stream, plainly shows the defective state of affairs. The attention of the Secretary of State for War has been drawn to the subject, Adjoining the place is also a population of about 500 persons whose houses are entirely unsewered.

Enfield (population 13,000) remains as it was, and, still more strange, with a satisfactory example of a combined system in an adjoining parish, the conditions of which are similar, the authorities have recently agreed to purchase another sewage farm. Next year I may be able to give results. One thing has been decided on, the attempt to keep storm water out of the sewers. This formed the subject of recent legislation with the owner of the existing farm. In places like Enfield the separate system ought to be carried out, and a combined treatment at the outfall.

Edmonton (population 15,000) continues to advance in the same satisfactory direction, of course there is room for more attention to details and for general improvement, still two years' experience under my own eye warrants my saying, that, for places similarly circumstanced, Edmonton shows an example other towns would do well to follow. The fact that 1,000,000 gallons a day of sewage, which from local circumstances cannot be "fresh," is satisfactorily disposed of without nuisance to either air or water, and without causing grumbling as to cost, forms a valuable precedent.

Tottenham (population 40,000) remains as it was, except that also, as at Edmonton, I am able to speak of the same system continuously at work, under my inspection, for upwards of 12 months, Here there is only a precipitation process carried on somewhat roughly. Sufficient care is not taken to empty the tanks frequently, and sludge is allowed to accumulate. Still, it is worth noticing that there is no nuisance. Here is some advance towards "pure air and pure water;" the whole place is fairly free from noxious vapours, the effluent is clarified and purified to such a point as to be admissible into the river, and permanently so treated as not to set up secondary decomposition. The sludge is dried by air alone, on a properly drained bed, to a consistency which enables men to load it into barges or carts; it is inoffensively disposed of, and is used in some instances for filling up low-lying ground. This, too, is a precedent many towns who are at a loss what to do would do well to follow. It is but fair to say that this place, while under the lime process, was an abominable nuisance, alike to air and water. The rowing clubs on the Lee were everlastingly complaining. The men at the East London Water Works at Lea-bridge, where a water-wheel is worked by the river, were constantly also telling me of the slimy nuisance which collected on the wheel, and of the sickening smell; these complaints have all vanished.

Tottenham is far from being perfect; still, it furnishes an example which may well be recommended.

Passing by Walthamstow, Leyton, and district, all of which are in progress, and leaving the Lee at Bromley Locks, we go into the Limehouse-cut, and thence to the Thames.

Limehouse-cut has been rendered notorious by the small-pox hospital agitation. This cut was formerly in a very filthy state. Apart from main sewers, which formerly discharged here, before the Metropolitan main drainage was carried out, upwards of 36 private drains have been abated during the last six years; and, with the exception of the trade of the place and loading manure from two dust yards, very little nuisance exists; this is a considerable sanitary advance in the East of London.

Returning to the main river, we find *West Ham*, now having nearly 100,000 population. The Metropolitan sewers cannot take their sewage, except at a cost which the ratepayers consider impracticable. No advance has taken place here; only two small tanks exist at the outfall in Canning-town, and in these the authorities are trying to treat the sewage, or rather a part of it; for their engineer reported, at a Government inquiry, held in May, 1872, that it would be necessary to construct six tanks, in addition to the two erected, giving an entire tank capacity of 2,513,600 gallons, and he estimate the cost of the additional six tanks at £10,000. They are having another trial at the lime process with the usual result; the fearful stench about the place, where the slimy, undryable sludge is spread, is something too horrible, and if the West Ham Board wanted to prove by demonstration that Canning-town was not a site suitable for treatment of sewage by chemical means, they could not have done better than create the present abominable state of things. This place is increasing, and the nuisance is unpardonable. There are those who cannot be got to move out of certain grooves; time will prove how far the Conservancies will allow West Ham to go on.

Next year, perhaps, a better state of things may prevail. This is the last outlet of lime effluent to the Thames; I trust it may soon be the last in my jurisdiction. Here we have neither pure air nor pure water; but one may get accustomed to anything—even a stink is nothing when you are used to it. Of course one is not blind to the fact that if, regardless of all sanitary conditions, we treat sewage by lime alone, and discharge the effluent into 20 or 30 times its volume of water, some improvement is effected.

The sewage of West Ham is especially foul. Considerable lengths of the sewers have little fall, and some none at all. They "are unmistakeably sewers of deposit, and consequently generators of foul gases to a serious extent."

Here would be a good oppotunity for deodorisation in the actual sewers. It is not always necessary to have tanks for the purpose.

In the tributaries of the Lee River, *Bishop Stortford*, on the River Stort (population, 6,000), still holds its own as a satisfactory example of a sewage farm on high land away from habitations. I am enabled to give, from published statements of the Local Board, an account of a year's working of the farm after the sewage has got there. Charges for pumping, &c., do not appear, therefore the statement must not be supposed to represent the cost of disposal of the sewage of the place:

Bishop Stortford Sewage Farm.

Cash Account for the Year, from March 25th, 1875, to March 25th, 1876.

Dr. Payments.	£	s.	d.
To payments of sundry tradesmen's bills, for work done, seed, corn, and other goods supplied	257	15	10
To labour	249	19	7½
To interest on loan for £6,600, effected in 1870, for the purchase of a portion of the farm, compensating outgoing tenant, &c., at 4½ per cent.	275	8	4
To interest on loan effected in 1870 for £11,000, of which some £1,300 was spent in laying out farm for the reception of sewage, at 4½ per cent.	58	10	0
To cost of management, proportion of Mr. Dudley's salary	30	0	0
To year's profit on the working of the sewage farm, after deducting the whole of the expenses, the sum of £4 3s. 6d. an acre as rent, the cost of management, &c.	5	12	2½
	£877	6	0
Cr. Receipts.			
By sundry payments to the treasurer for rye grass, corn, mangolds, and other produce grown on the farm	751	15	6
By value of oats supplied for the use of the town horses, from October 29th to March 25th	28	7	
By value of oats, hay, and straw in stock, by work done by farm horses in carting gravel for roads and coal for sewage and water-works, and by hay, straw, and rye-grass delivered for the use of the town horses	83	12	6
By outstanding debts for five loads of straw at 30s. a load, sold but not paid for, by keeping of stock from Christmas	13	11	0
	£877	6	0

Since last year, the pleasant little town of *Buntingford*, on the river Rib, about 30 miles from London, with a population of about 2,000, has been sewered in a very satisfactory manner; pipe drainage has been used thoughout, the sewers are well ventilated, and the old road drains take the storm-water; the outfall is on to land whereon the sewage previously deodorised is to be disposed of.

Fomerly, this was a very filthy place, so far as its sewage arrangements went. The Rib is nearly dry in some seasons, and all the drainage of the town and refuse from a large tannery used to pour into the bed of the river, there to stagnate till the rainy season washed it out, for the benefit of the London water companies.

Several villages and small towns still hold out, notwithstanding notices, prosecutions, and constant looking up. Some content themselves with employing engineers and surveyors to advise them and lay out schemes, then, frightened with the possible cost, these schemes are shelved.

The Rivers Pollution Prevention Act has not done much. The course of procedure in County Courts involves delay, Local Government inquiry, and uncertainty, and it is not without reason that a deputation on this subject waited on Mr. Sclater Booth in April. Still, as he told the deputation, the Act is an advance in the right direction. It must, however, be enlarged, and become compulsory instead of permissive. The authorities will, sooner or later, awake to the necessity of forming Conservancy Boards for the whole country. Daily experience teaches this more and more. It was recommended by the early Commissioners on the pollution of rivers. The watershed seems to be the best unit, either in its entirety, or in subdivisions in the case of large rivers, or an aggregation of small watersheds in smaller cases. Under any circumstances, the necessity exists for action in this direction, and it appears to me that the following would be a good way of carrying the idea into execution:—

1st. Head quarters and a central Board; the present Local Government Board, or a section thereof, for sanitary purposes only, reporting to the Home Secretary; in fact, a new department of the Home-office. The staff of the present chief inspector of the engineering department to be largely increased.

2nd. Territorial Conservancy Boards, the component parts to be on the basis of the Lee Conservancy Board, namely, representatives from each local authority in the selected area; the present local boards of health and other sanitary authorities to report to the conservancy board; this board to have freedom of action (subject of course to appeal to the Home Secretary in cases of oppression, if any), and be empowered to advise local authorities as to the best mode of dealing with the nuisances of which complaint is made, taking it as a dogma that each place must be treated with reference to its position and resources; this would prevent casting about for schemes, as hereinbefore referred to.

At present no advice must be given; authorities are told "land is the only purifier of sewage," and when no land is to be had the only answer to the question, "What are we to do?" is "Find out," (to use the words of a leading daily paper).

A properly selected officer, fully acquainted with the subject, of which, by this time many must exist, should be appointed under the board as chief officer of each territorial district. The medical officers of health should report to him, and the police also through their officers, and he should inspect periodically, and at uncertain times, as practised by myself.

As the work is arduous and extensive, the officer should be liberally paid, and provided with a proper staff. The local board surveyors should be under him, and they would then be working with him rather than apparently in opposition. The powers of the local boards in sanitary matters, save as reporting to the territorial board in those affairs, should be abolished. Certain qualification for membership of the territorial board should be required. All the doings of these boards to be made public, and published each month in a suitably condensed form, in a journal which would in time become a valuable library for reference and precedent. A general report from the head-quarters, forming a *précis* of the work of the year, should also be annually published. Many points may arise for discussion on this subject, which, I think, appears as an original suggestion.

Viewing the treatment of sewage as a "difficulty," among the points for chief consideration in discussing the present state of the question is the separate system of drainage, in other words, the storm water to the water-course; the refuse, or what is popularly called sewage, to the land.

An eminent chemist lately stated, in another place, that chemical processes of dealing with sewage may be considered to be nothing more than bringing the land to the sewage instead of taking the sewage to the land; the question is, which is the least expensive mode? But, how are we to get all our sewage on to the land? is one not to be lost sight of.

Again, the question of nuisance. The enthusiastic irrigationist declares sewage has no smell. His olfactory nerves must be differently constructed from those of ordinary mortals, or his prejudice must blunt the sensibility of those organs. True it is, there is little smell from fresh sewage, that is to say, the refuse direct from the body on to the land, of which refuse the liquid is the most valuable; but how few are the cases where such a condition exists.

We all know that sewage must stagnate before it will become offensive to such a degree as to be unbearable or dangerous to health; if we except the fact, to which attention has lately been drawn, that zymotic disease is propagated by the fluids from typhoid and other patients.

It would appear that a mode of treating urine, or urine and fæces combined, might point to valuable results in a sanitary and, perhaps, in a commercial point of view. My theory is, that all sewage (except in very few cases) should be deodorised before it is passed to the land, for it is to the land, and the power earth has of oxidising sewage, that we must look for the ultimate purification thereof, and the prevention of the pollution of our watercourses, at all events those out of which people draw drinking water.

Sewage, if received "fresh," and kept moving, may not be much of a nuisance. We have to suppose a case of a town whose sewerage arrangements are perfect, the gradients of main and tributary sewers are rapid, and no chance is given for the sewage to stagnate and stink, which system shall be, that of separating the storm and surface waters from the sewage, each being disposed of in separate channels, and a soil which shall be fully and completely suitable, both as to position, quality, and area, whereon the sewage may flow direct by gravitation, the only tank being one of sufficient size to hold a screen, which shall retain grosser solids, paper, &c., and, beyond this, a farmer whose interest it is to make the most of the undoubtedly fertilising liquid supplied to him, we then have the cheapest and the best mode of disposing of town sewage.

But let us take another picture. A large, low-lying district, sewers laid in low gradients, the main outfall sewer practically a long subsiding tank; at the end of this a reservoir or tank to hold the sewage, say for 24 hours' flow; beyond this a sewage farm, whereon the stagnated fluid has to be pumped. This is a condition more frequently found than the former case. Who is there bold enough to say there is no nuisance from sewage farming here? Here, to my mind, there appears a necessity for disinfection and deodorisation, if we are to have "pure air and pure water." Truth takes a long time in rising to the surface, and prejudice is also long-lived; vested interests, too, have lengthy existence; and, while we have blinded enthusiasts with no olfactory nerves, I fear many a fair district in this fair land will yet be poisoned by sewage odours, and diseases which ought never to exist—those which are born of foul air and a low condition of atmosphere—will still thrive. Again, there is a point which few have noticed, that is, the storm overflows, or, in other words, the "back door" by which the rivers are polluted, notwithstanding perfect sewage farm or tank arrangements at the outfall, when the sewage farmer or the precipitationist does not want the sewage. Where does the overflow from Bedford go? Where that from Cheltenham? Where that from many another place? I will leave the traditional echo to answer "Where?" This evil will continue till we get the separate system made compulsory. Here will be found plenty of work for the proposed chief officer of teritorial districts—everlasting inspection.

Moreover, the storm overflows or "back-doors" give to rivers sewage in its worst condition, for sudden storms stir up the decomposing deposited filth in the sewers, in fact scour them out.

This can be practically seen after heavy storms, at the metropolitan main drainage storm-water outlets at Old Ford, on the Lee navigation, where black and stinking fluid, worse in condition than that at either Barking or Crossness, may be observed running after sudden rains.

Although nothing particularly novel has arisen since last year to alter the conclusions I then arrived at, which further experience only confirms, it cannot be admitted, as one regrets to hear often expressed, that we know nothing about the sewage question, and that treatment of sewage is impossible. Britons are not disposed to give in like this. The Welsh colliers have latterly given us an example of endurance and bravery; the word "impossible" must not be in our vocabulary.

We are a nation of money-makers; to a certain extent this is unfortunate; if one-quarter of the money which has been wasted on Stock Exchange transactions, in connection with this question, had been spent with an honest intent to master the subject, the ever-hackneyed term, "the sewage difficulty," would have passed away.

I trust this paper may help in a discussion which will produce results. The Society of Arts is ever in the van with those ideas which tend to the well-being of England and the world at large; it is to be hoped when the present Conference is over, the Council may have good and practical conclusions to offer, and I may have done something towards that desirable end—after all, nothing more than trying to do my duty.

ESCAPE OF SEWAGE GAS INTO DWELLINGS.

By Rogers Field, Memb. Inst. C.E.

This question has attracted so much attention lately, that it is not necessary to enlarge on the evils which arise from the escape of sewer air into dwellings. One striking instance may, however, be given, which shows the great need there is for adopting other precautions than those usually taken.

Twenty-five years ago (in 1852), an alarming outbreak of fever took place at Croydon, on the introduction of a regular system of sewerage. The circumstances were thoroughly investigated at the time by Government Commissioners, and by several independent medical and engineering authorities, who arrived at substantially the same conclusion, viz., that one of the chief causes of the outbreak was the escape of foul air into the houses, through the defective construction and absence of ventilation of the sewers and house drains. Two years ago (in 1875), another considerable, though less serious, outbreak of fever took place at the same town, which was very carefully investigated by Dr. Buchanan, Assistant Medical Officer to the Local Government Board. The upshot of his official report to the Local Government Board (dated April 18th, 1876), was that the chief way in which the enteric fever spread was "the most direct and common place way of all, namely, by the escape of infected air from the sewers" into the houses, and its inhalation by persons susceptible to the disease.

Now, in the 23 years which had elapsed since the first outbreak of fever, very great improvements had been made, both in the public sewerage and private drainage of Croydon. Considerable attention, moreover, had been paid to ventilating the house drains, and making the waste pipes of sinks, &c., discharge with open ends outside the houses. It, therefore, appears surprising that any general passage of sewer air into the houses should have been possible. The explanation is, however, I believe, a simple one, and has been correctly given by Dr. Buchanan, namely, that the house drains and soil pipes are in uninterrupted communication with the public sewers, so that, to quote his expressive words:—"The air of the sewers is, as it were, 'laid on' to houses."

The arrangement whereby the sewer air is "laid on" to houses, is not in any way peculiar to Croydon, but is that usually adopted in connecting houses with sewers in the metropolis and elsewhere; and as I believe the method of connection to lie at the root of the evil, I propose to direct my remarks chiefly to this.

It is, of course, evident that, unless some precautions are taken, the pipes or drains which connect the houses with the sewers will allow sewer air to escape into the houses. The question is, what precautions are necessary? and with reference to this, I think there is a wide-spread misconception. It is generally assumed that all that is required is properly to "trap" the drains, and to relieve undue pressure of the sewer gases by ventilation, so that the traps may not be forced. Now, this is quite a mistaken notion, as water-traps of themselves are not sufficient security, even when in perfect order and relieved of pressure. It has been abundantly proved, both by scientific experiment and practical experience, that water-traps will allow foul gases to pass through them when there is no pressure, the gases being absorbed on one side of the trapping water, and giving off on the other. I have had many striking instances of this in my own practice, some of which I have published.

In considering, therefore, how to prevent the passage of sewage gases into dwellings, we must start with the fundamental proposition that water traps of themselves are no sufficient security, and seek for other means of effecting the object. The only reliable means, so far as I am aware, are, (1) the prevention, as far as possible of the formation and accumulation of sewer gases; and (2) the severance of the direct communication between the sewer and the house.

(1.) The formation and accumulation of sewer gases can be prevented, to a very great extent, by constructing the sewers and drains, so that there is no retention of foul matter in them, and by efficiently ventilating them. Efficient ventilation of sewers, however, implies more than is generally supposed. It is not sufficient merely to afford relief of undue pressure, but the openings for ventilation in the sewers must be sufficiently large and numerous to create a continuous current of fresh air through them, so as thoroughly to dilute any gases which are formed in them, and prevent their accumulating in a concentrated form.

(2). The severance of the direct communication between the sewer and the house will, if thoroughly carried out, render any passage of sewer air into the house practically impossible. One of the simplest forms of this severance, or "air disconnection," is the well-known arrangement by which the waste pipes of sinks, baths, cisterns, &c., are carried through the exterior wall, and made to discharge with open ends over a trapped gully. By this means any sewage gases which may pass the trap of the gully are dissipated in the open air, instead of passing on into the house. The same principle, though in a different form, can be applied to all drainage connections, so that no drain of any kind need be allowed to pass direct from the house to the sewer. By this means each set of house drains can be, as it were, isolated into a wholly distinct system, and thus any risk of sewage gases passing into the dwelling be avoided.

It cannot be too strongly insisted on, that the only way to prevent the sewer air being "laid on" to dwellings is to isolate the whole of the house drains by disconnection. It is often considered that it is sufficient to disconnect the waste pipes from sinks and cisterns, and that the soil pipes of water-closets may be left in direct communication with the sewers. This is an entire mistake. Take, for instance, the arrangement condemned by Dr. Buchanan, at Croydon, and which is a very usual one. The soil-pipe is left in direct communication with the sewers, and a small ventilating pipe carried up from the bend of the soil-pipe. This ventilating pipe is, of course, an improvement as far as it goes, but it will only prevent undue pressure, and will not clear the soil-pipe of sewer air. In fact, the ventilating pipe rather tends to draw sewer air into the soil-pipe than otherwise; as, if any air is removed by the ventilating pipe, it must be replaced by air from the sewers. The effect of this arrangement is, that if the least escape of air takes place into the house from the soil-pipe or the water-closet, it is "the common air of the sewers, not simply charged with the impurities it may receive from the particular house, but charged with any dangerous quality that it may have brought from other houses." It is, therefore, evident that, to leave the soil-pipe in direct communication with the sewers, is literally to "lay on" sewer air to the houses.

The only objections to severing the direct connection of the soil-pipe with the sewers which are worth mentioning, so far as I am aware, are, (1) that the soil-pipe ventilators will thus be prevented from acting as ventilators to the public sewers; and (2) that a smell may escape from the opening which is required on the soil-drain, in order to affect the disconnection.

As regards the first objection, it cannot be considered the business of private householders to ventilate the public sewers, especially when danger is thereby incurred to the houses. Moreover, the arrangement of ventilating the public sewers by soil-pipe ventilators is a very insufficient one, as the openings would be too small and too indirect to create a current of fresh air through the sewers, which is the true function of ventilation.

The second objection appears at first sight a more plausible one, but the danger of smell from the disconnecting opening on the soil drain is more imaginary than real. I invariably carry out an arrangement of this kind in my practice, and have never found any nuisance arise from the opening, if the house drains and internal drainage arrangements of the house are in good order. It is quite true that if this is not the case, there may be smell, but this can be removed by remedying the defects which cause the smell. In fact, the opening is a very valuable index to the condition of the internal drainage of the house, and any smell from it should (to quote Dr. Buchanan again) "be welcomed as an indication (otherwise wanting till ill-health occurs) of something about the drains requiring amendment."

The above remark suggests a point which it may be well to say a few more words about, in order to avoid misconception, viz., that the severance of direct communication between the house drains and sewers, though of vital importance, will by no means cure all the evils of bad drainage. If, as is so often the case, the internal drainage arrangements of the house are faulty, and the water-closet apparatus and traps are of defective design, foul matter will be retained in and about the house, and will decompose and give rise to foul gases. For instance, the so-called "pan-closet" apparatus and "D-traps," which are so very largely employed in and about London, almost always collect foul matter, the "D-traps" practically constituting small cess-pools. The gases thus formed will evidently not be cut off by disconnecting the house from the sewer, but can only be remedied by curing the defects in the house which give rise to them.

Having thus pointed out generally the precautions which require to be adopted, in order to prevent sewer air being "laid on" to dwellings, it only remains for me to make a few remarks as to what steps should be taken to ensure the adoption of these precautions.

The first step appears to me to be that the Local Board of Health, or other sanitary authority, should have a proper set of bye-laws prepared for house drainage, based on sound sanitary principles. The bye-laws of most sanitary authorities are at present lamentably deficient in this respect, but there is no reason for their continuing so, as the Local Government Board will allow very stringent bye-laws to be adopted. This I can speak to from actual experience, as the bye-laws and regulations for house drainage allowed by the Local Government Board for the Uppingham Sanitary Authority, which I assisted in preparing, embody all the most important sanitary precautions against the passage of sewer gases into houses. It is a good plan to have a few explanatory remarks attached to the bye-laws. These should be accompanied by a diagram, shewing how the various details of disconnection can be most simply carried out in practice*.

The next step is, that the sanitary authority should insist on these bye-laws and regulations being rigidly carried out in all cases of new houses or new connections with the sewers. This would put a stop to the crying evil at present in existence, of new houses being continually built with all the drains directly connected with the sewers, in such a manner that the passage of sewer-air into the houses is an absolute certainty, and would compel architects to pay more attention to this matter than they do at present. With reference to old houses, the case is much more difficult, as the bye-laws could not be generally enforced in their case. I am strongly of opinion, however, that the mere fact of the circulation of such bye-laws and regulations as I have suggested amongst the ratepayers, would greatly facilitate improvements in the drainage of the houses generally. Householders at present are, for the most part, absolutely in the dark as to what is the proper course to pursue, in order to remedy defects in drainage, and would be glad to obtain practical suggestions such as those accompanying the bye-laws. Again, builders, who at present are very ignorant on the subject, would, by having to adhere to the bye-laws in the case of new houses, soon see the advantage of the improved arrangements, and carry them out when called in to remedy defects in existing houses. In short, the bye-laws and regulations would supply what is now for the most part absolutely wanting, viz., an accepted standard as to what is right in the way of house drainage.

The following are the explanations and remarks as to house drainage, and accompanying diagram, attached to the Uppingham Bye-laws referred to by Mr. Field in his paper. The Bye-laws themselves can be obtained from Mr. Spon, Charing-cross:—

It will be seen by cap. vi., Bye-law 2, that before proceeding to carry out works of drainage, plans and sections of the proposed work, drawn to scale, must be deposited; and the sanction of the sanitary authority obtained for such works.

It is also required by cap. v., Bye-law 1, that the drainage works shall be done in accordance with "Regulations" set forth, § 1 to § 11.

The accompanying sketch has been prepared with a view to facilitate carrying out these Regulations.

Fig. 1 is a general view of the drainage arrangement carried out in accordance with the Regulations.

The drain is shown outside the house, and this is the proper course to adopt (see Regulation § 2). Stoneware-pipes with Stanford's patent joint, manufactured by Doulton and Co., will be found effective and economical for making the drains watertight (see Regulation § 1). It will be advantageous to construct small access chambers at every change of gradient or direction.

In order to keep the drains free from deposit (see Regulation § 3) they should not be larger than 6 inch, 4 inch is generally to be preferred, and they should have a good fall, say 1 in 40 (3 inches in 10 feet) or more if obtainable. If from insufficient fall, or other causes, the drains cannot be kept clear of deposit without flushing, special flushing arrangements must be provided (see Regulations § 3). Where water is plentiful, a discharge direct from a large cistern provided for the purpose may be obtained. Where water is limited, the drains may be flushed by introducing small paddles in grooves formed at the access or junction chambers, and suddenly releasing the pent-up water; or where the flow of sewage is small, a tumbler flushing box or Field's self-acting flush tank may be used.

A is a syphon trap (so called) placed on the line of drain between the house and the public sewer; B is a vertical pipe rising from an upright junction on the drain, and is situated between the house and the syphon trap, A. It is covered by an open grating, C, which affords the means for ventilation (required by Regulation § 5). The trap, A, should not be larger than 6 in. (4 in. is in most cases preferable) and the drain directly above the trap should have a rapid fall, as shown, to keep the trap clear. It will be seen that by this arrangement a complete severance or disconnection is effected between the sewer and the house, as the trap A shuts off the direct current of sewer air, and the vertical pipe, B (through the grating, C), supplies the soil pipe, D, with a continuous current of fresh air. Thus, should any sewer air find its way through the trap, A, it either escapes at C, or, as is generally the case, becomes mixed with a large volume of fresh air, and is carried up the soil-pipe, D, to escape at E.

Note.—There are some advantages in having a manhole or "disconnecting-chamber," instead of the pipe B to give means for inspecting the syphon trap, but this is more expensive.

The water-closets are shown against an external wall (see cap. v., Bye-law 4), and permanent ventilation is afforded by openings to the outer air as near the top as possible (see cap. v., Bye-law 4) and say not less than 12 square inches in area. The soil-pipe, D, placed on the outside of the house, is continued full size up above the eaves for ventilation, and terminates with an open end at E (see Regulation § 8). The end, E, is protected by a cowl, which may also be made to assist the upward current in the soil-pipe. Horizontal lengths or flat bends in this pipe must be avoided, as they impede the passage of the air (see Regulation § 4). The dotted line to F shows the continuation of the soil-pipe to the ridge of the roof, which is required if the end E is too near any window (see Regulation § 8).

The water-closet apparatus shown is the common hopper with a trap, not D-trap (see Regulation § 1); and if sufficient flush of water is provided, this closet apparatus is satisfactory and inexpensive. Pan-closets with iron "containers" are objectionable, as they collect

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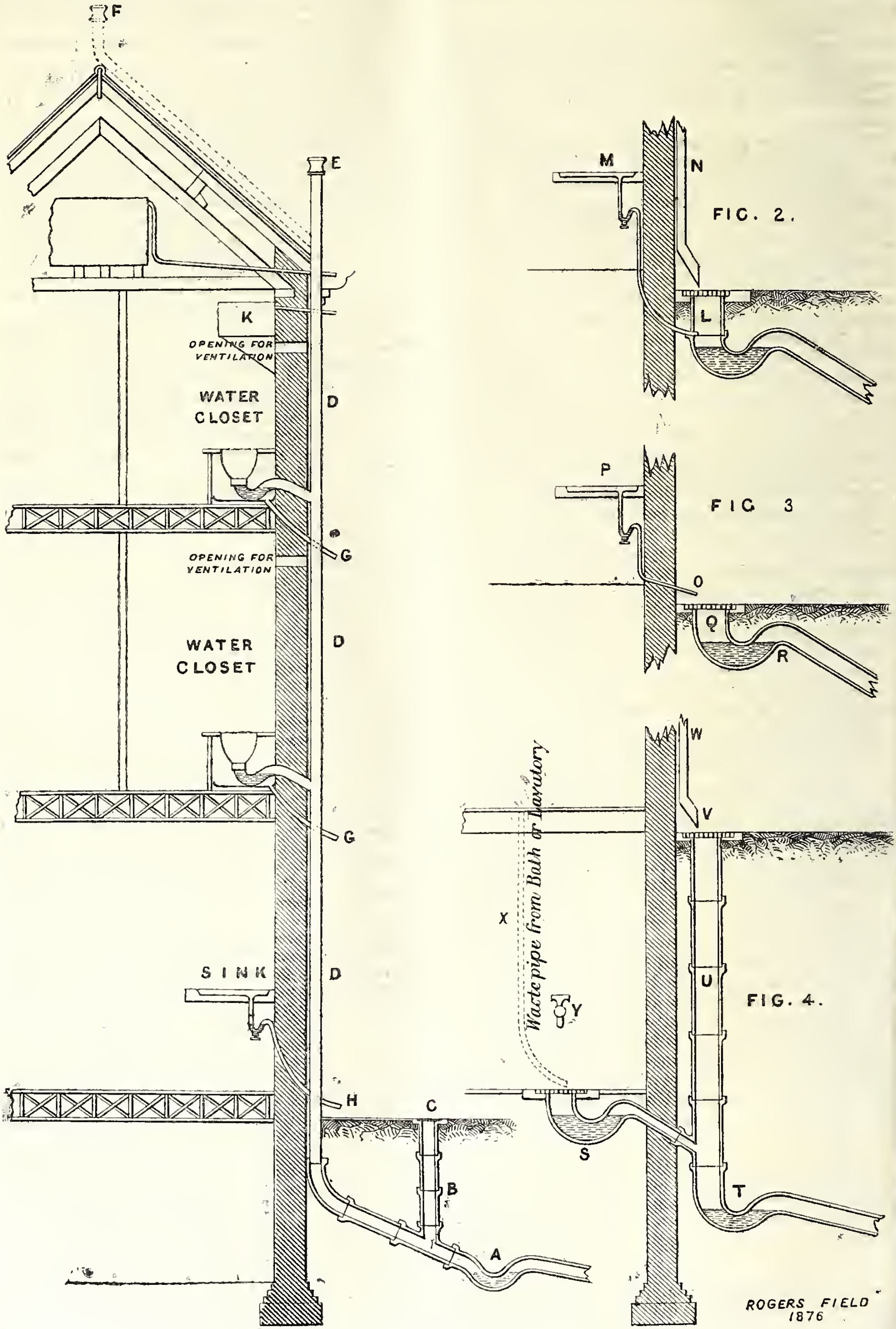
*At the request of several friends, I am having the Uppingham Bye-Laws and Regulations as to house drainage, with the explanations and diagram, reprinted and published (by Spon, Charing-cross). They are no doubt capable of improvement, but may be useful as suggestions of what is required.



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foul matter, and require to be taken down and cleaned periodically.

Note.—Small waste-preventing cisterns will be found advantageous, as, if they are provided with a large pipe to the closet basin ($1\frac{1}{4}$ or $1\frac{1}{2}$ inch) they will give a good flush, and will at the same time prevent waste of water. The use of the waste preventing cisterns will often render unnecessary the provision of a separate cistern for the water-closets.

The waste pipe of the "safe" or tray under the water-closets is shown at G, and is disconnected by passing through an exterior wall, and terminating with an open end (see Regulation § 10).

The waste pipe of the sink is provided with a trap beneath the sink (see Regulation § 6), and is disconnected from the drain by passing through the outside wall, and discharging with an open end at H, into a suitable channel leading to the grating at C (see Regulation § 10).

The overflow pipe of the cistern for general water supply, I, is disconnected by delivering through the wall with an open end into the rain-water gutter (see Regulation § 10). If there is a standing waste, it is advisable to carry the waste pipe down to discharge over a gully. A separate cistern, K, is provided for the water-closets, and its overflow passes through the outer wall. If waste-preventing cisterns are used, as mentioned above, their overflows pass through the wall in the same manner.

Figs. 2 and 3 show enlarged views of modifications of the sink disconnection mentioned above.

Fig. 2 shows a disconnection where the pipe, L, from the sink, M, is admitted below the grating over an ordinary trapped gully. This arrangement is suitable where from its situation the overflow from a sink over a channel or grating might be objectionable. A rain-water pipe, N, is shown discharging over the same gully.

Fig. 3 shows a similar arrangement to Fig. 2, where the pipe, O, from the sink, P, discharges over the grating, Q, of the trapped gully, R. The gullies should be of a similar form to that shown on the sketch, so as to be self-cleansing. "Dip traps" should not be used, except where it is desired to retain sediment; a 4-inch outlet is generally best.

Fig. 4 shows the method of disconnecting gullies in cellars or basements (see Regulation § 11). These should never be adopted unless absolutely necessary, but where unavoidable they must be trapped and disconnected by some such means as shown. S is the trap in cellar floor discharging by a pipe into and above the trapped gully, T, outside the house. This outside gully is surmounted by the pipe, U, reaching to the surface of the ground, where it is covered by a suitable grating, V. A rain-water pipe or waste pipe, W, is shown discharging over the grating, V, which serves the purpose of keeping the trap of the gully, T, replenished with water. The inner trap, S, also needs special provision for replenishing, for which purpose a waste pipe should be made to discharge over it, as shown at X, or a water tap, Y, should be arranged so that the drippings fall into it.

It is required by Cap. VI., Bye-laws 3 and 4, that all work must be done to the satisfaction of the surveyor to the authority; and if such work is not considered satisfactory, it shall be taken up and replaced by work to his satisfaction.

ON THE EXCLUSION OF SEWER AIR, WITH NOTES ON THE CONDITION OF METROPOLITAN BUILDINGS.

By Richard Weaver, C.E., F.C.S., Sanitary Surveyor.

There are various reasons why the more perfect exclusion of sewage emanations from the interior of buildings has not attracted that close attention of sanitary engineers, which the national importance of the subject demands.

The magnitude and the emoluments of out-door works entirely dwarf the comparatively trifling matter of the internal arrangements of domestic drainage, and the indifference of the public to the subject, combined with the simplicity of faith and unwarranted assumption that things out of sight are right, have certainly not hitherto been very encouraging to the reformer. Those gentlemen who are professionally engaged under sanitary authorities well know the repugnance evinced by tenants and landlords to carry out valuable suggestions, incurring, it may be, trifling expense, often, indeed, in instances where grievous defects are long tolerated, and the benefits are mainly for those who prove the most obstructive.

In another direction, the same apathy to the advantages of improvements beneficial to health are shown, from a source altogether devoid of official character. A gentleman largely interested in property has had some houses placed in a sound condition in respect of drainage and water supply, not with a view altogether of deriving benefit, but more as a test to gauge the susceptibility of his *clientèle*. But he informs me that the great majority evince no interest in the affair, and are more concerned as to the shade of the papers and the tint of the paints, than in the quality of the respirable air and the drinking water. Nevertheless, as the schoolmaster is abroad, and the diffusion of the laws of health, if slow, is established on a sure basis, this impassiveness must cease ere long. It is not far back since a want of knowledge of the principles of hygiene operated as a course of retardation of advancement; but the abundance and general excellence of the literature of sanitation, and the frequent reference to such subjects in the columns of the daily press, sufficiently disposes of the plea of ignorance; whilst a gradual awaking of the public sense to the imperfections of current modes of treating domestic offices, especially when that is combined with an acquaintance with the fact that the remedies are not expensive, in ameliorating existing buildings, which in new structures amounts to nothing additional upon the usual charges, will unite in good season to leaven the present universal indifference. It is a sign of the times, that will be earnestly read by the people, that a most eminent and popular statesman, rises in his official capacity, and from his exalted position declares to the world, that the sanitary condition of this metropolis and of the country is not satisfactory a fact long known, of course, to those gathered here in conference, and which will not be lost upon the masses to whom the information is conveyed. I would venture humbly to go further, and to say, and say it boldly, that the condition of many metropolitan buildings, against which it may be thought presumption to raise a breath of aspersion, are in an eminently unsatisfactory condition, and where the more urgent is the necessity of observance of sanitary laws, the less they are in practice.

An enterprising, plodding, prying, hard-working Charles Dickens, might open out a revelation of evil influences within public institutions and private dwellings--existing for the most part in blind faith, which seems to me inexcusable—as would, beyond doubt, shock the public sense of the proprieties.

Let me ask whether it is known to be anyone's business in particular to be intelligently acquainted with the state of the water supply, and the condition of the local drainage, with the means adopted against the entrance of sewage air? Let me go further, and ask whether it is anyone's particular duty—not nominally, but actively—to become responsible for the satisfactory quality of, and to maintain the breathable air and drinkable water of any establishment reasonably clean and wholesome?

The ladies of the duster and knights in livery are held strictly accountable for the satisfactory appearance of the furniture, floors, and stairs, with other needful matters of the household, but in the best ordered mansions that not unimportant item, the domestic water, is left to the careful attention of cockroaches and spiders, buried away in some dark and for the most part barely accessible position, revelling in an atmosphere replete with exhalations from the common sewers, conveyed through the waste pipe of the cistern. The general atmosphere of the house, too, being a cheap commodity, and apparently not worth consideration, is left to chance for governance.

True, it is charged with organic pollution of cloac, an origin freely admitted through the numerous vents in the scullery, baths, water-closet, and slop basins, mingled with the vapours of cooking viands, and flavoured with a *soupçon* of burnt gases. But what of that? Such matters are universal; we rather like it; it keeps us warm during the prevalence of these cutting east winds, and why should our children not do likewise?

Unclean and expired air, with damp, are accountable for 100,000 annual deaths in the shape of bronchitis and consumption. Unwholesome air and polluted water dispose of another 150,000 or so of lives carried off by zymotic diseases. But then this may be a useful provision, and tends to allay the too rapid growth of population, and as every man dies sooner or later, some folks think the sooner the better, and so, upon the whole, things are best left alone. A great deal has been said and written upon the potency of fixed and volatile organic substances in the stages of putresence upon the mortality of the country, much of which I agree with. I know of no one who is more keenly sensitive than myself to the inconvenience of breathing tainted air or drinking foul water, but I cannot approve of the often-uttered expressions by men, even of experience and influence, such as the "deadly sewer-gases," and "death in the cistern." Their opinions, given with good intentions, defeat their object, for people are apt to think that the shades are drawn deeper than requisite, and if the dangers were so great as presented, there would be fewer of us left to talk about it, considering that we all take our peck of dirt in the form of aërial and solid sewage rather frequently. It has been my privilege for some years past to describe the sanitary conditions of many provincial towns in the columns of a journal long interested in such matters, and I think that our country friends will not be averse to a description of the shortcomings of metropolitan household arrangements, for grievous although the former may be, they are at least equalled in the latter.

A careful examination of the substantial buildings in London in any direction reveals glaring evils, probably causing much injury in the aggregate, although the average death-rate would seem to indicate that the general damage sustained is not great. From this knowledge, gleaned during many years' investigation, and an acquaintance with the fact that we are, whilst within doors, always breathing a sewage tainted atmosphere—and this building is no exception—I am convinced that the actual injury from infringement of the laws of health is much less than is often represented to be the case.

There are congregations of populations within my knowledge who regularly consume their own filth, and drink up the fluid refuse with the water. Places where the receiving cesspits are in such near juxtaposition with the domestic well that the water-lines become identical, and intermittent exchange is maintained, and yet many of these places are considered healthy, and figure so in the Registrar's returns. It is only when the virus of specific forms of disease is introduced that death descends, and, like the cock-sparrow on the ant-hill, gobbles up the people right and left and round about him.

An example is within recollection of a small town where nothing more loathsome can well be conceived than the social habits of the inhabitants, where, for 14 years, the community enjoyed good health, before an imported epidemic attacked more than a third of the population, of whom many died. There are numerous instances where families and communities exist under the most unfavourable circumstances; but such is the repellent power of the human system, that evils are borne with year by year, apparently without injurious results, and this is probably a reason why so many people are indifferent to and actually resist improvements. Englishmen are fond of games of chance, and there is a charm in taking the odds against the risk. Ten men may live to an advanced age, they may breath sewer air and drink sewer water every day of their lives, and in the end not more than two of them die of diseases which, as we now reckon such things, can be attributed to disregard of the laws of hygiene. The danger is, nevertheless, considerable, more especially in young children, and I think it may be within the experience of most of us that whole families have been swept off by causes quite preventable. In again addressing the public upon this subject, I would refrain from calling attention other than in passing to the dangers to health and the irritation to temper, incurred by living under insanitary conditions, and I would rather take up other ground, and appeal to the high sense of the proprieties characteristic of English women and men to the high value attached to the exercise of scrupulous cleanliness; and in doing so, if I wound the sensitiveness of some and raise any feelings of disgust, it must be borne with me that I simply state the truth of facts—I do not create them.

The remedy for prevailing errors lies in a recognition of their existence, less by legislative action than by reform within the bosom of every family without distinction, and it should rightly begin with those who sit in high places, for my range of observation, if limited, is sufficiently wide to enable me to say with some confidence that the larger and more important residences are relatively in a worse condition than the humbler abodes of the working classes, causing necessity for a more frequent change of air and locality, due to the foul state of the atmosphere of metropolitan mansions, a condition of things rarely suspected, but universally existing. If it may be said, there is not much detriment to health from the present state of dwelling houses, if viewed from the point presented by reference to the mortality rates, I still venture to think that much of that indefined indisposition of families—headache, nausea, dyspepsia, lassitude, and such small complaints, are often created by breathing the foul atmosphere of the house, a foulness, most likely, not perceived by the usual inmates. At all events, such effects are produced upon myself and family, and I observe that children become rosy cheeked and firm fleshed when they are supplied with good fresh air, whilst in the house or schools—not draughty air—and especially in the dormitories. Possibly, the time even may come in the future, when the sanitary man will be as freely consulted upon the remedy of prevention of such matters as our medical *confrères* now are for their cure.

There is no occasion for me appearing rude, and I have no intention of being so, in the following criticisms, but I am induced to submit them, so as to bring home to every one the fact that, notwithstanding we pride ourselves on our decency and cleanliness, and our inclination to set ourselves up as patterns to Continental neighbours, I say, the fact is, we are a dirty and an unclean people. Indeed, could we but see ourselves as we really are, I think we might even admit we are a filthy folk, and deserved to be scourged. There is a handy phrase that pointedly excepts the present company always, but I will take no shelter under that conventionalism, and I say that the charge is against me and you, and I believe every family in the kingdom. Some medicines are disguised with saccharine matter of less or more cloying sweetness, but I have no sugar to offer, and you must take my facts as I find them.

I repeat this in letters large writ, and hung up that those that run may see and read, for the proceedings of this Conference are not confined within these four narrow walls. If a hound strays from our heels and laps up the soil from the street, left by neglected children, he is switched and called a brute; and if a servant were guilty of polluting the domestic beverages with the contents of the slop-pail, the act would be considered a heinous sacrilege. But practically we do this every day, and what do we care when the foulness of our water-closets is injected from the containers or the soil pipes to the cisterns, and mingles with the water we consume, which, I am able to say, from personal examination of many hundreds of houses, actually occurs in nine out of ten residences not of recent erection. We boast of our civilisation, and send forth missionaries abroad to teach the heathen. In the good old book of Leviticus are excellent sanitary morals, but do our ministers cull from them their full excellence? It is often alleged by speakers, and I have heard it said in this hall, that the errors of old buildings do not exist to nearly the same extent in new erections, and especially greater improvements are effected in the storage of water. It would be interesting to know how this conclusion is arrived at, whether as an effort of observation, or conviction, or mere hearsay. As regards the latter, I know of no direction in which fallacy is more persistent than in respect to house sanitation.

There is a fixed determination amongst householders that things must be right, and that they are right. But a little reflection in the mind of every responsible head of a family will show there is no special dispensation, and careful search would show that gross defects exist.

A few days ago, I made an inspection of a medical gentleman's house—a man who is a frequent attendant upon social conferences, and well read in matters of hygeia. Well, when I came to the water cistern, he assured me the waste pipe delivered into the ground a little below the surface, but as I make it a point to take nothing for granted in my examinations, and must have personal demonstration, we opened out the subsoil and found the overflow orifice discharged into a drain directly communicating with the sewer up which air of a fetid character arose. In point of fact, the waste pipe acted as the upcast shaft to ventilate the house drains and public sewer, the delivery taking place in the cistern an inch or two above the water line.

Of course, seeing the defect himself—one of many—the fact was confirmative, otherwise I think it would have been difficult to convince this gentleman of the nuisance. In new residences there is an average improvement upon the water service storage, for I find that seven houses in ten only are contaminated locally by connection with the sewerage, or with facilities for the absorption of gaseous sewage at some point.

If a guest enters a drawing-room with boots spotted with honest mud, he is, peradventure, looked upon askance; but it is a matter of no moment that the host immediately charges his lungs with abominations vomited forth from the common sewers, through defective closets and scullery sinks, with which the atmosphere of the house is tainted, curiously hidden in vapour of preparing viands ascending from the kitchen, which no mansion, however modern, seems without. We are, forsooth, a peculiar people, and our notions of decency seem sadly erratic.

It is a singular thing, and, perhaps, suspected by few minds, that the conditions essential for the enjoyment of sound, robust health, least exist in localities where they are most required; and I put it to you as the fruit of observation, that our hospitals, as types of public institutions, are the most indecent in respect of their sanitary measures; whilst the gin palaces, as representative of another class, are the best. In the first, I include public buildings, houses, churches, clubs, schools, hotels, and coffee-houses, with many others; and, in the second, the business parts of butchers', bakers', greengrocers', confectioners', with some other shops. Basing the calculation of averages from an examination of several hundred buildings, made within the last year, I am in a position to say that 99 per cent. of metropolitan dwellings are polluted very seriously by the admittance of sewage air through the various openings for the removal of liquid refuse. In many are no trapping arrangements whatever for keeping back aërial sewage, which flows uninterruptedly into the house, often, indeed, to the extent of tens of thousands of cubic feet per day, and the odd thing is that this is always unsuspected by those who should know it, and it is not thought of much consequence when pointed out. But let me ask whether this is common decency to charge the respirable air of a mansion with the exhalations of filth, and to breathe the same, whilst professing some sentiments of cleanliness and refinement? If there were any adequate means of air ventilation of houses, the nuisance now enveloped in the vapours of cooking would not be so great; but there is no systematic attempt, and the internal atmosphere, from basement to garret—and the higher up the more stagnant—is generally fetid with foul air, more especially during the nocturnal hours. So general is this defect, that, on admitting a guest, he is met at the front entrance of the establishment with a gush of mixed air, tainted with smells from the kitchen and drainage evolutions, which a trained nostril has no difficulty of identifying. The proper ventilation of houses—that is, the introduction of pure, fresh air without draughts, and the speedy removal of consumed air, so as to maintain the inner atmosphere in a condition approximating to the outer air—has occupied my attention during many years, and as the objects sought for are accomplished, I hope soon to find an opportunity of making known the system, which the scope of this Conference does not now permit.

Some recent discoveries relative to the state of certain modern—I was going to say model—Government offices, the Mansion-house, and others, have been looked upon as alarming, if I understand the matter, but I can say with some knowledge that, if the published accounts represent all the defects found, then the efficiency of those buildings is certainly above the average; and as there seems no palpable reason for their being so, I am constrained to think it is just possible that other indecencies might have been brought to light, if the search had been more closely followed.

Specimens of new dwellings were described in the *Journal* of this Society a few months ago, and since then I have seen others equally defective and indecent, and the samples now furnished refer to older buildings, of jottings from my note-book on the spots, and may best serve to illustrate the average condition. In a mansion at Regent's-park, which the owner considered perfect in its sanitary appointments, and with that object had expended considerable sums, deleterious gases from the drains entered to the extent of several thousand cubic feet per day. The service cistern contained a filter covering the whole of the bottom, so that all water withdrawn for supply underwent the formula of cleansing—even that taken for water-closet use; but, with the logic of irony, the waste pipe discharged directly into the public drains, the trumpet pipe communicated openly with the pan of water-closet, whilst each action of the valves squirted a jet of water from the closet container into the cistern of potable water.

In a West-end club, noted for the scientific attainments of its members, I found the interior of the premises in direct contact with the street sewer, from which some portion of the air supply was derived with which the visitors are regaled. At all events, through a single untrapped aperture, mephitic vapours flowed at the computed rate of 12,000 cubic feet per day. Most of the water cisterns are polluted in various ways, the greater part of the waste pipes going right into the drains, whilst one cistern supplying the cook with his requirements, is flavoured with an injection of water shot up from the pipe serving the water-closet, each time that necessary convenience is used by the servants.

Into a well-known restaurant near Regent-street, there is as much sewage air entering as would seem sufficient to ventilate the sewerage system of a small town, seeing that in the cellarage alone it is estimated that the intake of foul gases equals 30,000 cubic feet; and the exhalations from the closets, urinals, sinks, and lavatories add to the sum total. On inquiry from the superintendent of a department, the atmosphere of which appeared highly charged with impurities, what was the tone of health of the staff, and whether any of them died? He said none of them stayed long enough for that. Just by way of taking off the rawness of the gaseous sewage, the establishment arrangements are very complete for distributing the kitchen fumes and the burnt air from probably thousands of gas gets throughout the building, and for this liberal supply of lung food I believe the management most considerately make no charge upon the guests.

In a block of substantial houses, which were in perfect sanitary efficiency—so the architect and surveyor assured the owner for whom he acted—I found in each of them sewer air of a peculiarly fetid character, entering at the rate of several thousand cubic feet *per diem*, distributing its noxious qualities amongst the domestic water and air.

A very fair example of the condition of a London hospital is found in one upon which I lately reported, and the medical staff should be better judges than me whether the arrangements are conducive to the health and convalescence of patients. The drainage system ramifies below the basement floor the length of the hospital, rising by vertical pipes to the wards and upper premises, and between the sewer at one end and the wards and chambers at the other, there is, through the elongation of pipes, no trap intervention whatever, so that perfect channel communication is established between them. The fact is, as no air ventilation is provided, the deficient supply is augmented from the sewer, from which the soil, bath, and lavatory conduits act as up-cast shafts, thus ventilating the sewers into the hospital wards.

Some of the cisterns are also polluted by exhalations, one that supplies the dispensary, I understand, rather considerably so from the closet, as the motion of the lever discharges foul air in bubbles through the water stored in the cistern.

The saturated air of the hospital, stagnant from want of motion, with no apparatus for extraction, without inlets for fresh air beyond the usual crevices, is particularly unpleasant to sensitive lungs. Many examples might be furnished of similar examinations, but the faults are alike, differing only in detail, and the effects are not dissimilar, viz.:—indelicate adulteration of air and water, the cheapest but most necessary elements of existence.

Before passing on to the practical object of this paper, the means available for effectually avoiding the current nuisances common to all dwellings, I will intrude upon you one more illustration of the indecencies of modern living, taken from the residence of a sagacious, well-informed gentleman of eminence—who, always interested in social subjects, is not unknown in this hall—which I was invited to inspect so recently that the evils pointed out still remain unameliorated. In the first place, in the kitchen, as there is no open fire-place, but close stoves and hot plates, the whole of the volatile culinary products are discharged into the basement, the bulk of which ascend to the upper premises. There are no ventilating appliances in this palatial establishment, but a fair amount of air of a sort is procured from outside the building, conducted through the yard grids, and thence, by the scullery-pipes, to the several passages of the house. Another supply, voluminous in quantity, is emitted from the soil-pipes of the water-closets, another source being through the waste-pipes of the service cisterns. The air of the whole building—of the magnificent chambers of great length and height, and of the upper offices, is singularly stale and unpleasant. Nevertheless, the servants express perfect satisfaction, and profess to enjoy excellent health; but, if this is so, are the conditions of living proper—are they decent even?

It is many years since I became acquainted with the inadequacy and insecurity of the usual hydraulic traps applied to house drainage to stop the back flow of sewer air. At the most, and under the best conditions, assuming perfect joints, and with sound materials, they merely obstructed the rush of air; the passage from the drains to the house took place more slowly and insidiously. Well, after labouring for some time for improvement, I adopted a simple device formed out of a syphon glazed ware pipe, with an opening at the socket, and communicating with the ground surface for the entrance of fresh air, and then, by the aid of openings at the tops of stack, bath, and soil-pipes, to keep up a system of natural and self-acting air circulation throughout the drainage; so that any passage effected through the porous pipes, joints, or traps—very little, perhaps, by reason of the equal tension of the air within and without the pipes—would be robbed of virulence, because the air, being ordinary atmospheric air, and not sewer emanations, is quite harmless. The idea was taken from—and, in fact, was an attempt to adopt underground—the system not much practised in London, but common in provincial towns, of severing connection with the scullery, by delivering the pipe into the air over a trapped grating, but which had never been carried into practice, so far as I know, with water-closets, nor with drains passing through the house.

As the arrangement has become known through the professional press, and by the proceedings of a kindred association, and possibly is known to you, I need not further describe it. I may, however, say that with some years' experience of its working it gives me every satisfaction, as it thoroughly effects complete severance between the house and sewer, preventing the admittance of any foul air and pollution to water, the whole being accomplished at a cost which, I think, is not immoderate considering the substantial benefits derived; and that it does not generally exceed £5 per house in occupied buildings, in new structures practically amounting to nothing extra upon the usual drainage outlay.

Some question has arisen as to the feasibility of implied action of the syphon system of ventilating and trapping drains and sewers, which is best answered by stating the result of many hundred examinations. The air circulation is produced by compound causes—first, we have the currents due to the natural mobility of the air, as exemplified in all vertical shafts open at each extremity, and well illustrated by a chimney flue without a fire. This motion is accelerated by the passage of water down the pipes, creating a reversed aërial current, and again by the warm discharges from the kitchen. The upward flow is augmented by the heat absorbed from the sun's rays by the ventilating pipes. But the most potent agent in keeping up the circulation is the wind blowing squarely across the mouth of ventilating pipes, creating an exhaust and consequent up-current, for it is old knowledge that the rapid passage of a fluid across the orifice of a tube reduces the tension within that tube.

Under exceptional circumstances and local obstructions, there is occasionally a down draught through the pipes, which act as the long leg of the syphon system of ventilation, but this is of no moment, for the outlet being lower down and outside the building, the aërial discharge takes place there after sweeping through the drain pipes, and is generally devoid of smell, for I find that, after a few weeks operation with fairly laid glazed pipes, although they may have been down for years, the oxidising effect of the continuous body if fresh air passing over the surface deposits within the pipes, entirely consumes the putrid matters. The currents however, are generally ascendant, and deliver at the roof level. A series of observations conducted under varying conditions and localities determine the average velocity of flow at three to four lineal feet per second in calm weather, which increases to nine feet, and often 12 feet with a strong wind. And it is to this severance of the house from the sewer by the water seal of the syphon trap, in conjunction with the sweeping air currents maintained through every drainage pipe of the house, that I depend for clean air and clean water within the building, and is most certain in its action; whilst the means I have devised for the effective disposal of the locally generated exhalations—the expelled breath of the body, the burnt gases, the emanation from the walls, paper, furniture, and miscellaneous effects stored upon the premises—admitted on all sides as an object well worthy of attention—as I have said, I will take another opportunity of describing.

ON CERTAIN MORAL AND LEGAL OBSTACLES TO SANITARY PROGRESS.

By C. N. Cresswell, Esq.

(Of the Inner Temple.)

In reading this paper I am to be understood, not as speculating upon possible and contingent obstructions, but as giving the result of actual experience in the work of urban sanitary administration.

It may be premised that we have arrived at an important epoch in the history of sanitation, and that a new point of departure must be obtained, in order to achieve a further substantial advancement. Certain well-known and tried processes have passed through the crucible of practical experience, and there is no lack of scientific means and agencies to dispose of our sewage, render our dwellings wholesome, and purify the sources of our domestic water-supply.

Sanitary science has its axioms and postulates, *e.g.* :—

1. That sewage must be removed from our dwellings, and refuse no longer permitted to infect the air.
2. That our rivers and water-courses shall not be polluted, nor the sources of our water-supply poisoned by sewage-infiltration.
3. That sewage-purification should be estimated from a sanitary rather than from a commercial point of view.
4. That each area, or combination of areas, should be compellable to provide for the disposal of its own waste, and not be permitted to relieve itself at the expense of its neighbours.
5. That no universal panacea for our sewage difficulties has yet been discovered, and that the means to be adopted in each particular district will depend upon a variety of local conditions and circumstances.

These are some of the axioms universally recognised, which have been crystallised, so to speak, by common consent and experience.

I see around me the apostles of irrigation, precipitation, intermittent filtration, and even of the expediency or economical advantages of waste, and in this hall we have lately heard a demonstration, by an eminent authority, that it is more logical to keep excrementitious matter out of water altogether, than first to pollute, and afterwards endeavour by laborious processes to eliminate the causes of the pollution.

Some have ventured to think that the water-closet is a most mischievous invention, illogical, unscientific, and a violation of the laws of nature. Others contend that water is the best vehicle for the disposal of refuse ; moreover, even if water-closets were abolished by an Act of Parliament, we should have still to cope with that pollution which arises from the scourings of our streets and the refuse of our factories.

Without entering upon this arena of discussion, I believe that the sum total of our experience may be expressed in the words of Dr. Frankland, at the Institution of Civil Engineers, not many weeks ago, "That sewage must either be applied to land, or land be applied to sewage."

But there are postulates as well as axioms of sanitary science, and the purpose of this paper is to direct attention to one which, during the local elections of the past month, assumed very tangible proportions, viz., that sanitary law cannot be effectually administered without enlisting the sympathies and intelligent co-operation of the people.

The obstacles with which local representative bodies have to contend are moral rather than material, and these may be traced to the inherent immobility of the British character, that stolid jealousy of departmental supervision which resents each visit of a sanitary inspector as an intrusion. "An Englishman's house is his castle," says the owner of each filthy tenement, and the maxim of "*sic utere tuo, ut alieni non lœdas*" is yet undreamed of in rural philosophy.

When the newly-elected local authority contrives, with the proverbial energy of new brooms, to sweep away some of the time-honoured abuses and "rotten relics of antiquity" which deface every suburban town, its walls at the next election are placarded with—"No interference with private rights!" "Rouse yourselves, electors! The palladium of British liberty is the sanctity of the home!" and similar platitudes, addressed, not to the reason but to the pockets of the ratepayers. There is always a confusion of ideas in the bucolic mind, but his instincts rebel against another sixpence in the pound for health and cleanliness.

The selfishness of some, and the apathy of others make up the tale of those obstacles which every local candidate has known and appreciated. Whatever is attempted by way of sanitary improvement or precaution, is regarded with suspicion and resentment. Even the local gentry have caught the prevailing contagion, whilst all the petty proprietors, who are rated as owners under the compounding clauses of the Public Health Act, are banded together in a solid phalanx to thwart the efforts of sanitary reformers.

Parsimony is the fetish of their imaginations, yet the policy of the legislature has placed within their reach a formidable engine of corruption and oppression. At every local hustings in the late elections their power has made itself felt of ostracising those who have striven to do their duty; and long, dingy rows of unwholesome cottages remain to prove that the voting power, as at present regulated, lies with those who are the greatest offenders, whose shortcomings are the source of disease, of poverty, and of degradation. The Poor-rate Collection Act of 1869 gives the occupiers of small tenements the right of voting, although the rates have actually been paid by their landlord. They lose all interest, consequently, in the exercise of the franchise. To them an increase in the rates brings no terrors, but they have an interest, meanwhile, in submitting to the dictation of their landlord, especially if the rent of the previous month be somewhat in arrear, or cottages are scarce in the vicinity; and thus it comes to pass that the petty landlord holds the votes of all his tenants in the hollow of his hand. They fill up the voting papers as he dictates, or affix their mark to them already filled up, too glad of an opportunity to conciliate the good graces of one who knows well how to show mercy at the right season, but is a tyrant indeed when balked in the enjoyment of his local influence.

There are many instances, within twenty-five miles of this metropolis, where a petty job-contractor disposes of one hundred votes in the local elections, whilst the greatest territorial magnate of the country can muster only his maximum of twelve. The poor tenant, meanwhile, drags out a woe-begone existence in his filth-sodden cottage, trembling lest haply the visit of a sanitary inspector should bring down upon his head the wrath of a suspicious landlord. Many a cleanly housewife would complain if she dared, but there is "a shadow on the hearth" which forbids redress, and closes the door to inspection or improvement. The remedy, however, is simple, viz., by abolishing voting papers, and giving the protection of the ballot in municipal as in parliamentary elections. Let the poor cottager have the protection of the ballot, and those who have at heart the real well-being of the community will find their best support and encouragement in the free, unsolicited votes of the humblest class of ratepayers.

As things are at present, woe to to the energetic reformer who honestly strives to do his duty! So soon as his turn for re-election comes round, the place which knew him will know him no more, and a more docile successor will be provided, to forthwith inaugurate a policy of masterly inactivity.

It has become the fashion to form Ratepayers' Protection Associations in each sanitary district, and an analysis of the list of members in almost every case will show that they are neither more nor less than organised combinations of cottage proprietors, against the increase of local burdens by the pursuit of sanitary crotchets and fantastic innovations.

There is another remedy for this growing evil, in a more efficient system of supervision and inspection on the part of the Imperial Government. It is true that the President of this Conference, in a memorable speech at Halifax, in 1875, protested against the tendency to centralisation in modern days, as dangerous to the best elements of our national character. He saw light only in one direction, viz., the enlargement of areas and the elevation of tone and functions of local self-government; but he well-nigh anticipated my argument, when he added these words, "and by so arranging the conditions of imperial supervision and control, as to give a sense of real though ordered freedom and responsibility to local governing bodies, even in their relations with the State."

It is this ordered freedom which I desire to see developed, in the shape of a more efficient supervision, by pressure from above, and by that opportune impulse of authority which will suffice to carry the machinery of local government over the dead centre of parochial resistance.

We have had, since 1875, both combination of areas and elevation of functions. It was only on the 6th April of this year, that the President of the Local Government Board took credit for the labours of his department, and the wholesome fermentation which had been excited throughout the country. If, however, he would but institute a series of periodical inspections by competent and independent men, and organise a house-to-house visitation in some of our fair-seeming suburban villages, he would discover that this vaunted enthusiasm is but a thin veneer after all, and that there is, to quote Mr. Cowen, of Newcastle—

> "Fever in the cesspool
> And sewage in the well"

of thousands of the cottage homes of England. The number of inspectors at Whitehall is far below the requirements of modern legislation; and the energy of the few able men who compose the whole staff at the disposal of Government, cannot dispose of the business which waits its turn in the official pigeon-holes. Their efforts should be supplemented by the appointment of independent, well-salaried "County Health Inspectors," nominated by the Government, and paid out of the county-rate, to stimulate and supervise the work of the district and medical officers, too many of whom find themselves in a position of uncomfortable antagonism, sometimes of actual conflict, with their patients and familiar friends.

Moreover, I have yet to learn that medical men are superior to the ordinary incidents of humanity, and that the supply of local practitioners is so far inadequate to the demand that they can afford to give offence by a too strenuous discharge of obnoxious duties.

The man who in some measure depends for his existence upon the favour of his neighbours, is disposed to take at all times a lenient view of his responsibilities; nevertheless, his local knowledge and experience will serve him in good stead, and be useful, withal, to the community, under the control of a superior officer of head-quarters, whose emoluments and position place him far above the enervating atmosphere of parochial politics.

In too many instances the Sanitary Board is regarded as a species of Inquisition, and the fear of personal unpopularity in the social circle tends to cripple even the best of good intentions.

I am well aware that I am treading upon slippery ground, and that there is a deep-rooted antipathy in the nation to a paternal system of departmental administration, which arises, like other popular illusions, from a confusion of ideas, and exaggerated conceptions of individual liberty.

The Government of the day is but the expression of the popular will, which is embodied in the legislation and decrees of Parliament. No minister can, with impunity, permit those decrees to fall into abeyance, in deference to the fears and prejudices of a narrow section of the community; and it is the province of imperial authority not only to investigate truths, and demonstrate methods, by the use of those scientific agencies which its resources alone can command, but to enforce their application in the daily life and habits of the people.

If everything must be left to individual enterprise, or the initiation of local authority, where, I would ask, is the scope or the use of an imperial administration? Permissive legislation and government by commission have been carried to their utmost limits, and the time has arrived for the use of the word "shall" in lieu of "may."

"Even the gods themselves," it is said, "are unable to cope with stupidity;" and we must trust to patience and the progress of national enlightenment for the elimination of this distressing element; but where the grievance is patent, and the remedies simple, there is no longer any excuse for inaction, or the pursuance of a timorous, vacillating, and half-hearted policy.

ON THE RIVERS POLLUTION PREVENTION ACT, 1876 (39 and 40 Vict., 6, 75).

By J. W. Willis-Bund, Esq.

The reports of the Rivers Pollution Commission disclosed a state of things that, in the Commissioners' own language, amounted to "a national evil." After reading their report, we feel tempted to ask, Does such a thing as pure water exist? If so, where? That the subject was ripe for legislation, was universally admitted. Each successive President of the Local Government Board stated that the matter was receiving his most careful consideration, and no less than five Bills were introduced in successive sessions to check pollution of rivers. These Bills seem to have followed the universal law, that continued contact with water, and even polluted water, wears away the substance, for, mild as the first Bill originally was, it got perceptably milder each year, until at last, in 1876, the measures culminated in the so-called Rivers Pollution Prevention Act. If it were not for the rule that the preamble of an Act of Parliament explains its object (and the preamble of this Act states, "that it is expedient to make further provision for the prevention of the pollution of rivers, and in particular to prevent the establishment of new sources of pollution"), it would have been difficult to have imagined that such was the object of the Act.

In order to see what the Act does, or, rather, fails to do, it will be well to state what the law was before it was passed, and what was required to make that law complete.

If a person, or a body of persons, polluted a river, the person or persons who were injured by such pollution could take the following remedies:—

1. If the pollution amounted to a public nuisance, so as to injure not merely one individual, or class of individuals, the person causing the pollution might be indicted for a nuisance, and, if convicted, fined and imprisoned.

2. If the pollution only damaged one person, or a class of persons, such person or persons had a remedy by action, for damages against the person causing the pollution.

3. In the same case, instead of an action, the person damnified might apply for an injunction to restrain the nuisance, and also for damages; in late years this has been the favourite remedy, and various instances of its use are to be found in the reports, *e.g.*, Goldsmid *v.* Tunbridge Wells Improvement Commissioners (Law Reports, 1, ch. 349); Crossley *v.* Lightowler (Law Reports, 2, ch. 478).

These remedies were applicable to all kinds of pollution wherever situated; there were also special remedies (1) in certain localities, and (2) in regard to certain pollutions. As to (1), the provisions of the Thames Conservancy Act, 29 and 30 Vict., c. 89, and the Salmon Fishery Act, 24 and 25 Vict., c. 109, and as to (2), the provisions of the Gas Works Clauses Act, 10 Vict., c. 15, may be cited as examples.

But the objection to all these remedies was, that those of a general application involved great expense, great delay, and the result was very uncertain, even in a greater degree than the proverbial uncertainty of the law. It might often happen—indeed it did often happen—that even if they were successful, one or two years might elapse before the remedy could be obtained, and all the while the pollution was going on, the evil increasing; while, as to those remedies of a special kind, they were so hedged round with restrictions and exemptions as to be nearly valueless. What, therefore, was required, was an Act giving a cheap, quick, and summary remedy, that should apply to all parts of the country and to all kinds of pollutions, and thus enable any pollution to be dealt with speedily and effectively. Such an Act the Government proposed to give to the country in the Rivers Pollution Prevention Act. In justice to the Government, it should be stated that the Act in one point completely satisfies these requirements. It applies to the whole of England and Wales, and also to Scotland and Ireland. It also professes to, though it does not, include all kinds of pollution. But having said this much, the praise of the measure is exhausted, for it does not stop pollutions; it does not give a cheap ,summary, or effective remedy; indeed, in many cases, it gives no remedy at all.

The Act is divided into six parts, and purports by

Part 1. To give the law as to solid matter.
Part 2. Law as to sewage pollutions.
Part 3. Law as to manufacturing and mining pollutions.
Part 4. Administration of the law.
Part 5. Application to Scotland.
Part 6. Application to Ireland.

With the two latter parts it is unnecessary to deal, for they only define what certain legal terms shall mean in Scotland and Ireland.

The first part deals with solids. It states that every person who puts, or knowingly permits to be put, into any stream, either singly or in combination with other acts of the same or any other person, so as to interfere with its due flow, or pollute its waters, the solid refuse of any manufactory, manufacturing process, or quarry, or any rubbish or cinders, or any other waste, or any putrid solid matter, shall be deemed to have committed an offence against the Act." On this there are one or two important points to be noticed. (1) The person must do it "knowingly." Having regard to the fact that this is a penal act, and the recent decisions on the point as to how far a master is liable for his servant's acts, it would seem very doubtful if a quarry or mine owner, from whose works large quantities of waste went into the stream, would be liable, especially if he could prove it was done without his knowledge. It will also be observed, that it is not an offence to put in any solid matter, but only to put in solid refuse, rubbish, cinders, or putrid solid matter. The Courts have held that nothing can be said to be rubbish or waste that has a commercial value, so that, unless the complainant can prove that the solid matter has no commercial value (a rather difficult task in these days), or that it is cinders, or putrid, the section will not apply; and even this is not the worst. If we turn to the definition clause, we find that "solid matter" is defined as not including "particles of matter in suspension in water." Now, it is from these very "particles in suspension" that some of the worst pollutions from solids arise, for example, the China clay works, in Cornwall. To these, and such as these, the Act will not apply. It would be idle to add more to show that, as to solids, the Act is not an effectual remedy of universal application.

Part two relates to sewage. It provides that every person who causes to fall or flow, or knowingly permits to fall or flow, or to be carried into any stream, solid or liquid sewage matter shall be deemed to have committed an offence. Now for the qualifications. What was said as to "knowingly" again applies here. Further, with regard to which, if at the date of the passing of the Act (15th August, 1876), the channel through which the sewage flows was constructed or in process of construction, no offence is committed if the person used the best practicable and available means for rendering harmless such sewage. So if a person had begun to dig a ditch before the 15th August, 1876, and uses what he considers the best practicable and available means, he is not liable under the Act. The means he uses may not be the best—there may be far better; but he has the conclusive defence that any other means than those he uses are not either available or practicable, or if available not practicable, or if practicable not available, a point upon which he will be able to go into evidence. If the person who causes the pollution can induce an inspector of proper qualifications, appointed by the Local Government Board (whatever this may mean, for we have been always taught to assume that Government inspectors are properly qualified for their places, and if not that they would not be appointed, but this Act seems to give a Parliamentary sanction for saying that certain of the Local Government Board inspectors are not properly qualified; we should like to see a list of the names of this class), to say that the means used are not the best, but the best under the circumstances of the case, then, for two years the happy polluter can go on polluting under the Act of Parliament, and at the end of two years the certificate may be renewed for another two years, and so on, as long as the polluter and inspector agree. True, there is an appeal from the inspector to the Local Government Board, but he would be a bold man who would venture to appeal, running, as he would, the risk of of having to pay all the costs, and knowing that an appeal from the inspector to the Board is a proceeding analogous to what used to be seen in the Court of Chancery, from Lord Eldon at Lincoln's-inn to Lord Eldon in the House of Lords. Yet further, the Local Government Board can give any sanitary authority who are polluting rivers time to take steps to adopt the best practicable and available means to make sewage harmless, or, in other words, to judge from the case of the Thames, can allow them to go on polluting from year to year, while they are trying so-called experiments. So far as to sewage, it will therefore be seen that the Act is neither cheap, speedy, or effective.

If the Act as to solid pollutions and sewage is not what it it professes to be, part 3, as to manufactures and mines, is still less so. As in the other parts, the Act begins by declaring that every person who causes to fall or flow, or knowingly permits to fall or flow, into any stream, any poisonous, noxious, or polluting liquid, proceeding from any factory or manufactory, shall (subject as in the Act mentioned) be deemed to have committed an offence against the Act. In the first place, the old objections as to "knowingly" again arise; to prove an offence against the Act it must be proved that the polluting liquid is "noxious," for by the definite clause "polluting liquid" does not include "innoxious discolouration." The same rule as to works in existence or in progress as was stated as to sewage, equally applies to this class of pollution. Under the Act, a manufacturer can obtain what he could not have done by any means before, a legal right to pollute streams. As to mines, it is no offence to discharge any water that has been drained or raised from the mine. The worst of the mining pollutions are those from water that is pumped out of them, and this class is expressly excepted out of the Act. However, poisonous, however polluting, the water drained or raised from a mine may be, it is no offence to discharge it into a stream.

But the protection the Act throws over the mine-owner and manufacturer does not rest here. Suppose a case of a manufacturer cleaning out some part of his manufactory, and allowing all the washings to go into the adjoining stream, which is the water supply of the town below, no very improbable case, what is the remedy that this Act gives to the persons, who are suffering from the nuisance and who require immediate relief. They must take the following steps:—

1. Complain to the sanitary authority.
2. If the sanitary authority agree to prosecute, they must ask for leave from the Local Government Board to do it.
3. The Local Government Board, before giving leave, are to take into consideration the industrial interests involved in the case.
4. They are not to give their permission to a prosecutor in any district, the seat of any manufacturing industry, without previous local inquiry..
5. Having got the leave of the Local Government Board, the person to be proceeded against may object, and require the sanitary authorities to hear him, his agents, and witnesses on the subject as to whether proceedings are to be taken or not.

Now, assuming the Local Government Board to to be more activo than they usually are, it is obvious that all these matters take time. Meanwhile, the pollution is going on, doing, it may be fatal injury to the health of all the inhabitants of the district, destroying property, injuring trade; and until the sanitary authority and the Local Government Board have done deliberating and inquiring, nothing can be done. The law's delays are proverbial, and in some of the courts of the Chancery division of the High Court of Justice it is difficult to get an application for an injunction heard, but the proceedings in Chancery are expeditious to a degree to the proceedings under this Act. It is an injustice to the former to institute any comparison; it is like comparing the electric telegragh to a carrier's waggon, and the worst is, there is no remedy; the Act is so safely fenced round in favour of pollution, that it is very doubtful if any proceedings against mine owners or manufacturers not under the Act would be successful. If this clause stood alone it would be sufficient to condemn the Act; and yet, from his reply to a deputation that waited upon him the other day with regard to it, the President of the Local Government Board seems to have a particular affection for it, and expects good results from it! Enough has already been said to show the Act is really an Act to give increased facilities to pollute rivers.

One other point, a comparatively minor one, may be noticed, that will show that really the proceedings under this Act will be more expensive than under the old law. Any plaint entered in a County Court can be removed into the High Court of Justice, and when this is done, in what better position is the unfortunate person who seeks redress from pollution, than if he had begun in the High Court at once? Simply this, he has incurred considerable costs in the County Court that he need not have done if he had proceeded under the old law.

So far as really dealing with pollutions and giving any effective remedy, the Act is worse than useless; it not only deceives the unwary, by professing to give a cheap and simple method of restraining pollution, while really it only gives to the wrong-doer a legislative sanction for his acts, but it leads to an endless sea of litigation, and useless litigation; for even if the complainant is ultimately successful, the injury complained of is, most likely, long ago abated, the damage done, the public health sacrificed, while sanitary authorities are deliberating, and the Local Government Board inquiring and issuing certificates. If this is to be taken as a fair specimen of the way her Majesty's Government redeem the pledge of the Prime Minister as to *sanitas sanitatum omnia sanitas*, so far as relates to the Pollution of Rivers, the original is truer than the adaptation, and the Act is only another example of *vanitas vanitatum omnia vanitas*.

NOTES ON THE LIERNUR SYSTEM.

By Captain Liernur.

The description of the sewerage system, by the engineer of the Local Government Board, Mr. Rawlinson, and published in the report of that Board for 1876, contains a great many errors. The great importance attached to this report, on account of its official nature, demands that these should be corrected, by calling public attention to them.

It is due to Mr. Rawlinson to say that I do not hold him responsible for these errors. They are manifestly the result of want of reliable information. In the first place, he seems not to have had sufficient time for the purpose, for I have ascertained that his personal examination of the works he describes has been of the most hasty kind. This is also proven by the fact that he does not mention one single word of my peculiarly constructed sewers for house and rainwater, nor of the arrangement for subsoil drainages. He has taken only notice of the division of the system for fæcal matters, the so-called pneumatic part, and has seen of this little more than a few privy closets, constructed after my earliest and most imperfect models, when I was still experimenting. From his own observation he knows nothing of the rest whatever, nor has he seen my later works, and in Dordrecht he has not been at all.

Secondly, the source of his information is very unfavourable for obtaining an impartial statement. According to his own account, his informers were the Director of Public Works of Amsterdam, Mr. Kalff, and the city engineer of Amsterdam, Mr. von Niftrik. The former is angry with me, for having ridiculed his proposal of employing the city canals regularly as open sewers for all sort of filth, and erecting gigantic steam engines for keeping up a powerful current in them, while the second is not less irritated that his plan for sewering Amsterdam on the English system, on which he has been working for years, has been rejected on all sides, through my pointing out its faults. Consequently, a word of praise on any matter connected with my system is never heard from these gentlemen, unless it is absolutely pumped out of them, and both delight in pointing out imperfections of execution, leaving the impression that they are due to wrong principles of construction. Mr. Rawlinson's account of what he, no doubt, honestly took to be my system, but which were in fact chiefly temporary arrangements, is explainable in no other way.

Thirdly, it has escaped his notice that the execution of my plans is entrusted to the very men he obtained all his information from, namely, the city engineer and the director of public works, I not having anything to do with it, and being not even told whether my plans are executed or not. Hence, what he describes is not my work, but, in all but preparing the plans, their work, or rather what they make of my system. How they now attend to this can be found on page 63 in Mr. Rawlinson's report. There he mentions that, "with the exception of one of the nine quarters of the town where the system is introduced, no control has been exercised over the work inside the houses," and that these are, consequently, places where the system does not work well. Mr. Rawlinson states this on the authority of the Director Kalff himself.

It is evident from this, that neither I nor my system can be held responsible for whatever is wrong, and that Mr. Rawlinson's conclusions have no value. It appears, from his own report, that he has not seen my system, nor is acquainted with my plans, but only describes what my opponents have made of the one division of it, which he considers the whole, and that this has been executed by them without supervision over its most important parts.

Having explained the cause of his errors, I will shortly point out what they consist in.

1st. Mr. Rawlinson says that the system serves only for the solid human excreta, and appears thus to have credited an absurdity of Mr. Kalff. The fact is, that the closets must receive, like those of any other system, besides the urine produced when the closet is used, the contents of all the urine-utensils of bedchambers, this being the result of the cleanly habits of the people. They simply cannot be made to empty these utensils anywhere else. Of course, the closets receive in this manner also the contents of the wash-basins of bedrooms; but I do not mind this dilution in the least, nor does it seriously affect the cost of removal. That all the urine is received by the closets is proved by repeated analyses. What I desire to keep out is the immense quantities of water used in Holland for scrubbing and flushing floors, and it is for this that I insist upon providing proper gullies, to prevent it finding its way into the closets.

2nd. Mr. Rawlinson says that I acknowledge that towns should have the subsoil waters lowered, that they must be sewered, that the houses must be drained, and that the fluid refuse of manufactories must be attended to. This is a very grave error, for it means nothing else but that my system does not provide for all these wants, and that, consequently, besides the pneumatic system, precisely the same sewerage works are required as constructed by him on the English plan. Further from the truth it would be very difficult to get. The fact is, that there simply does not exist any plan of the system made up by myself, without showing special provisions for everything connected with the drainage of towns, the various arrangements forming together a whole, like the links of a chain, and being as different in design and construction from the English pattern as they possibly can be. The arrangements for ventilating the sewers, the sewers themselves, the street gullies, the house gullies, the arrangements for subsoil drainage, and those for the treatment of manufactory fluids, have all special and peculiar characteristics forming part of my invention, and it is due to these characteristics that the whole combined, including the pneumatic part, is far cheaper than the English water-carriage plan. This is the chef error of Mr. Rawlinson's report, and is evidently committed in consequence of being absolutely unacquainted with the matter he describes.

3rd. Mr. Rawlinson says that the municipal authorities of Holland have come to the conclusion that the country is too low and flat for constructing main sewers and house drains, like in English towns, and that hence they resort to the pneumatic system. This conclusion is also contrary to the fact. The municipal authorities are, as a rule, in favour of the English system, on account of most city engineers deeming this easiest and best, and always reporting in favour of it. This is the cause that the introduction of my system goes so slowly. These gentlemen seem actually to love to prepare plans on the English system, for, being mostly builders of the old school, it is more within their range of knowledge; while my system, requiring conversancy with mechanical engineering and chemistry, is to them a horror of complication. They look upon it like a bricklayer upon a telegraphing apparatus, or like a cook upon a sewing-machine. The reason that the town authorities, in spite of their technical advisers, prefer my system (by which I mean the whole arrangement for draining towns, and not Mr. Rawlinson's notion of it), is the one given above, namely, that it is far cheaper to construct. This argument appeals stronger to the head and heart of an alderman than any other. It is chiefly upon this ground that the mayor and aldermen of Amsterdam have, in their message of 12th December, 1876, to the common council, proposed to extend my system over the whole new part of the city, comprising about 1,000 English acres. Their message on this subject is very exhaustive, containing a review of all the inquiries and reports made about it during the last five years. The conclusion is, that my system is easier to construct, sanitarily more perfect, less liable to produce a nuisance, and, above all, far cheaper than any other. The report is also interesting for disproving several statements against the system by the Director of Public Works. As the language of Holland is not difficult to understand for an English reader, I advise those who wish for the proof of the above assertions to obtain the message with report referred to. It can be had, at little cost, on mere application at the town hall. Those who do not like to take all this trouble I advise to proceed to Blackfriars Bridge Hotel, London, where the *Amsterdam Handelsblad* is kept. By asking for the paper of 8th March, 1877 (second edition), they will find an editorial *resumé* of four public discussions upon the sewage question held during February last, and provoked by the great opposer of my system, and supporter of the English system, Mr. Tindal. The charges made against my plan were utterly insignificant, being all referable to imperfect construction and want of supervision, and were brilliantly refuted; and it was shown, from figures furnished by the Director of Public Works, that whereas the English system in the new part of the city would cost ten million florins, mine would cost but three millions, or not quite one-third. I may add, that the Director of Public Works, though so bitter against me, advised my system himself, on account of the financial advantages it offers, which he proved, and because he calls it sanitarily and technically good. No better proof than this can be brought of the utter want of foundation for the chargo of Mr. Rawlinson of my system being too costly and complicated, and of the great necessity for contradicting it. English towns giving credit to his statements would spend at least twice more than necessary, than they would do by following my plans, besides being spared the nuisance of not knowing what to do with the sewage, and polluting the streams in the most disgusting manner.

4th. The fourth important error of Mr. Rawlinson relates to the closets of the system. Although he reports that no control was exercised over their construction, so that nobody knows whether my plans were followed or not, he lays (page 23) great stress upon the circumstance, that in some cases the pan of the privy was filled to the brim, the air suction failing to empty it, and condemns the arrangement on that account altogether. Now the fact is, that the throat of what Mr. Rawlinson calls the pan, and by which he means the syphon at the bottom of the funnel, has one inch more diameter than the throat of an English water-closet. As now a closet can only get choked by foreign substances too large for passing through the opening, there is evidently far less abuse and negligence required to choke and overflow an English water-closet than a closet of my system. Under the same circumstances, the former is therefore more liable to become a nuisance than the latter. What engineer would, however, condemn water-carriage sewers, because he found a couple of water-closets in a filthy condition?

The chief mistake of Mr. Rawlinson lies in his deeming the closets he complains of an essential part of the system. The fact is, that it is perfectly immaterial, in a technical point of view, what sort of closets are used. The pneumatic privy was constructed by me for the poorer classes, who cannot afford the expensive mechanism of a water-closet. That they give so much satisfaction that even the rich use them, I cannot help; it is their choice, not mine. I allow everyone to use whatever closet he pleases, so long he pays its cost. There is, therefore, not the least difference in this respect between Mr. Rawlinson's favourite sewerage system and mine, and he might have spared himself the trouble of rushing about, examining closets and pans, and writing reports about it. All the possible praise he might sing about his own closets refers equally well to mine. It is only that I personally object to English water-closets on account of their clumsy construction, and great liability of becoming a nuisance through getting out of order; this is, however, no law for others, and there is no accounting for tastes.

5th. The fifth great error of Mr. Rawlinson consists in his allegation (page 24) that I have been particularly fortunate in the introduction of my system in Holland, because they are there so well acquainted with the manure produced by it. He evidently was thinking of Brabant and Belgium, where this is the case. In Holland there is nothing of the sort, and the want of all knowledge of how to deal with this substance is one of the great difficulties I have to contend with. As an instance, I may mention that Mr. Amersfoordt, owner of the farm Badhoeve, visited by Mr. Rawlinson, absolutely put 17 times more manure per acre on his land than, following my advice, his neighbour does, who obtains the finest kind of crops. As Mr. Amersfoordt paid 17 times more for his manure than was necessary, and burned his crops besides, it is no wonder that he found it rather expensive, and stopped using it. Perhaps there is no country in the world where it is so difficult to find a sale at any price for liquid fæcal manure as Holland, and Mr. Rawlinson testifies to himself this without knowing it, through quoting at full length the letter he received from the director of public works at Amsterdam. That gentleman says (see page 66) "the pastures around this town are used principally, if not exclusively, for milch cows, and those meadows do not want such manure." But there is no more. Just on account of being almost chiefly a cattle-growing country, which produces its own fertiliser, it needs but little additional manure at all, and the very best fertiliser, guano, is just as much a drug in the market, as far as a ready sale is concerned, as the manure produced by the pneumatic system.

All Mr. Rawlinson's speculations upon the unsaleability of sewage manure, which he bases upon the condition of affairs in Holland, are therefore withou tthe slightest value. At the same time, he has committed the error of not reporting a circumstance connected with this subject, which is of the greatest importance in the sewage question. He does not mention one word of the result of the official trials taken on tillage land, with the manure produced by my system, as compared to Peruvian guano and stable manure, in order to ascertain the precise money value or price the farmer could afford to give for it. Through these practical trials it has been indisputably proven that, through the utilisation of separately collected fæcal manure, all the working expenses of my entire system, including interest and redemption, can be more than covered, so that, as the capital is returned, my plan of sewering a town costs actually nothing at all. To bring this about, all the town has to do, is to take the same steps the water-carriage system is forced to in case of utilising its sewage, namely, leasing or buying land for the purpose. The income is then independent of the question of demand for manure, and the ignorance of the farmer, for it is secured by the will of the party interested in obtaining it; and tillage land can always be had, no matter however difficult it may be to find irrigation fields. This mode of dealing with the subject, and not the one allowed in Holland, of offering the manure for sale to farmers who do not need it, and do not know what to do with it, is what I have always advocated and prescribed as belonging to my system.

To conclude, I have shown that, contrary to Mr. Rawlinson's statement:—

1. The pneumatic division of my system provides for the removal of all the urine, as well as the solid human excreta. I may add to this, that it removes also, at the same time, the sediment and solids of the kitchen sinks.

2. That my system embraces all the arrangements required for the drainage of towns; and that this combination is cheaper of construction than the English system of water-carriage.

3. That the water-carriage system is quite practicable in Holland, and that the municipal authorities chiefly prefer my system, because it is cheaper, does not pollute the streams, and effectively disposes of the sewage.

4. That there is no difference whatever in the form of closets which my system requires from those in use by the English system, and that all condemnation of my plan on that account is mere humbug.

5. That the little want in Holland for fæcal material, on account of being a cattle-growing country, and the want of knowledge in using, which makes it nearly unsaleable, is one of the main reasons why the introduction of my system is not more rapid. That, however, official trials on tillage land have shown that its value is abundantly great enough to pay for the system, both first cost and working expenses; and that towns can easily obtain this income by utilising the manure on lands obtained by lease or purchase under their own control, like is done by the irrigation fields of the English system, the difference being that this never pays, whilst my system does it with the most absolute certainty.

The conclusions Mr. Rawlinson has come to are therefore entirely wrong, and his report is highly detrimental to the public interest.

Finally, I may mention that the trials at Dordrecht, of reducing the liquid manure of the pneumatic system to a dry powder, by evaporating the water upon it, in a partial vacuum, after having mixed a little sulphuric acid with it for the purpose of fixing the nitrogen, have been entirely successful, and that it has been shown that the method is highly remunerative. I will, in a short time, publish an account of these trials, thus placing the results and the means of ascertaining the correctness of my statements in the hands of the English reader.

E. Kist, Secretary of the City of Leiden (Holland,) writes, under date of 28th April, 1877, to the Secretary of the Society of Arts:—

> "I have pleasure in stating that Captain Liernur's pneumatic system is applied in this town, to a district containing nearly 1,200 people, and that it has been in constant operation for over five years, and has given the greatest satisfaction. Numerous deputations from your and other countries, including commissioners from your Local Government Board, have visited this town, and to all of them that I have come in contact with, I have had the pleasure of giving the strongest possible testimony of the undoubted technical success of the system, there never having been any difficulties nor irregularities in the working. As there appears to be a misapprehension that the town council have resolved not to extend the system, I beg to state that this is a mistake. It has given such perfect satisfaction that divers commissioners, in separate reports, have recommended the preparation of plans for extension to the whole town, and that the principal inhabitants, including many professors of the university, many years ago, had petitioned long for such extension. The obstacle has solely been the financial one; and this, I have no doubt, will, by the manufacture

of poudrette, as shown experimentally at Dordrecht, be overcome. The authorities paid an official visit of inspection of the manufacture at Dordrecht; but the question of further extension has not yet come up again for consideration. All the medical authorities are convinced of the great sanitary benefits of the pneumatic system of Captain Liernur. Not long ago, that system was recommended as the best system by all the official medical inspectors of this country."

WHAT IS THE LIERNUR SYSTEM?

By Adam Scott.

In the opening sentence of the account given of the Liernur system in the last report of the English Local Government Board upon the sewage of towns, it is stated that "the system known by the name of Captain Liernur is one for dealing with the solid of human excreta, and not with town sewage."

As the system known by the name of its inventor, Captain Liernur, is a comprehensive one for the drainage of a town, and has in all departments many novel features complying with the requirements of the most advanced knowledge of sanitary matters, it is desirable briefly to describe that system.

By Captain Liernur's system the sewage of a town is classified, and the work to be done so divided, that every detail is kept under complete mastery, instead of being allowed, as in the water-carriage system, to be mixed all together, and to defy reasonable control in the houses and streets as well as at the outfalls.

1. *Pneumatic Subdivision.*—This is for the collection of solid and fluid excreta, and the sedimentary products of kitchen sinks, separated automatically from the bulk of the water which accompanies them, also of bedchamber slops, as they contain urine. This pneumatic subdivision is the greatest among the many novelties of the Liernur system, and many people fall into the erroneous notion that it alone is the Liernur system, because the other subdivisions of that system are not generally adopted in Holland. They jump, therefore, to the conclusion that the Liernur system is an incomplete one, that does not deal with the whole sewage of a town, a conclusion quite unfounded.

In the ninth report of Mr. Simon, the medical officer to the Privy Council, it is stated that the first condition of public safety from the diseases caused by excremental pollution, such as typhoid fever,[*] cholera, &c.,[†] is that, by "appropriate structural means all the excremental produce of a people shall be so promptly and so thoroughly removed that the inhabited place in its air and soil shall be absolutely without fæcal impurities." Now, the only method in the whole world—I repeat, the only known method in the whole world—which does effectually remove such matter so promptly and so thoroughly, that the inhabited place in its air and in its soil shall be absolutely without taint of any kind from excremental pollution, and yet without requiring intrusion into houses, is the pneumatic subdivision of the Liernur system. By it excremental matter, solids and fluids, being the most dangerous, and yet the most valuable part of sewage, is collected by means of underground 5-inch pneumatic air-tight cast-iron pipes. The removal is effected daily, if the provisions laid down by the inventor are obeyed, and the motive power or vacuum is created by means of air-pump engines in a central station.

By the provisions of the system, the fluid manure thus collected is, without ever being allowed out of air-tight vessels, and by a continuous process, evaporated, after a slight admixture with sulphuric acid, into a valuable concentrated dry poudrette, containing from 7 to 10 per cent. of ammonia, and all the other valuable manural ingredients of the original manure. Extracts from the report of the Commissioner of the Irish Local Government Board upon his inspection of this manufacture of poudrette will be found in the discussion. The sale of the manure in a fluid state is not in accordance with the provisions of the Liernur system, and Captain Liernur disclaims all responsibility for the financial results of such sale. All the air that has been in contact with the excremental matter in the pipes and tanks, and has been thus contaminated, is drawn through the pipes, and all the germs of disease with which it may be laden thus undergo a most effectual cremation. I need scarcely say that such is also the fate of any germs that may be in the manure itself. Such is the wonderful simplicity of the pneumatic system that, in the whole system of pipes from and including the closet, there is no mechanism, automatic or otherwise, that moves or requires to be moved, save and except the cocks, like water-cocks, on the street tanks, which cocks can be lifted up, examined, and replaced at a moment's notice.

Closets without Water.—These, which are intended specially for the poorer classes who form 80 per cent. of the community—although quite suitable for the better classes—are thus described by Mr. A. R. Abbott, of the Tottenham sanitary authority. (See *Society of Arts Journal*, 9th April, 1875.) His opinion has been repeatedly endorsed by numerous English deputations:—

> "Mr. A. R. Abbott said he had seen some scores of the closets, described in the paper, in some of the poorest localities in Leyden, Amsterdam, and Dordrecht, and was much surprised to find that they were positively sweet and pleasant, in fact superior to the average arrangement to be found in middle-class houses in England as regarded freedom from all kinds of effluvium."

Water-closets.—Those who wish these, and can afford to pay for them and for the cost of evaporating the additional water thus used, may have them, but they should be of a water-saving character, either that invented by Captain Liernur, or any other equally effective. A water-closet may always be considered a kind of life annuity to the nearest plumber.

Technically, wherever the pneumatic system has been introduced in strict accordance with the plans furnished by Captain Liernur (I specially draw attention to this), it has been a complete success, and as such has been testified to by the highest authorities in all the towns where it is in operation.

The pneumatic system, as a system for collecting solid and fluid excreta and chamber slops, is in operation in parts of Amsterdam (5 years), Leyden (5 years), Dordrecht (3 years), Prague (7 years), Brünn (6 years), Olmutz (6 years), and St. Petersburg (18 months).

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[*] Typhoid fever alone kills 15 000 persons, attacks each year one person in every 200 of the population, lasting in each case from three to six weeks, besides generally leaving a complaint of some kind behind it.

[†] Dr. B. W. Richardson sets down fifteen different diseases as capable of being conveyed by sewage.

2. *Sink Sedimentary Refuse.*—This, which is the same as fæcal matter, only that it has not passed through the human body, is, within a few seconds of production, separated automatically from the bulk of the water accompanying it, and when the pneumatic operation takes place, is collected along with the excremental matter.

By the trap which automatically effects this separation, all possible air communication between the houses and the sewers is completely prevented, so that, if gas did exist in the sewers, it could not come into the houses through the drains at all.

3. *House-water.*—The only thing that can militate against the economical reduction of the manure to poudrette is the dilution that might be got from house-water from kitchens being always put into the closets. The Liernur system meets this difficulty by providing, in such a position as to be always easier of access than the closet, a house-water sink, not of the ordinary shallow type, into which water must be emptied slowly, but funnel shaped, so that house-water may be "thundered" down it without fear of overflow. It is this facility that makes the closet the favourite receptacle for dirty water, but by providing the convenience easier of access, the mere laziness of people will effect the purposes intended. It is quite true that some of the liquid manure will at times be thus lost, but this, of course, cannot be helped. It is not the cause of either typhoid fever or cholera.

With regard to the dilution that may be expected from chamber slops, it must be remembered that the ablutions of the poorer classes are generally performed at the kitchen sink, and that they do not indulge in the luxury of slop pails.

4. *Separate Drainage of the Subsoil.*—This is effected by agricultural drain-pipes placed in front and in the rear of the line of houses, and emptying at intervals into the sewers. These subsoil drains are preferably placed at the lowest level of the subsoil water, so as to keep it permanently at that level. The Liernur system is the only scheme of town drainage which systematically provides for that great sanitary necessity in towns, a properly drained subsoil.

5. *Ordinary Sewers.*—These are made of vitrified earthenware, so as to be impervious, and thus neither to let the sewage out to pollute the soil, nor to let subsoil water in by percolation. By keeping the subsoil water pure, the wells supplied by it are kept free from pollution.

The sewers, being below the permanent level of the subsoil water, have also a hydrostatic pressure upon their outside from that water. Their dimensions can consequently be made so small as to allow of their being completely full in times of heavy rain without any danger of bursting. The speed of flow being regulated by the gradient of the sewer and the head of water in it, the cleansing effect in the small sewers is proportionately great. These subsoil drains and impervious sewers are together, when applied to a whole town, only half as costly as the old method.

Captain Liernur's impervious sewers and subsoil drains are only in actual existence on a small scale in Holland. In towns or places already sewered, the people need not adopt Captain Liernur's subsoil drains or impervious sewers, but use their old sewers for house or rain-water. Of course they lose certain sanitary benefits in this way, but that cannot be helped.

6. *Manufacturing Waste Water.*—There being no magic receipt which will cleanse manufacturing waste water, mixed with the sewage of a town, and ever varying in its chemical constituent and combinations, Captain Liernur requires this to be purified separately by the manufacturer, he being the only one knowing the composition of his own waste water, and able, therefore, to treat it. This being the principle of the law, though with notorious exceptions, needs no remark. It must commend itself to the common sense of all. The question of cost is another matter. The manufacturer who has, as it were, acquired a vested right to pollute sewers, must be reimbursed by the community if this separate purification causes a loss, as it is the business of the community to ensure that the soil and air of towns and the water of streams shall not be polluted.

As has hitherto almost invariably happened, there is little doubt the manufacturer would generally find the separate purification a source of profit. Captain Liernur provides a bend on the pipe from the factory to the sewer, connected with the pavement by an upright tube, by means of which the inspector of nuisances can at any time, with the aid of a small hand-pump, take a sample for examination.

7. *Mud and Street Detritus.*—This is not allowed to enter sewers, to form deposits, and consequent nuisance in them or in the rivers. The street gullies are provided with iron buckets, into which, by a funnel, all the street water enters, but can only escape into the sewer by filtering upwards outside the funnel, through a loosely-woven thick straw mat. The mud and detritus is cast down into the bucket for periodical removal by scavengers, and the water going into the sewer thus receives a purification from all coarse particles.

8. *Purification of Ordinary Sewer Waters.*—As this no longer contains excrement, sink refuse, manufacturing waste, nor mud and street detritus, but only consists of house and rain water, it is, if required, easily purified by filtration through gas-coke. The defecating and purifying powers of this material are well known, and in the present case its effectiveness will not be destroyed by its being choked up by solid or semi-solid substances. As the coke, with all the impurities it has absorbed, is afterwards used in the pneumatic furnaces, the cost of purification is that of labour only.

For the purpose of this purification, which can cause no nuisance, Captain Liernur would never propose the enormously costly intercepting sewers now built, to carry all the sewage out of town to a distance to be treated. The simple drainage water in his sewers would be treated in comparatively small divisions, by suitable filtration beds (in duplicate), placed, in accordance with the natural drainage of the district, at the mouth of large sewers, or by connecting a number of small sewers together, special care being taken never to allow such a large volume in any one place that could not be effectually kept under control,

Plans, and a description of these filtration beds in detail, may be seen in Captain Liernur's report to the Chorlton Union, Manchester, upon the drainage of their district, and published by them.

Resumè.—The reader will have seen from the above that the system known by the name of Captain Liernur is a comprehensive one, that it includes all the sewage of towns, viz., excremental matter (solid and fluid), house and rain water, sink sediment, mud and street detritus, manufacturing refuse, purification of ordinary sewer water, besides a thorough drainage of the subsoil of towns, and the prevention of excremental pollution diseases.

I conclude by quoting the unanimous resolution of the Official Sanitary Board of Holland upon the question of town sewage in October, 1876. After utterly condemning the water-carriage system, "even with the most unlimited supply of water," because it is "dangerous to the public health already inside the town, quite apart from its effects outside of it," they say:—

> "No other system answers so fully and so well all the claims that can be put to the collection and removal of excremental matter, of slop and rain-water, and of the waste water of factories, and to the regulation of the subsoil water, as the Liernur system, as well as from a sanitary, as from an æsthetic, technical, and economical (agricultural and financial) point of view."

This Dutch Government Board then unanimously recommends the universal adoption of the Liernur system, except in places with a scattered population. This fact surely speaks volumes.

CHEMICAL SECTION.

Thursday, April 19th, 1877; F. A. Abel, Esq., F.R.S., in the chair.

(The publication of the following paper and discussion has been unavoidably delayed).

The paper read was on—

SPONTANEOUS COMBUSTION IN FACTORIES AND SHIPS.

By Charles W. Vincent, F.R.S.E., F.C.S.

Strictly speaking, there is no such phenomenon as spontaneous combustion. The inflammation of various organic and inorganic substances, without the immediate contact of any ignited matter, which has given rise to the term, is, nevertheless, as certainly the result of some direct act or acts which can be accurately traced, as is the firing of a lucifer match when struck on a rough surface.

The discovery of what the active agents are, and the circumstances under which they occasion visible ignition, has long been the subject of research, and, one by one, they have been so fully investigated that there should be little difficulty in at once assigning the specific cause to every species of "spontaneous combustion." It is, nevertheless, so difficult to shake off the trammels of incorrect observation, and theory founded thereon, that there are even now many cases in which combustible substances catch fire, in spite of great precaution having been taken to prevent such catastrophes, and this because care and attention has been wholly directed to prevent something which is not likely to take place, and no thought has been given to that phenomenon upon which all combustion, as it is commonly understood, depends, *i.e.*, the combination of the components of the combustible body with oxygen.

It is not here intended to treat of fires arising from friction of machinery; lighting of explosive gases or vapours; the action of the sun's rays through unintentionally disposed lenses, such as may be formed by glass globes filled with water or knots in a pane of glass; firing of disseminated flour, or cotton, &c.; but to examine some of those cases when starting with the combustible at the ordinary temperature, it gradually becomes hotter and hotter, and at last takes fire without, to the unscientific observer, any apparent reason for its so doing.

Many animal and vegetable substances heaped together in a large mass, when neither too wet nor too dry, are liable to take fire by the heat produced by their own decomposition. Haystacks often afford examples of this. Heaps of any dry fibrous vegetable material, or of dry wool, cotton, cloth, calico, paper, sawdust, &c., when smeared with grease, oily matter, or particularly a drying oil, such as linseed, and left undisturbed in a warm dry place, are tolerably sure to be consumed by fire. Coal, piled in quantity, and left too long in one place, or confined in great bulk in the hold of a ship on a long voyage, frequently behaves in a similar way. A comparison of the conditions under which the spontaneous combustion of these three classes of bodies—viz., damp organic matter, dry oily organic matter, coal—takes place, may be useful by suggesting the means of preventing them from happening.

In a rough way, we may describe heat as being the effect of a blow upon an immovable body. A nail on an anvil struck by a hammer becomes hot, the visible motion of the hammer is converted into the invisible "mode of motion" (to use Dr. Tyndall's happy phrase), heat. If the nail were perfectly free to move, the blow would produce no heat. A wave of the hand in the air, though made with the exertion of the utmost muscular power, produces no sensible heat, because the air is set in motion. The same force applied to strike a blow upon enclosed air—as, for instance, in the fire syringe, or in a force-pump—produces a very sensible quantity of heat. The air is less free to move, and the heat produced is in proportion to the destruction of its motion. Were we to follow out, to its fullest extent, the effect of the blow on the free air, we should find that heat resulted here also; each particle of air struck drives before it the particles surrounding it. But, though air is very mobile, it is not perfectly so; amongst other restraining agencies, it is somewhat held together by the force of gravitation. The circle of motion, though extensive, still has its limits; the full force of the blow received is, therefore, not imparted to the surrounding molecules, and the amount of force which thus disappears is manifested as heat, but the concussions, being feeble and spread over a large space, are imperceptible to our senses. The resulting heat is, nevertheless, quite as great in quantity as when the air is struck in a chamber with rigid boundaries.

Imagine a vessel devoid of air, to which air is suddenly admitted; the air will rush in, will strike against the side of the vessel, its motion will be arrested; the force which produced that motion cannot be destroyed, it is converted into heat.

Freshly burnt charcoal is as a vacuous chamber to many gases, since it has the power to condense within itself many times its volume of some of them. The falling in of these gases and their condensation is a succession of blows followed by a stoppage of motion, heat is produced, and in some cases makes its presence unpleasantly manifest. Condensation of a gas, by whatever means, implies application of force followed by cessation of visible motion; every such condensation must, therefore, produce heat.

Freshly reduced iron is in a similar way vacuous to oxygen. If the iron is so finely divided as to afford room for the gas to strike a sufficient number of blows at it, the clashing of the atoms produces enough heat to raise the temperature to that at which chemical combination of the iron and oxygen can take place, and this with so much rapidity that the metal takes fire and burns spontaneously.

In the instances already given, heat is clearly the product of physical action. The heat produced by chemical combination is also the result of blows given and received. The stroke of a hammer concentrates and expends a certain amount of force in one blow; friction expends the same amount of force in producing a succession of blows less in intensity; in condensation by charcoal the gas expends force in producing a succession of blows, still feeble, but infinitely more numerous. When a substance burns in air, the action which takes place is of precisely the same character, the blows being, however, indefinitely multiplied.

The combustible is first heated to a particular temperature, varying in different substances, called its point of ignition; to continue burning it must continue at this temperature; if cooled below this point the combustion would not be maintained. The initial temperature is that at which the particles of the bodies uniting receive sufficient momentum, when the molecules of oxygen and the combustible rush together.

At the moment of combination, their motion is checked and converted into heat and light. The greater the rapidity of the action, the more intense is the heat, and the less its duration, the slower the action the more feeble is the heat, and the greater its duration. The quantity is in each case precisely the same.

This meeting together of the atoms of bodies is an expenditure of force; a combustible in burning loses something; the chemists of the past century termed it "phlogiston," those of to-day "energy." The heat produced is something more than that due to the condensation in volume; this surplus is the heat due to the loss of energy.

Heat and energy are equivalent values. All the elementary bodies have a specific power of performing work, if this power is lessened, as it is when they enter into combination with each other; it is lessened by the expenditure of part of their power for doing work, and heat results. The combinations so formed may be broken up and reconstituted by the accession of some element, or combination of elements, whose power of working is not exhausted, and again heat may be evolved, but at last a point is reached when the constituents of a body have lost all power of motion, and then no further change can take place till they are torn asunder, and their energy restored. This can be done by heat; given a sufficient amount of heat, there is no compound whose constituents are so tightly bound together but that they would fly asunder.

The heat developed by the disruption of any compound substance capable of combustion is exactly equivalent to the amount of heat absorbed in its construction. The heat developed by the combination of elements is exactly equal to the amount of heat required to tear them apart if once united, and no change of constitution of any substance can take place without a certain amount of heat being either absorbed or evolved. If the substance undergoing this change were formed by the expenditure of a large amount of heat, and is passing into combinations which can be formed by the expenditure of a less amount of heat, then heat is evolved; and if this change of state takes place with rapidity, incandescence ensues. If, on the other hand, during the formation of the compound, heat was evolved, then, in order to bring its components into their original state, the same amount of heat must be restored which they parted with when they entered into combination.

There is a powerful factor which can restore to many burnt (that is combined) elements their original working power, by enabling them to absorb gradually, and by slow degrees, the amount of heat expended in their combinations; this is vegetable life. The seed, the plant, the tree, derive all their sustenance from tightly combined elements, which they combine to a more complex, but a more loosely held together state; in point of fact they bring them more nearly to their elementary condition. Plants do this by absorbing the radiant heat of the sun, and by some incomprehensible action of that mysterious power, "life," bringing it to bear upon the inert compounds in the air and the soil.

So long as a plant is living, the heat which falls upon it, if not so great in intensity as to be incompatible with the life of the organism, is absorbed and stored up in the complex, yet feebly combined, substances which form woody fibre, starch, the vegetable juices, &c.

Walking on a midsummer evening beside a grove of trees which has been exposed all day to the glare of the sun, no heat is felt; placing a hand on the trunks of the trees, or on the leaves, they are found to be of the same temperature as the air; the heat has all been absorbed; but touch a dead trunk which has been exposed to the same sun, and, though it has been some time shaded, it will be found to be hot; the heat which fell upon it is now radiating back into space. At the foot of Drayton-park, Highbury, is a crescent of houses upon which the sun falls for a great part of the day; on setting oneself in the focal point of the crescent some time after the sun has gone down, the concentrated rays of heat make the position conspicuously hotter than the rest of the street.

Dead or mineral matter is incompetent to store up the solar heat, or in any way to make it available for chemical decomposition. The work of the sun, unassisted by life, is purely mechanical. A vegetable whilst alive eagerly absorbs heat, using it for "unburning" burnt matter, but so soon as the life has departed, the dead body appears as eager to part with the heat it had gathered; the elements composing its structure are, as it were, rejoicing in their new powers, and are as eager in their turn to enter into more fixed states, in doing which they will part with the heat lately bestowed upon them. It is for this reason that substances of vegetable origin are liable to spontaneous combustion. From the moment that life is extinct, decay (which is really only another term for combustion) sets in, carbonic acid, water, &c., are evolved, the plant crumbles into a blackish brown mould, and is ultimately entirely destroyed. In the course of this change, the whole of the heat which had been collected by the plant is dissipated. It need not, therefore, be a matter of surprise that bodies containing so much bound up heat as do vegetable fibres of all kinds, more particularly hay, cotton, &c., coal of all kinds, oily rags, greasy sawdust, varnish rags used by painters and polishers, the waste at railway lamp stores, &c., should be particularly liable to take fire when stored in bulk.

Spontaneous combustion of these substances can only take place when they are so packed that small increments of heat may be stored up. If they are freely exposed to the air, the heat evolving action which goes on with it may be increased rapidly; but, as when the hand is waved in mobile air, the infinitesimal blows are free to rebound and react over so large a space that their effect is dissipated. But when their striking space is limited they act like the struck air enclosed in the fire syringe, their heat motion is intensified by concentration, and ultimately throws the whole mass into such commotion that the moving power of the molecules is manifested as light as well as heat.

But there must be a beginning to this heat motion. Oiled rags and bodies of that kind derive the initial movement from the oxidation of the oil. Perfectly dry vegetable fibre at ordinary temperatures oxidises extremely slowly, it is practically indestructible by atmospheric oxidation. Mummy cloths possess much strength after the lapse of two to three thousand years. Oils, however, are formed at the expense of a still larger amount of heat than vegetable fibre, the elements comprising them are combined much more loosely, and they are consequently ready to form more stable compounds, and release their bound up heat on very slender provocation. Oils absorb oxygen with great avidity, becoming viscid, and, in the case of drying oils, solid. In doing this they give out heat, which is due partly to the condensation of the oxygen, and partly to the carbon and hydrogen of the oil having by combination with the gas lost part of their energy, in fact they have been partially burnt.

In a heap of oiled rags, greasy sawdust, or matters of that kind, air, though not excluded, has only limited access to the centre, the heat of oxidation is not there carried off by convection currents; and though not at first great, goes on increasing, because it is surrounded by barriers of non-conductors, *i.e.*, bodies incapable of transmitting the heat motion, and so spreading it over a larger area, until at length it reaches a temperature of about 323° C., when the oil takes fire, and speedily fires the whole mass of which it is a part. The combustion being caused by absorption of oxygen, it is sufficient to exclude the air from the oily materials in use in factories, to effectually prevent their becoming so hot as to take fire. To revert to our parallel, the oils are vacuous to oxygen, absorb it with great rapidity, become hot, and the finely divided vegetable fibres become sufficiently hot to enter into combination with the oxygen on their own account.

In the spontaneous firing of hay-stacks, there is no oil to act as an absorber of oxygen, and thus to raise the temperature to that point at which the mutual action of the fibre and gas can take place. Here water is the active agent, though not in the sense in which it is commonly supposed to operate.

It was formerly held that plants underwent decomposition by direct absorption of oxygen from the air, and that the effect of water in promoting the action was to soften the tissues, and allow free access of the air to fresh surfaces, as those acted upon fell away.

Thoroughly dry wood and thoroughly dry hay are safe from destruction by fermentation, decomposition, or "eremacausis," as it is termed somewhat indifferently by various writers. But add water to the woody fibre, and the change takes place with greater or less rapidity, occurring most rapidly in young, spongy plants, which admit the air freely, and contain a good deal of albuminous matter more slowly in slow growing hard woods.

Fermentation produces heat, and, if the heat is shut in by non-conducting matter, as it is in a haystack, it will, under favourable circumstances, accumulate to such an extent as to cause the hay to take fire; and as fermentation cannot happen unless moisture is present, the water is, therefore, blamed for the combustion. This view, however, does not express the whole truth. Carbon combining with oxygen to produce carbonic acid evolves 7,900 units of heat (Andrews), this unit being the quantity of heat required to raise one kilogram of water 1° C. This amount is invariable.

Grass, when growing in the field, is covered with numberless microscopical organisms, whether vegetable or animal, matters not for our present purpose; it is sufficient to state that amongst their number are very many which, in the course of their growth, consume oxygen and give off carbonic acid in great quantity, and derive their nutriment from substances of vegetable origin. Such organisms as these are the active agents in every kind of decomposition by fermentation.

If hay were stacked immediately it was cut, it would, in a very short time, become mouldy; its organic structure would be broken up by the feeding upon it of the parasites which prey upon it, and its power of affording nutriment to cattle would entirely disappear. Experience, gained in the remotest ages, has taught the farmer that these detrimental effects can be entirely stopped by the process called "curing the hay," *i.e.*, by choosing hot weather in which to cut the grass, and then allowing it to remain exposed to the sun's rays until it has become thoroughly dry. Such hay not only keeps perfectly good, but does not take fire, however long it may be stacked.

What has the farmer done? He has by evaporation removed the water from the interior of the stalks and leaves, and has by so doing cut off from the germs of ferment the means of absorbing into their own organisations the sustenance which the grass would otherwise have afforded them. But he has done something more than this. He has, by exposing the grass to the high temperature of the summer sun, destroyed the life in a very large number of the germs themselves. Whilst the grass was living, they were preserved from the intensity of the heat, by reason of its absorption by the grass; but, so soon as the grass was cut, it lost its power of gathering up the heat, so that by far the greater part of the germs have lost all chance of doing further mischief.

Hay, properly cured, is not much damaged, even if afterwards partially moistened while being stacked, nor is it liable to take fire. Suppose, however, that the hay, instead of being thoroughly dried, was stacked whilst still damp; or that though dry, it had not been exposed long enough to the sun's rays to kill the larger part of the microscopical germs, and subsequently was accidently wetted. The germs would grow, would throw off millions of offshoots, would prey upon the grass, drink the water, and breathe the oxygen, which, however closely packed the hay may be, nevertheless penetrates to the innermost recesses of the stack. In doing all this, they would produce carbonic acid, and this fact alone is sufficient to prove that heat must be generated, since carbon and oxygen cannot be combined without giving forth heat, any more than carbonic acid can be broken up by the plant without absorption of heat.

The ferment germs also induce other dangers of the vegetable structure in which heat is evolved, but if their formation of carbonic acid stood by itself, it would be sufficient proof that they are heat-producers.

Fermenting germs feed by choice on the juices of the plant; this peculiarity of their growth aids spontaneous combustion, inasmuch as it leaves a large part of the carbon in a fine state of division and the better able to condense and combine with oxygen.

The centre of a fermenting hay-stack, when on the point of combustion, is blackened as if charred, and a sudden influx of air is almost certain to cause it to blaze. This is well known by farmers, and if on testing a suspected stack (by thrusting into it an iron rod and withdrawing it) they find the middle dangerously hot, they admit air to cool it by degrees, and with much caution.

The heat produced by the germs has no means of escape; it therefore accumulates, and at last, as in the case of the oily waste, varnish, rags, &c., a temperature is reached at which the woody fibre and oxygen can combine directly, vivid ignition takes place, and conflagration of the whole stack ensues.

That this is the real course of events, and that water, without germs, is powerless to set hay, cotton, jute, and other woody fibres on fire, is indirectly proved by the mode of making a hot-bed practised by gardeners when manure is scarce. Having taken a quantity of hay sufficient for the required purpose, this is spread out in a thin layer, and, according to the weather, watered several times a day for several days, or perhaps a week. It is then raked together in a heap, and left to ferment, and soon becomes hot enough to be used for the required purpose. Or, a space of ground the size of the intended hot-bed is covered with a thin layer of hay, and watered; after a short time a second thin layer of hay is put on and watered, and so on until the hot-bed has the required depth; the frame is then put on, and in a short time a very high degree of heat is attained.

If water were the only thing required to set the fermentation at work, it would surely be sufficient to water the heap when thrown together, but this is found to be inadequate to cause the hay to become heated. Why? Because the hay, if properly cured, has had so many of the germs killed that enough do not remain to start and keep up an active fermentation. No doubt, in time, the whole mass would ferment, but it would not do so until fresh germs had been imported into the heap, or the few that remained had time to multiply. When the hay is spread out in a thin layer, a large number of germs settle upon it, and when afterwards heaped up, the greater part are carried to the middle of the heap, where the heat can be retained, instead of being for the most part on the outside, as they would be if the hay were piled up before it was watered. Since then the heat which fires a hay-stack is the result of oxidation produced by fermentation, and inasmuch as it has been abundantly proved by Pasteur and others, that fermentation is decomposition of organic structures brought about by the growth and multiplication of living organisms, whose seed is ever floating in the air, it necessarily follows that to these minute seeds the combustion is due. Thanks to the indefatigable exertion of our foremost scientific men, the world at large is at least beginning to appreciate the immense power of destruction possessed by these living creatures, some of whom, though so minute as to be invisible to the human eye when assisted by the most powerful microscope, can yet light up a beacon to alarm a whole county side; whilst others of their brethren can in a few weeks devastate a continent, killing more cattle and men than would fall in an extensive, prolonged, and bloody war.

The most serious cases of spontaneous combustion are in ships carrying coal. These have, of late, been so numerous, and have so often occurred in despite of manifold precautions, that a Royal Commission was recently appointed to make inquiry into the causes of these terrible catastrophes, and to suggest remedies which it may be possible to adopt for preventing and guarding against them. Numerous Board of Trade inquiries had already been made into casualties caused by explosions or fires in coal-laden vessels, but without any improvement in the safety of shipment resulting therefrom, until, at length, the Board declined to hold any more, for the reason that the findings of their courts (which invariably took the form of an exoneration of the ship's officers, and a recommendation in favour of better ventilation) appeared to be entirely disregarded, both by shipping and underwriting interests.

It was evident, from this state of things, that the coal shippers conceived that they knew more of the causes of these accidents than did the assessors of the Board of Trade. The Salvage Association thereupon urged that an inquiry should be held by a Commission, consisting of men of high scientific attainments, and especially acquainted with the nature of coal in all its conditions, and of men practically acquainted with coal, both at the pit and in the ship's hold. They pointed out that the result might be to fix, with a certainty absolute or qualified, the causes of this dangerous combustion, thereby attaching to proper persons the responsibility for due precautions.

The Commission sat, and has now issued its report, from which much valuable information as to the nature of these disasters can be obtained, and, to a certain extent, modes of preventing them, though this part of the subject still requires most serious consideration, since at present the carriage of coal for a long distance at sea must be regarded as hazardous, whatever precautions may be adopted.

At the commencement of the inquiry, they were struck by the circumstance that by far the greater part of the casualties happened on board ships which were on long voyages. In 1874, among 31,116 shipments, amounting to upwards of 13,000,000 tons of coal, the accidents were 70. But, of these shipments, 26,000, amounting to over 10,000,000 tons, were to European ports. This left 60 casualties among only 4,485 shipments, amounting to 2,855,831 tons of coal, to Asia, Africa, and America.

Again, they were startled to find that the proportion of casualties traceable to spontaneous combustion increases, *pari passu*, with the tonnage of the cargoes. This becomes still more apparent when the European trade is deducted.

There were in 1874 :—

2,109 shipments with cargoes under 500 tons, in which 5 casualties occurred—or under ¼ per cent.

1,501 shipments with cargoes between 500 tons and 1,000 tons, in which 17 casualties occurred, or over 1 per cent.

490 shipments with cargoes between 1,000 and 1,500 tons, in which 17 casualties occurred, or 3½ cent.

308 shipments with cargoes between 1,500 and 2,000 tons, in which 14 casualties occurred, or over 4½ per cent.

77 shipments with cargoes over 2,000 tons, in which 7 casualties occurred, or 9 per cent.

The casualties in vessels bound to San Francisco were the most remarkable. Deducting vessels under 500 tons (in which no cases of spontaneous combustion were recorded) the returns show 9 casualties out of 54 shipments. These also increase in proportion to the tonnage of the cargoes, till we find that, out of 5 ships with cargoes of over 2,000 tons sent to San Francisco in 1872, 2 suffered.

Careful thought might have predicted results of this kind, from a consideration of the nature of the substance carried, the mode of carriage, and the place to which it was going.

So long ago as 1852, Graham pointed out that the tendency of coals to spontaneous ignition is increased by a moderate heat, and gave examples. For instance, in one case coal had taken fire by being heaped for a length of time against a heated wall, the temperature of which could be easily borne by the hand; in another, coals ignited spontaneously after remaining for a few days upon stone flags covering a flue, of which the temperature never rose beyond 150° Fahr. Coals thrown over a steam-pipe ignited, &c. At the Chartered Gas Works, coals piled against a brick wall two feet thick, of which the temperature did not exceed 120° to 140° Fahr. became ignited. Neither did it appear to matter whether the coal was Lancashire and sulphurous, or Wallsend and bituminous. If they were exposed to this very moderate heat for a short time they were sure to ignite.

Coals conveyed through the tropics are certainly put in this state of danger. When coal takes fire spontaneously, it is invariably in the centre of the heap of small coal at the foot of a hatchway, or in the middle of the cargo, in this respect resembling the spontaneous combustion of haystacks, oily waste, &c., and from hence it may be inferred that the increments of heat which cumulate in vivid combustion are very small, since they require to be held prisoners by impassable barriers of non-conducting matter, or they would escape.

Coal in small quantity, and in a cool place, never ignites spontaneously, but it does not, therefore, follow that all the conditions leading up to spontaneous combustion are absent, but only that one of them, and that an all-important one, the means of accumulating of heat, is absent, since the barriers interposed to its escape are not sufficiently close-fitting.

The large ships to San Francisco had to encounter elevated temperature, and at the same time the coal was in great mass; they were, therefore, much more liable to accident than those carrying smaller quantities, and for shorter distances.

It has already been pointed out that, whilst wood is living, moderate heat, so far from causing its destruction, promotes its growth; it is the heat which disappears, not the plant. When the wood has ceased to live, moderate heat dries up its juices, renders it brittle, and ultimately causes its complete disintegration and combustion if air is supplied, though the process is exceedingly slow. Some years ago, the sawdust packing round a steam pipe at the Queen's Printing-office, Shacklewell, was found to be charred. Wooden beams resting against hot plates which never reach the boiling point of water, are sometimes found to be charred, but oxygen being of necessity excluded by the position of the wood, combustion does not happen.

At the ordinary temperature of the air, oxygen has so little action upon wood that it is practically indestructible. In coal, however, the wood has undergone charges which render it far more readily affected by the oxygen of the air than it was heretofore, and it must be borne in mind that if once a combustion is sufficiently rapid to overcome the cooling effect of currents of air, it will proceed with increased vigour, and the ignited coal will burn, not only in the interior of the cargo or heap, but on its surface also. Knowing, then, that coal if kept in bulk at a temperature slightly raised above the common is sure to ignite, the question still remains,—How does it attain the degree of heat at which active combination can take place? And at what temperature do the combinations of the carbon and oxygen, the hydro-carbons and the oxygen, begin to take place? In other words, what is the temperature of the initial point of the combustion, and how is it reached? Many explanations have been given. The well-known fact that heaped-up iron pyrites in shale, when wetted, often causes the combustion of the pile, as in alum making, has been used as an argument against the shipment of "brassy" coal, *i.e.*, coal containing these pryrites. But, supposing this were so, and that the pyrites were disseminated through a part of the cargo in sufficient quantity to cause evolution of heat when wetted, this would account for but a small number of the cases of spontaneous combustion of coal, since by far the larger number happen with coal free from pyrites.

Condensation of oxygen by carbon, which was referred to at the outset of this paper, is a far more likely mode of attaining the initial temperature. This is pointed out by Professor Abel and Professor Percy in the appendix to the report of the Royal Commission. As already stated, carbon, in a finely-divided state, has the power of condensing oxygen within its pores; now, to condense a gas, force is consumed, and heat is produced. In the fire-syringe a piece of tinder is set on fire by the heat evolved by the condensation of the air. When charcoal condenses oxygen, heat is liberated, and if the charcoal is freshly burned, the rapidity of the action will produce such an amount of heat as to cause the chemical combination of the oxygen and carbon, when, of course, combustion takes place with evolution of light and heat. The initial temperature of the action is here due to the sudden squeezing together of the gaseous molecules, for if the air be admitted to the freshly-burned charcoal by slow degrees, no combustion takes place.

The Appendix suggests:—

> "The tendency to oxidation which carbon and carbon compounds, existing in such a substance as charcoal, possess, is favoured by the condensation of oxygen within its pores, whereby the very intimate contact between the carbon and oxygen particles is promoted. Hence the development of heat and the establishment of oxidation occur simultaneously; the latter is accelerated as heat accumulates, and chemical action is thus promoted, and may, in course of time, proceed so energetically that the carbon or carbo-hydrogen particles may be heated to igniting point.
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> "This explanation has a direct bearing upon a spontaneous ignition of coal. The more porous and readily oxidisable portions of coal, which are known to be more or less largely disseminated through seams from different localities, undergo oxidation by absorption of atmospheric oxygen, and by the exposure of large surfaces to its action, and the heat developed by that action, will accumulate, under favourable conditions, to such an extent as soon to hasten the oxidation and the consequent elevation of temperature, until some of the most finely divided and readily inflammable portions actually become ignited.

Water does not assist in the spontaneous combustion of coal, except where pyrites are concerned. There is much misunderstanding as to the part played by water in the changes leading to spontaneous combustion. The water itself is not decomposed, as some people have imagined. The heat evolved during the combustion of hydrogen and oxygen, during their combination to form water (the heat of the oxy-hydrogen blow-pipe) must be supplied before they can be again torn apart, so that, so far from water being a producer of heat, it is likely to be a consumer.

Moreover, experiment goes to prove that coal requires no initial temperature for its combustion, and that the supposition of condensation by porous coal, though it may take place, is unnecessary for its spontaneous combustion. The ties holding the constituents of coal together, which in the living plant were so strong that they defied the power of the sun to rend them asunder, have now become so weak that the oxygen of the air, even when no hotter than 55° Fahr. can seize upon and combine with at least some of the carbon, forming carbonic acid. Air blown through a tube, filled with coarsely powdered coal, into baryta water furnishes a considerable amount of barium carbonate in a very short time. Other circumstances may aid, but it is sufficient to prove the production of carbonic acid to make it certain that heat is set free, and if escape of the heat is barred, it must accumulate, till at length it reaches the point at which combustion becomes visible, and in too many cases uncontrollable.

As there is no amount of cold which may not be intensified by free radiation, so there is no limit to the heat which may be produced by concentration, or, in other words, by stoppage of all radiation except to one common point. Siemens' admirable regenerators act on the principle of continuous passage of heated gases through passages, where the gases are deprived of heat; when the heat-producers go forth to do their work, they are first made to pass through these heated passages. In addition to their own proper heat, they thus convey forward the stored-up heat, and the most intense heat yet met with for practical purposes is attained.

It is to be feared that, in ventilating the cargoes of coal-ships, the principle of Siemens' regenerator is infringed upon, to the great damage of the cargo. Air is forced through the coal, oxidation and heat follow throughout its course, the heat is absorbed by the coal, and the air, as it is continuously forced in, passes over surfaces which are becoming hotter and hotter, the air is itself heated, and the work of combustion, once begun, goes on more and more rapidly.

In view of these facts, there is small wonder that the uniform recommendation of the Board of Trade Assessors, "To ventilate the cargoes," should have met with cavalier treatment. The subject is, however, yet far from being fully understood. Evidence has been collected from most trustworthy sources, and a clear understanding obtained of the various conditions under which spontaneous combustion of coal takes place. What is now wanted is a thorough experimental investigation of the causes of the spontaneous combustion. The reasons already given are probably correct, but they are supported by the feeblest experimental support, and until this is strengthened, we can neither speak with the necessary boldness in reproving the actions which lead to the lamentable losses of good fuel, good ships, and, but too often, of good men; nor can we decide as to the proper means for preventing their occurrence.

DISCUSSION.

Mr. Cooke said he had lately gone into the statistics on this subject, and found that out of eighty cases of ships which had been burned, twenty were supposed to arise from spontaneous combustion, and three certainly did. One was the case of the *Amazon* in 1852. In 1856, an excellent paper was read in that room by Mr. Braid-wood, who was unfortunately killed in the fire at Cotton's wharf. Mr. Papworth also adduced many interesting cases of spontaneous combustion in a paper which appeared in the *Globe* on 9th December, 1875. He there showed that explosions of fire-damp generally followed atmospheric changes, or the firing of guns, and that in many cases the safety lamps were defective. A letter appeared in the *Times* of to-day, signed an "Old Sailor," in which he said that kerosene oil and lucifers were the great causes of fires in ships.

Mr. B. Francis Cobb said:—The importance of this paper, on the spontaneous combustion of coal, may be best appreciated from the fact that in 1874 and 1875, the years of the largest exports of coal, shipments at the rate of a million tons per month took place, and although the export declined subsequently, there would appear reason to believe that the present year will show figures not much short of these, and as the per-centage of casualties have increased in recent years, the question of how this destruction of property and loss of life can be prevented becomes a matter for the most serious consideration. The irregular way in which coal cargoes burn is not the least among the many puzzling circumstances connected with coal on board ship, for it is difficult to assign a reason why one ship should be on fire a certain number of days, another carries her coal of the same description much further and then burn. while a third delivers similar coal at the common destination not heated. In the last case there will have been no doubt a time during the voyage when the coal was heated, but had cooled again before reaching port, and the reader of the paper has explained this to some extent. But the most important section of these casualties, and one which the Royal Commission did not notice, is the missing coal-laden ships—vessels of which we have no record beyond the fact that they sailed coal laden, and neither ships nor crews have been heard of since. We know that in most cases of reported burnings at sea the crews have been saved in boats after more or less suffering and hardships, but the number of lives lost, of which we can only say they "are missing," is hardly suspected. The vessel is posted at Lloyds, and the insurances duly paid, and in a short time the whole thing forgotten, except among the families of those lost, who are still hoping against hope that something may yet be heard of some small portion of the missing crews. In 1874, the missing coal-laden vessels, were 11 vessels of a tonnage of over 7,000 tons. In 1875, the number had advanced to 28 vessels of upwards of 15,000 tons. In 1876, there were 21 coal ships missing, of a tonnage of over 10,500 tons. For these three years we have a total tonnage of 33,000 tons register. Some of these vessels were steamers, which would carry engineers, stokers, &c., such as the *Ionia*, 1,758 tons, Shields to Aden, the *Thornaby*, 1,000 tons, Cardiff to Bombay; while some of the sailing vessels were known to have a few passengers on board. It, therefore, is only a moderate calculation to reckon the number of lives at 3½ per 100 tons, which gives, for the three years, a total of 1,155 lives lost through the spontaneous combustion of coal. Of course, one cannot be certain of the cause in every instance; but, as far as human foresight can predict, the cause is that which has been so ably illustrated by Mr. Vincent to-night. Of course, it is possible some of them may have been otherwise destroyed, as we have only the melancholy fact that there is nothing known as to their exact fates. The tonnage of the missing coal-laden vessels of the last three years I have shown, in round figures, at 30,000 tons register, and we may take this as representing 37,000 tons of coals. In addition to these, there were, during the last four years, 37,712 tons of shipping, and 47,873 tons of coals, burnt from spontaneous combustion, 47,873 tons shipping, and 58,866 tons of coal "on fire." Including the missing ships, the loss of property may be taken in round figures as £1,250,000 sterling, represented by 70,000 tons of shipping and 107,000 tons of coal. My object has been rather to bring to your notice the loss of life, viz., 1,155 lives lost during the last three years, than values of property destroyed, but both will serve to draw attention to the very serious nature of the subject, and the great value of the paper we have heard to night, as a means of obtaining suggestions whereby this appalling loss of life may be avoided in the future. If I have trespassed upon your time unduly, or introduced subjects into this discussion foreign to the Chemical Section and nature of this meeting, my excuse must be that I plead on behalf of lost lives, to the extent of nearly 400 per annum; lost from causes which, I think you will agree with me Mr. Vincent has demonstrated to be preventible; and if from the paper and discussion here to-night some means may be found to save the lives of over a thousand sailors during the ensuing three years, that alone would prove that the formation of the Chemical Section of this Society has been a step for which the Council may be congratulated.

Mr. Sinclair said he was somewhat taken aback by the statement in an early part of the paper, that a haystack had been recently seen on fire, arising from spontaneous combustion. He had had considerable experience in the making and storing of hay, and there was no doubt it would sometimes take fire, but never after the rick had been made for about six weeks. He could always tell when his stacks were safe, by piercing them with an iron rod, and pulling out a little of the hay, which showed by its appearance whether it had gone through the process called sweating. There was a possible cause of fire in dwelling houses, which had not been alluded to. On leaden roofs and gutters a certain deposit took place, probably from oxidation, and he had collected this in a gutter, and on letting it fall through the air it took fire the same way as some of the substances which had been exhibited that evening. He knew of one case where a strong blast of wind blew this up, and falling on some combustible material set it on fire. This showed the necessity for keeping gutters clean.

Mr. Hale having expressed his gratification with the paper,

Mr. Pearsall said he was inclined to think that one fertile source of mischief had been overlooked. He should like to raise the question whether coal and other hydro-carbons might not give off a hydro-carbon, as yet without a name, which was capable of spontaneously taking fire on contact with the air. Those who had experience in the distillation of oils, turpentines, and tars, were aware that there were many explosions and conflagrations when dealing with those substances, though it was not in the interest of the parties to magnify them, and they were generally kept quiet. He hoped, therefore, that this point would be further investigated. There was an experiment carried on for some days at the Royal Institution, where the temperature was regulated with boiling oil. It was under the direction of Mr. Faraday, and it was a question of the condensation of gases, and what would take place when substances were raised to a given temperature. He remembered very well assisting Mr. Faraday at the time, and late in the evening of about the third or fourth day the oil took fire. Preparations had been made to cover over the small vessel which was over the sand bath, which cut off the flame, but it again took fire, and then it was agreed to desist from the experiment, and Mr. Faraday took the small cauldron out into the yard, and after some minutes took the board off the top, but it again burst into flame, and this was repeated not three or four times, but fully twenty times, and he distinctly recollected Faraday calling his attention to the fact that it burst into flame when it was nearly cool. That was a case where oil had been heated repeatedly for several days, and apparently gave off some hydro-carbon, which was exceedingly inflammable. This point was of grea importance, especially in considering the cases of thos enormous warehouses where fires sometimes took place, as showing the difficulty of extinguishing them, because if there were aggregated together an enormous mass of sugar and other things at that temperature, and if, as these experiments seem to show, when you had a porous body and the air round it capable of absorbing the vapours so given off, and if some of these inflammable hydro-carbons were then introduced capable of bursting into flame, it would appear that there was no means of extinguishing it until the thing had burnt itself out.

Mr. Hatcher asked if Mr. Vincent could give any information whether the size of the coal had any influence on its liability to take fire. Having stored large quantities of coal in the winter, his impression was that nut coal was more liable than any other; in fact, they almost always found it heat, and sometimes take fire.

Mr. Woodall asked if the presence of moisture in coal had no influence on the tendency to heating and ignition. His own experience with quantities of coal stored in close rooms, was that if stored when moist they were much more likely to ignite than if stored dry. Also, that if stored rough and coarse there was anything but the same disposition to ignite, as if very small. He had had the storing of some 10 or 20 thousand tons during the greater part of the year, and had never found any disposition to ignite either on the part of large or nut coal, but always with small coal. Mr. Vincent had pointed out some of the reasons why ignition took place, and having found out the causes, he hoped that some means could be suggested for avoiding the effect. In some ships, as well as in many stores, efforts were made to ventilate the coal, and he had known stores constructed specially with gratings for the purpose of bringing a current of air up along channels through the coals. In other cases, however, every possible attention was taken to exclude the air as thoroughly as possible, and, as far as his own experience went, the latter means had been most effectual.

Mr. Hughes said it was always a rule at Cardiff for the hatches to be kept open when a coal ship was in port, which would tend to show that the introduction of air, or allowing the confined gases to be given off, was considered beneficial.

Mr. Wills remarked that this question was one of great importance. Combustion, of whatever kind, was a relative matter; it depended as much upon the supporter of combustion as upon the combustible itself, and it was necessary in any case, in order for combustion to take place, to have both a combustible and a supporter of combustion present. Beyond this first condition there was another equally necessary, namely, that the initial temperature at which the body took fire should be reached. That initial temperature must be reached either slowly or rapidly, and it follows as a necessary consequence that those bodies which had the lowest ignition points would be in this respect most dangerous. Spontaneous combustion is not a phenomenon which occurs without any previous warning, but is simply the result of accumulated heat, causing a combustible to unite with oxygen so actively as to produce ignition. This initial temperature of combustion was, in most cases, reached very gradually; but, in order that it should be reached at all, it was necessary that air, or oxygen, should penetrate into the mass of the material, and that this should not be able to travel through it at any great speed, but should remain for a definite time in contact with the combustible material, in order that the heat generated should not be carried away by radiation or conduction; because it was evident that, if the heat were carried away as rapidly as it was generated by the union of the oxygen with the combustible, it could not be raised to the initial temperature necessary for ignition because the heat would be decreasing rather than increasing. Mr. Vincent had stated that some people seemed to hold the view that, when coal was damp, it was necessary that the water should be decomposed in order for it to take fire; but that point did not arise at all. When bodies were moist, oxidisation went on more rapidly, and therefore wet coal or other combustible material, such as hay, would unite with oxygen more rapidly than when dry. There were two ways in which evidently spontaneous combustion might be prevented; one was by totally excluding the supporter of combustion, *i.e.*, air or oxygen, and the other was to so thoroughly ventilate the combustible material that all the heat produced should be carried away as rapidly as it was formed, and thus the initial temperature at which ignition took place could never be reached. These two methods were very carefully gone into by the Royal Commission, which he believed came to the conclusion that it was better to exclude the air altogether than to attempt to ventilate the combustible material, because you could not ventilate it uniformly; and even if you could, you were still liable to the chance that in some particular part heat was being generated, although the other portions might be cool. Spontaneous combustion in coal mines was a point of great importance, and Mr. Galloway, who had recently investigated this subject, was inclined to think that certain combustions took place on account of exceedingly fine coal-dust, which was found diffused throughout the atmosphere of the mine, and which acted like a combustible gas. The ignition point of this mixture of fine coal-dust and air was low, and under certain circumstances he thought that spontaneous combustion might occur, and undoubtedly it added very much to the force of an explosion when once set up, because it had been found in certain collieries that the explosion had been carried far outside the limits of the inflammable gas. The same thing had been observed in the case of flour mills, where the flour diffused through the air had been ignited at one point, and had travelled like a flash of flame from one portion of the building to the other.

The Chairman said that the paper which they had heard had not only been instructive, but also valuable, in eliciting a very interesting discussion, and some of the points which had been raised were so intimately connected with the subject, which he, as a member of the Royal Commission, had been investigating, that with Mr. Vincent's permission he would reply to them. In the first place reference had been made to the state of division of the coal as influencing the tendency to spontaneous combustion, and after what they had learnt as to the effect of fineness of division of substances in promoting their union with oxygen, and the rapidity of that union, and the consequent heat evolved, there was no difficulty in conceiving that if coal were reduced to a comparatively fine state, but in such a state that air could have access to a large surface, then you had the conditions favourable to ignition. If coal were very finely divided, indeed, it would pack so closely that air could have little chance of circulating, and the small quantity found in it would very soon have exhausted its action. Any attempt at ventilating coal of that description would have very little effect in promoting a further change, but if coal were reduced to a state not so fine, but still comparatively small, in which the form of the particles favoured circulation of air, then if you promoted the continued action of air and the evolution of heat due to that action, you were in fact promoting the tendency to spontaneous ignition, so that there was a limit to the influence which the reduction of coal to a fine state of diffusion might have in promoting this effect. With regard to the action of the water, there were two distinct causes giving rise to the spontaneous ignition of coal. One was the oxidation of certain portions of coal, which consisted of carbon and hydrogen, and not readily acted upon by the atmospheric oxygen, besides which the coal contains, condensed within its pores, certain gases. Then you have the action of pyrites or sulphide of iron—a substance very prone to oxidation, especially if in a comparatively moist condition. In the case of iron pyrites, the moisture acted as a carrier of oxygen to the sulphur and to the iron, and promoted the rapidity of oxidation when once it had been set up, so that where you had pyritic coal, full of "brasses," as it was termed, you had one, the tendency of which to spontaneous heating would be promoted by wetting. If, on the other hand, the tendency was due to the existence in the coal of certain carbon and hydrogen compounds, probably the wetting would have the opposite effect, because there the action was due to the tendency to absorb and condense oxygen, and if you filled the pores of the material with water they would be so far precluded from absorbing or condensing oxygen; and, therefore, that source of the accumulation of heat would be reduced. The action of water, therefore, might promote the generation of heat or not, according to circumstances. Indeed, a large proportion of the casualties which occurred in coal had been due to the action of pyrites, but there were also very many which could not be traced to that cause, or to its containing that particular kind of pyrites which was specially susceptible of rapid oxidation. Pyrites, although identical in chemical combination, would vary very considerably indeed with regard to its tendency to oxidation. Two samples possessing the same chemical composition, and differing only slightly in mechanical structure, behaved very differently indeed in this respect, so that you could not always assume that because coal was rich in pyrites it was necessarily prone to spontaneous combustion; still the fact remained that there was this tendency in pyritic coal. A curious point came out in the evidence before the Royal Commission, that since the Mines Regulation Act came into operation, which rendered the employment of boys comparatively difficult, coal had become more pyritic, and was shipped in a much dirtier condition with respect to this particular impurity. Boys were largely employed to pick over the coal and pick out the brasses, and when the Act came into force this ceased to a great extent, and the examination of the coal became comparatively imperfect. With regard to ventilation, Mr. Wills had given the true explanation of its useful and mischievous effects. If you so ventilated a cargo as to continually sweep air through it at all points so rapidly as to carry away the heat as fast as it was generated you would undoubtedly put a stop to the chance of spontaneous ignition, for this so-called spontaneous ignition was due to the gradual heating up of the material until the point was reached when chemical action was set up very rapidly, and to an extent sufficient to raise the substance to a red heat. But in the case of coal cargoes, it was absolutely impossible so to arrange a ship that air could be uniformly and with certainty drawn through every portion of the cargo. The mere fact of its being more or less broken in different parts would point how difficult it must be, but even supposing it entirely consisted of a uniform mass it would be very difficult to draw air through it so as to keep it completely cool. If, however, this could not be done, no doubt ventilation became mischevous, because then it only supplied additional oxygen instead of allowing that existing in the mass of the coal to become exhausted in its action. Many remarkable instances were produced, with regard to this point, before the Commission. It was at first believed that ventilation was the thing to be aimed at in coal ships, but it soon came out that the majority of casualties arose in ships where attempts had been made to ventilate, and one very remarkable instance was mentioned. Four large ships were laden with coal at Newcastle, all the ships receiving the same kind of coal and at the same time, so that there were the same conditions as to weather, &c., and the ships were exactly of the same burden, from 1,500 to 2,000 tons each. Three of them which were bound for Aden were notably lost from spontaneous ignition, whilst the fourth arrived at Bombay and discharged her cargo safely. The only difference was that the three of them were ventilated, whilst the fourth was not ventilated at all. There was one other point, however, with regard to ventilation, which had not been noticed. Mr. Vincent had dealt only with the one subject of spontaneous ignition, but there was another source of accident, namely, that due to the ignition of explosive mixtures of air with the gases which gradually escape from coal, especially if placed on board ship soon after it was brought from the pit. Masses of coal, especially from certain seams, contained within its pores a considerable quantity of inflammable gas—the same mixture in fact which constituted the fire-damp of coal mines. This gradually escaped; sometimes only to a trifling extent; at other times to a considerable extent, and would gradually diffuse itself through the air in the vicinity of coal cargoes, and thus form an explosive gas mixture which eventually reach some source of light by which it might become ignited and produce an explosion. Many of the casualties to coal vessels were due to this cause, and ventilation of a particular kind was very valuable in guarding against accidents of this description. If you could keep up a constant current of air over the top of the coal cargo these explosive gases would be drawn off and carried out of the ship; so that surface ventilation was extremely important in connection with coal cargoes, and should be insisted upon, whereas ventilation through the cargo should not be attempted. In conclusion he proposed a vote of thanks to Mr. Vincent for his interesting paper.

The resolution was carried unanimously, and the proceedings terminated.

MISCELLANEOUS.

COOKERY IN BIRMINGHAM, &c.

The following is a copy of a memorial, addressed to the Right Honourable the Lord President, the Lord Vice-President, and the Lords of the Committee of Privy Council on Education:—

The Memorial of the School Board of Birmingham,

Respectfully Sheweth,—That your memorialists consider a knowledge of Practical Cookery, as part of the education of girls in public elementary schools, to be of the utmost importance.

That while regarding with satisfaction the introduction of Domestic Economy into the Education Code, as a specific subject for girls, your memorialists are of opinion that many of the subjects at present classed together under that heading, and especially that of "Food and its Preparation" (which should include Practical Cookery), are of such importance as to justify a division of the subject (Domestic Economy) into two or more separate subjects, upon each of which grants could be earned.

Your memorialists therefore humbly pray:—

1. That your Lordships would be pleased to provide in the Education Code that grants may be made on the results of instruction in Practical Cookery, as a distinct subject, on the same principle upon which grants are now made to elementary schools through the Science and Art Department.

2. That aid be given towards the proper fitting up and furnishing of places for practical instruction in cookery; and

3. That female teachers be encouraged to pass special examinations with a view to the teaching of Cookery.

And your memorialists, &c.

The notices of motion of the House of Commons announce that in Committee of Supply, Mr. Leveson-Gower will call attention to the importance of promoting instruction in Domestic Economy in the public elementary schools.

MR. DAVIS'S NEW SODA PROCESS.

In the discussion on Mr Davis's most interesting paper on his new method of manufacturing carbonate and caustic soda, my name having been introduced in connection with the "Mactear process" of manufacturing alkali, may I be permitted (as having been unavoidably absent when the paper was read) to correct some statements, made no doubt in the heat of the discussion by Mr. Davis.

1st. "That the 'Mactear process' is not generally used." It is seldom that a new process becomes generally used in its third year of existence; nevertheless it has been adopted to such an extent, that at the present time the returns from licensees in Great Britain alone show an annual decomposition of 121,762 tons of sulphate of soda. A number of other manufacturers are now preparing to start working on the system.

2nd. "That several manufacturers who had used the 'Mactear process' had gone back again to the old one." This statement is totally incorrect; not one of the licensees has abandoned or proposed abandoning the process. It is true, however, that Mr. Davis, while in charge of an alkali works near Liverpool, failed to succeed with the process, from causes to me unknown, but the experiments were made without any license having been signed, and were not in any way under my control.

3rd. "Had he been shown the black ash-balls lying in the yard he should have said they were short of limestone." Mr. Davis is well aware (as I have had the pleasure of showing him the process at work and explaining it to him), that the great point of my process is that they are—what has long been considered—short of limestone.

As I intend reading a paper on the "Mactear process" at the approaching meeting of the British Association, I need not enlarge upon it here. Suffice it to say that a process that has in so short a time been adopted by so many of our leading manufacturers, and which is also being taken up with great success on the Continent; which saves about 20 per cent. of the raw materials, makes about 30 per cent. less waste, and, with a better decomposition of the sulphate (and at least 2 per cent increased yield of 48 per cent. ash from 100 of sulphate), turns out 60 to 70 per cent. more work from a given furnace than by the old process, deserves a little more consideration than Mr. Davis seems inclined to give it.

James Mactear.

St. Rollox, Glasgow, 23rd May, 1877.

OBITUARY.

Sir Matthew Digby Wyatt died on the 21st of May, at his residence, Dimlands Castle, near Cowbridge. He was born in 1820, and was son of Matthew Wyatt, late a Metropolitan Police magistrate. He commenced practice as an architect in 1847. In 1849, he reported on the French Expositions for the Society of Arts, then engaged in organising the Great Exhibition of 1851, to the Executive Committee of which, on the issue of the Royal Commission, he became the secretary. He was joint architect for the Great Western Railway Station at Paddington, and with his friend, Owen Jones, formed the Fine Art Courts and Collections at the Crystal Palace. He became surveyor to the East India Company, and filled the office of President of the Institute of British Architects. He was knighted in 1869, and was Slade Professor of the Fine Arts in Cambridge, receiving the honorary degree of M.A. Elected a member of this Society in 1852, he took an active part in its proceedings, serving on its Council, and notably acting as one of the judges for awarding the Prizes to Art Workmen.

NOTICES.

PROCEEDINGS OF THE SOCIETY.

Special Meeting.

Tuesday, June 5th, at 2.30, "On Insect Pests Injurious to Agriculture," by Andrew Murray, Esq., F.L.S. The Duke of Buccleugh, K.G., will preside.

MEETINGS FOR THE ENSUING WEEK.

Mon.... Victoria Institute (at the House of the Society of Arts), 8 p m. Mr. J. E. Howard, Annual Address.

Royal Institution, Albemarle-street, W., 2 p.m. General Monthly Meeting.

Society of Engineers, 6, Westminster-chambers, 7½ p.m. Mr. Ralph H. Tweddell, "Direct Acting Hydraulic Machinery."

Royal United Service Institution, Whitehall-yard, 8½ p.m.

Tues. **SOCIETY OF ARTS**, John-street, Adelphi, W.C., 2.30 p.m. (Special Meeting) Mr. Andrew Murray, "Insect Pests Injurious to Agriculture."

Royal Institution, Albemarle-street, W., 3 p.m. Prof. James Dewar, "The Chemical Philosophy of Sir Humphrey Davy." (Lecture III.)

Biblical Archæology, 33, Bloomsbury-street, W.C., 8½ p.m.

Zoological, 11, Hanover-square, W., 8½ p.m. 1. The late Dr. Bowerbank, "Description of Five New Species of Sponges, discovered by D. A. B. Meyer on the Philippine Islands and New Guinea." Communicated by Dr A. B. Meyer. 2. Mr. E. L. Layard, "Remarks on Dr. Finsch's Communication on a New Species of Fruit Pigeon from the Pacific Islands of Rapa or Opara." 3. Mr. Arthur G. Butler, "A Collection of Lepidoptera, from Cape York and South-east Coast of New Guinea."

Wed.... National Health Society (at the House of the Society of Arts), 4 30 p.m. Rev. Harry Jones, "Homes of the London Poor."

Geological, Burlington House, W., 8 p.m.

Entomological, 11, Chandos-street, W., 7 p.m.

Microscopical. King's College, W.C., 8 p.m.

Archæological Association, 32, Sackville-street, W., 8 p.m.

Obstetrical, 53, Berners-street, Oxford-street, W., 8 p.m.

Royal Horticultural, South Kensington, S.W., 1 p.m.

Thur....Royal, Burlington House, W., 8½ p.m.

Antiquaries, Burlington House, W., 8½ p m.

Linnean, Burlington House, W., 8 p m. 1. Dr. Maxwell Masters, "Morphalogy of Primroses" 2. Mr C. W. Peach, "Observations on British Polyzoa." 3. Mr. Marcus M. Martog, "Floral Development and Symmetry in the Natural Order Sapotaceæ" 4. Dr. W. C. McIntosh, "The Annelida obtained during the Cruise of H.M.S. *Valorous* to Davis Straits, 1875."

Chemical, Burlington House, W., 8 p m 1. Mr. Y. W. Thomas, "On the Gases Enclosed in Lignite." 2. Dr. Wright, "Narcotine, Cotarnine, and Hydrocotarnine." 3. Mr. C. H. Piesse and Dr. Wright, "Otto of Limes."

Society for the Encouragement of the Fine Arts, 9, Conduit-street, W.

South London Photographic (at the House of the Society of Arts), 8 p.m.

Royal Institution, Albemarle-street, W., 3 p.m. Mr. E. Dannreuther, "Chopin and Listz," with Pianoforte Illustrations. (Lecture I.).

Inventors' Institute, 4, St. Martin's-place, W.C., 8 p m.

Zoological, 11, Hanover-square, W., 5 p.m. (Davis Lectures) Prof. Flower, "Sloths and Ant-eaters."

Royal Society Club, Willis's Rooms, St. James's, S.W., 6 p.m.

Psychological, 11, Chandos-street, W., 8½ p.m.

Civil and Mechanical Engineers, 7, Westminster-chambers, S.W., 7 p m. Annual Meeting.

Fri.......Royal United Service Institution, Whitehall-yard, 3 p.m. Mr. J. Scott Russell, "The Development of our Modern War Fleet."

Royal Institution, Albemarle-street, W., 8 p.m., Weekly Meeting. 9 p.m., Prof. Tyndall, "Putrefactive and Infective Organisms from a Physical Point of View."

Astronomical, Burlington House, W., 8 p m.

Royal Botanic, Inner Circle, Regent's-park, N.W., 4 p.m. Professor Bentley, "Plants, with Reference to their Life and their Organs of Reproduction." (Part 2.) "On the Organs of Reproduction." "Of the Kinds of Inflorescence. Of the Parts of the Flower:—The Floral Envelopes or Non-essential Organs." (Lecture V.).

New Shakespeare Society, University College, W.C., 8 p m. Prof. Hiram Corson, "On Shakspeare's Versification."

Sat.......Physical; Science Schools, South Kensington, S.W., 3 p.m.

Royal Botanic, Inner Circle, Regent's-park, N.W., 3¾ p m.

Royal Institution, Albemarle-street, W., 3 p.m. Mr. Charles T. Newton, "Recent Discoveries at Mycenæ." (Lecture II.).

JOURNAL OF THE SOCIETY OF ARTS

No. 1,281. Vol. XXV.

FRIDAY, JUNE 8, 1877.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

CONFERENCE OF INSTITUTIONS IN UNION.

The Council have determined not to summon a Conference for the present year, and will invite the Institutions to send delegates to the Congress on Domestic Economy, which the Council are organising, to be held in Birmingham in the third week in July next, in connection with the Educational Institutions of Staffordshire, Warwickshire, and Worcestershire.

A programme of the Conference at Birmingham will be published in the *Journal* shortly.

HEALTH AND SEWAGE OF TOWNS.

The Conference took place on Thursday and Friday, 3rd and 4th May, 1877, the Right Hon. James Stansfeld, M.P., late President of the Local Government Board, in the chair, assisted by the members of the Executive Committee:—Lord Alfred Churchill, Chairman of the Council; F. A. Abel, F.R.S.; Colonel Du Cane, R.E., C.B.; Sir Henry Cole, K.C.B.; Major-Gen. F. C. Cotton, R.E., C.S.I.; Captain Douglas Galton, C.B., F.R.S. The Conference met each day at 11 a.m., and sat till 1.30, then adjourned till 2, and sat again till 5 p.m. The following was the order of proceedings:—

Thursday.—Opening of the Proceedings by the Chairman. Papers and discussions on—

1st. Dry Systems.

Pails, Pans, Boxes, Earth, Middens, Cesspools, Ash, and other Closets; their influence on health, cost of collection, commercial value of products, &c.

2nd. Water-carried Sewage.

a. New facts about Sewage Farms, with or without precipitation or subsidence, profit and loss thereon.

b. Effluent Waters.
Subsidence.
Precipitation.
Filtration.

c. Possibility of producing an effluent harmless to health.

3rd. Escape of Sewage Gas into Dwellings.

4th. Discharge of Sewage into Sea.

5th. Additional Facts to those Stated in the Report of the Local Government Board on Disposal of Sewage.

Friday.—Proceedings resumed. Papers and Discussisns continued.

The object of the Conference was to discuss existing information in connection with the results of the systems already adopted in various localities; to elicit further information thereon; and gather and publish, for the benefit of the public generally, the experience gained. The introduction and discussion of untried schemes was, therefore, not permitted. Special papers, prepared at the request of the Council, were printed and circulated at the Conference, and have since been printed in the *Journal.*

The Chairman opened the proceedings with an address which will be found fully reported at p. 568 of the *Journal.*

Representatives from several towns sending returns, in reply to a paper of questions issued by the Committee, were then called upon in alphabetical order, and the discussion took place as follows:—

Mr. Chesshire (Birmingham) said he was not an advocate of the pail system, which had been extensively adopted in Birmingham; his objection to it was this, that it was intended by that system to collect both the solid and liquid matters, but that it failed in doing so completely must be obvious to any one. Only a very small proportion of the liquid excreta, the urine, passed down the water-closet, or the dry closet, or any other closet, the bulk being passed either into chamber vessels or other places out of doors; consequently, it must be obvious that any ordinary system could not intercept the urine. His proposal was, therefore, to allow the liquid portion to go away altogether, and not attempt to intercept it. It was the passage of the solid matter into the drains which produced sewer-gas, and if the liquid were allowed to escape, it very soon passed into the river, and so into the sea. The dry system he proposed intercepted the solid portion of the excreta only, and, by means of a strainer placed vertically, allowed the whole of the urine to escape and pass freely away. The solid portion could be retained without material nuisance, because there were three factors of decomposition, air, heat, and moisture. If the moisture were allowed to go away, one factor was got rid of; if you prevented the admission of air, you did away with another; and if, thirdly, there were no heat applied, scarcely any decomposition would take place. The solid part might be retained in a dry form without any nuisance, and removed at the end of a year or two without any evil arising, either in the shape of sewer-gas or offensive smell. Probably for a month or two in a year, during the hottest weather, it might be necessary to put in a little dry earth once a week or so, but that was all. The point he wished to insist upon was, that the pail system now in operation, which professed to deal with both the solid matter and the urine, was a complete fallacy, because the main part of the latter did not pass down the closet at all. He should have to speak later on with regard to the water-carriage system.

Mr. Councillor Pollard (Halifax) next spoke as follows:—Representing the Mayor and Corporation of Halifax at this conference, I beg, Sir, with your permission, to offer one or two observations respecting the Goux system as adopted at Halifax, where it has been in operation for seven years. I will give the result of the last twelve months, during which the Corporation have had the work under their control; previous to that the Goux Company managed the working department, and the Corporation paid them 7s. per closet, after that 12s. per closet, and at the end of 1875 the Goux Company declined to carry on the work by contract, on account of the loss by their not being in the town to superintend the work, as they ought to be. We then took their plant over as it stood, and the number of closets now in use at Halifax is 3,400. We have also 2,700 water-closets, and over 4,000 on the old privy system, with ash-middens attached. The Goux system is, no doubt, perfectly understood by all the gentlemen here, so that I need only give you the result of our twelve months' experience. I may say, in the first place, that we have the following staff to do the work, namely, one manager, whose duty is to see that everything is carried out to the satisfaction of the Sanitary Committee, to sell the manure, collect monies for same, and who has the control of the whole department; one clerk in the office, who keeps the books, and makes out daily lists for the collectors, keep men's time, &c.; one inspector, who is responsible to the manager for the collection of tubs and ashes, and who attends to all complaints that may be reported, and whose duty it is to see that the drivers and collectors do the work in a cleanly manner, and to give any instructions he may receive from the manager; two coopers, for making and repairing tubs; one man to wash the tubs as they are emptied; two men to screen ashes, and turn over manure after draining; six vans and horses for collecting closet tubs; five carts and horses for collecting ashes; 11 drivers, and 11 men with them as collectors. The tubs are packed in the yard with screened ashes, soot, or charcoal, shoddy or mill refuse, and street sweepings, and one man and boy do this work. The tubs are then sent out in the vans, each containing 21 tubs, which are taken to replace the full closet tubs, which are brought to the yard, and there allowed to drain a few days, then mixed with more charcoal, or soot, and screened ashes, and then it is either carted away by neighbouring farmers or sent away by railway or canal, principally the latter; but, on account of Halifax being surrounded by other manufacturing towns, as Leeds, Bradford, Keighley, Huddersfield, &c., we cannot command so good a price for the manure as some towns in agricultural districts would do, the average price we have received for manure during the year being 3s. per ton. The total receipts for manure and for taking away the slaughter-house refuse manure, &c., were about £500, and the total cost of working the Goux system about £3,660, leaving a net cost to the ratepayers of about £3,160; and the cost of cleansing the Goux closet and ashes amounts to about 18s. 6d. each. The emptying of the old privies and middens costs the Corporation (the work being done by contractors), 14s. 6d. each, or 4s. each less than the Goux system; but when we take into consideration that the Goux closets are cleared every eight days, and the old privies on an average once a year, we are satisfied that, in a sanitary point of view, the Goux system is infinitely superior. I must confess that, in my opinion, and in the opinion of the Sanitary Committee over which I have the honour to preside, that the Goux principle is the most satisfactory we have yet seen, and we have seen many, and have given the subject some consideration during the last seven years. The great advantage over others is, that the packing which is placed in each tub will absorb from six to eight quarts of liquid, and the charcoal or soot which is in the packing prevents decomposition, and deodorises the excrement and urine as the tub becomes full, and also to a great extent fixes the ammonia, and so makes a good fertilising manure. We have tried the plan without lining, and found the disinfectant which was put into the bottom was soon so much diluted that, to a great extent, it lost its effect as a deodoriser and disinfectant, and when the receptacle was used partly full, there was a disagreeable effluvia, on account of its being nearly in a liquid state, whereas the liquid or urine is gradually absorbed and deodorised by the packing of the Goux tub. Another advantage of the system is, that when the sanitary inspector informs the manager of the Goux department of any case of fever, the closet is cleared every two or three days; and from an analysis which has been made, it was found that there had been fewer cases of fever in the wards or districts where the tubs were in use. I am satisfied that constant removal is a step in the right direction, and am glad the question is receiving more attention than it has hitherto done, for we ought no longer to allow fæcal matter to be deposited within a few feet of the very atmosphere we breathe, and allow it, together with all kinds of animal and vegetable matter, to decompose for twelve months, and in many cases the liquid matter to percolate under our house floors. I may say the Goux principle might be carried out in some towns at a less cost than at Halifax, on account of the many steep gradients, which requires more men and horses to collect than if the streets were level. In Halifax the Corporation as well as the Sanitary Committee are very well satisfied with the Goux system. We have had very few complaints since we took the management into our own hands, and the only drawback is the cost. It costs 4s. per closet more than the old system, but it is much superior in a sanitary point of view.

Colonel Du Cane, R.E., asked what was done with the slops and other liquid refuse and surface water?

Mr. Pollard said the liquid matter was drained from the mass into a tank which was perfectly covered up, and was sold to farmers and gardeners at 1s. per tub. The slops and bath-water went into the sewers.

Lord Alfred Churchill said he understood the increased cost was due, in a great measure, to the heavy gradients at Halifax.

Mr. Pollard replied in the affirmative, and added that it being surrounded by other manufacturing towns, they could not get rid of the manure so advantageously as might be done in other places. In answer to another question, he said the ashes were collected in tubs and carried away separately. They were afterwards screened, and a portion mixed with the manure, the remainder being carried to a tip.

Mr. Woodward asked whether the total cost of the pail system and water-carried system was not between £8,000 and £9,000 a-year?

Mr. Pollard said he was not prepared to go into the question of the sewage generally. If all the closets were put on the Goux system, they could be dealt with at less cost than 18s. 6d. each. With reference to the sewage, they had unfortunately had an injunction against them, which cost a good deal of money. The cost of the collection of ashes was included in his figures, amounting to about £1,400 a-year.

Mr. Moore asked if any comparisons had been made between the Goux system and water-closets?

Mr. Pollard replied that the comparison was made between the Goux system and the old privy system.

Mr. John Towle (Oxford) asked what was the death-rate at Halifax?

The Secretary said 23·4 per 1,000.

Sir Henry Cole drew attention to a coloured diagram on the wall, showing the death-rate of the different districts in the borough.

Mr. Pollard said there were more cases of fever where the old privy system prevailed than where the Goux closets were in use. In replying to another question, he said the ashes rather more than paid for the cost of collection. A good portion was sold mixed up in the manure. Some of the screened ashes were mixed up with the soot and shoddy, and this material was used for packing the tubs, and absorbed the liquid portion as the tub became full. When it came to the yard, it was drained into a tank, and mixed with more ashes, in order to get the refuse into a portable state.

Lord Alfred Churchill asked if the system were compulsory in Halifax?

Mr. Pollard said no. It was very much preferred; the only difficulty was the cost of altering. In some cases they found an ash-pit was not emptied for two years, which received the contents from 14 privies. In replying to a question whether this system was enforced in the case of new buildings, he said that was not the case at present, but they hoped in a short time to do so.

Mr. Pollard, in reply to a question, said he believed the lowest charge for water was, under £20 rental, 5s.; over £20 rental, 7s. 6d. per house; but it increased with the rateable value of the house.

Mr. C. Neve Cresswell asked if the injunction spoken of in the printed returns made from the town had anything to do with the Goux system?

Mr. Pollard said no. The Goux system was now in action in every portion of the town. It was most general in the most populous parts, but it was not confined to the houses of the poorer classes. The only objection made to it was on account of neglect in collection when it was in the hands of the Goux Company, which arose from the fact that they lost money from the contract through not getting as large a price as they had anticipated for the manure.

Mr. Hewson (Rochdale) asked if any royalty was included in the cost, or any expense for plant, because he believed Halifax was the first town which had taken up this plant, and obtained more favourable conditions in consequence?

Mr. Pollard said the royalty was included in the price paid for the old plant. They were not supposed to pay any royalty, but took the plant over at a given price.

Mr. Curtis asked if any deodorising material were used besides the packing?

Mr. Pollard said the lining, which was composed of charcoal and soot, deodorised the contents as a tub was filled and absorbed the liquid. Some persons used a little soot or charcoal in addition; but it was not general.

Mr. Denham (Southsea) asked whether the process was a very offensive one to look at?

Mr. Pollard thought not so offensive as the pail system without the lining, or the old privy system.

Mr. Haresceugh (Rochdale) asked if there were any probability of other towns being able to obtain plant and a right to work this system on anything like the same terms?

The Chairman remarked that Mr. Pollard could hardly say what terms the Company would offer, but he might state whether there were exceptional reasons why Halifax obtained specially favourable terms.

Mr. Pollard said they were promised at Halifax that if they would adopt it they should be treated more favourably than other towns which adopted it hereafter.

Mr. Woodward asked if it was not a fact that, in consequence of the offensive nature of the deposit, the borough was at this moment involved in legal proceedings?

Mr. Pollard said he was not aware of it. In reply to a further question, he said the tubs, when taken to the yards, were turned out, washed with a hose and jet, repacked, and sent out again perfectly clean.

Mr. Haresceugh (Rochdale) asked how many houses were allowed to one closet?

Mr. Pollard said one tub was required to every new house, but to old houses one closet to every three. They were collected every eight or ten days, or oftener if found necessary.

Dr. Kenyon (Chester) asked the cost of altering a closet to the Goux system, and whether, if it were adopted all over the town, the injunction would be removed. If not, whether £1 per house cost for collection, added to the £4,000 already spent on the sewage, would not make a sum sufficient to introduce the water-closet system entirely. At present there were over £7,000 spent on the Goux system, and there must be at least £6,000 more required for the annual cost of renewing the pails.

Mr. Pollard said that the majority of the Sanitary Committee did not approve of the water-closet system. The report from which the figures had been quoted, had been prepared and sent up without his having seen it, so that he was hardly prepared to verify all the statements in it. The Goux system was more expensive than the ordinary water-closets, on account of the expense in providing sewage tanks, &c.; but, taking everything into consideration, he thought the total under the latter system would be as much or more.

Mr. Mason said the cost of the Goux system in construction was less than that of building middens, and £10 less for each closet than for a water-closet. The comparative cost therefore, was about 75 per cent. in favour of the Goux system over the water-closet.

Dr. Kenyon said a water-closet need not cost £10.

Mr. Mason said there were connections between the water supply and the conveyance to the outfall to be included.

Mr. Pollard examined many of the water-closets in the poorer districts of Halifax, and found they very soon got of order, became stopped up, and in such a filthy condition that they were not fit for use; so that he could not recommend that system for universal application.

Mr. Ernest Turner said that, as an architect, he did not consider £10 at all too high an estimate for water-closets.

Mr. Moore (Petersfield) asked which were the least offensive in the lower parts of the town, the Goux closets or the water-closets?

Mr. Pollard said the water-closets frequently got out of order, and it was no one's business to attend to them in such localities; the Goux system was preferable.

Mr. Kerr (Halifax) said he had had practical experience of the Goux closet. In his house there was at first an old ash-pit and privy, which sometimes got very offensive, but five or six years since he had it converted into a Goux closet, at an expense of £3, and from that day he had never found it offensive at all, except on one occasion, under the management of the company, when the men were on strike, and would not empty the tubs. The difficulty had been where three families used one closet, and the tub got too full, but in that case they had adopted the plan of putting a close-fitting lid on, and removing the tubs; and when the system was properly conducted, there was nothing offensive connected with it. At other houses, where there were water-closets, there were almost continual complaints of them in the summer time, although they had a plentiful supply of water. Taking one thing with another, he considered there was no comparison between the Goux system and any other. If they could do away with the water-closets and the old privies, there would be no difficulty; but there should not be more than two families to one Goux closet. One advantage was, that it required only one-third of the space of the old ash-pit and privy, which was a great consideration where land was valuable.

Dr. Syson said he had had experience of the Goux system in its earliest introduction, and had been asked to give his opinion upon its merits. He saw it first about 1869, when he was connected with Salford, and they were making sanitary experiments with a view to abolish the old middens. The simplicity and cleanliness of this system then struck him. He called the attention of the Health Committee to it, and a somewhat extensive trial was made. During the time it was on trial they had an outbreak of small-pox, but in the district where it was in use, the lowest in the town, not a single case occurred. It had been said that it was abandoned in Salford as a failure, but this was an utter mistake. It was not given up because it failed, for they had numerous deputations from various Health Committees to inspect it, and all gave their opinion unanimously in its favour. He believed the real reason it was not adopted generally was that the scavenging was not in the hands of the Health Committee, and that the Scavenging Committee were—as often happened—too much wedded to old customs. It might be said that he was an officer of health, and that officers of health might not be quite unbiassed, but you could not persuade numerous deputations consisting of town councillors and aldermen in that way; and it was on record in the minutes of their meetings repeatedly, that they thought this system a great improvement on the old system. He was not an opponent of water-closets, and for a single house no doubt the earth-closet is preferable, but for towns or villages where water-closets could not be well introduced, this system would be much preferable.

General H. Y. D. Scott, C.B., F.R.S., said the test of any system of converting fæcal matters into manure would depend on the difference between the price obtained for it when manufactured and the cost of manufacture. They had heard what was the cost of removing the pail stuff to the yard, but had not had any information as to the cost of manufacture when it got to the yard. The substance used for this lining had, he believed, to be bought at from 5s. to 7s. per ton, and it would be interesting to know, in the case of the manure, which they heard was sold at 3s. per ton, what it cost to produce. He was of opinion that the collection should invariably be done by local authorities, but was not quite certain that the manufacture would not eventually be undertaken by other parties. It was manifestly of importance to a town, in undertaking the manufacture, to understand what was the difference between the cost and the selling price, and he hoped this information would be given.

Mr. Mason said the cost of the manure at the yard was simply that of emptying the pail and re-lining. The price was spoken of at 3s. a ton, but last year he had sold 2,447 tons at 7s. 6d., without any manufacture at all, and the fact is, that the more it was manipulated the more the ammonia was driven out.

General H. Y. D. Scott said that scarcely answered the question. With regard to Halifax, it was sold for 3s., and he wished to know what it cost to produce.

Mr. Kerr said they did not sell it as Goux manure, but they mixed a considerable proportion of dry ashes with it on purpose to get rid of them, and if they mixed it up and kept it sufficient time, they might probably get double the price; but their desire was to get rid of it as quickly as possible, having no depôt to keep it in.

Mr. Pollard said the analyses for 12 months showed that they had used 370 tons of mill refuse or shoddy, for which they paid from 2s. 6d. to 7s.; street-sweepings, 485 tons, for which they had debited themselves 1s. a load; ashes, 200 tons; and disinfectants, 20 tons. Sometimes, when they had a larger demand for it than they could supply, they put in rather more ashes. The disinfectants were peat, charcoal, and soot, the former being produced by the Crowle Charring Company at a cost of £3 a ton, and the soot cost 50s. a ton. They sold over 2,700 tons, and there were, perhaps, between 700 and 800 tons of drainings, which went into the tank, and was carried away, evaporated, or sold.

The Chairman said this discussion had been very interesting, not only on account of the special merits of the Goux system, but because it had illustrated the comparative merits and demerits of the dry and water-carriage systems. Halifax had been driven to the Goux system because of the difficulty of disposing of the sewage at the outfall. It was of no consequence how perfect the system of drains and sewers might be, if, when you got to the outfall you failed to dispose satisfactorily of the sewage. Besides that, there was the difficulty at the point of junction of the sewer and the drain, or of the drain and the house. It might be perfectly true that on the whole the pleasantest and most civilised system was a well regulated water-closet in good order, but to obtain that, first of all, you must ascertain that the local authority could succeed in preventing the irruption of sewer-gas into the house; and, secondly, you must remember the fact mentioned by Mr. Pollard, that when you come to the poor classes of cottages there was greater danger of the water-closet getting out of order, and if it got out of order, it might remain so for an indefinite time without the local authority becoming aware of it, and thus disease and danger might arise and spread. One advantage, therefore, of the dry system was, that the authorities were compelled to go round to collect the contents, and in that process you had a process of inspection, which ensured the detection of any nuisance before it became a source of danger.

Dr. Haviland explained the coloured diagrams of the borough of Halifax, which he had prepared. Being medical officer of health to the Northamptonshire combination, which included not only that county, but also portions of Leicestershire and Bucks, he found some four years ago, when he first entered on his duties, that the sewage disposal was the great difficulty he had to contend with, and, practically, in the 365 villages and towns under his charge, the water-carriage system was a failure. On setting to work to see what could be done to meet the difficulty, he found that the first thing to do was to see that a proper system of scavenging was carried out. Next year he examined the different modes of sewage disposal which had been proposed by different companies, and carried into execution throughout the country; and, after finding failure here and failure there, he was much struck with the success of the dry mode adopted at Aldershot. He thereupon went into it more thoroughly, and promised to lay a report before the sanitary authority; and for this purpose he went again to Aldershot, and twice to Halifax. In order to see the real effect upon the public health of this system, he determined to investigate the whole matter for a great number of years, in order to show the geographical distribution of disease; he had been in the habit of showing the high or low rates of mortality in different districts by two different colours, the high rate being coloured blue, and the low rate red. The proportions, therefore, below the average were coloured red, the most intense red showing the least mortality, and the most intense blue the highest. He first required to satisfy himself that the health of Halifax had really improved since the adoption of the system under investigation, and therefore made maps showing the general death-rate from fever and other diseases, classed by Mr. Simon as "filth diseases." He found that, in 1870 to 1872, before the practical working of the Goux system had been adopted, the mortality from all causes was considerably greater in all the different districts than it was later, as would be seen by the maps; for whereas in the first period only two of the districts were coloured red, indicating a mortality below the average, after the adoption of this system, in 1873-75, there were now only four out of nine or ten which were above it. Again, taking the deaths from fever in 1870-72, there were only three districts below the average, whereas, after the extension of the Goux system in 1873-75, there were only two below the average. He had very carefully worked out these figures himself, for every case of death for the last ten or fifteen years, and had eliminated all doubtful cases. To show the Northamptonshire combination of sanitary authorities his belief in the efficacy of the Goux system, he undertook this laborious task, and also to satisfy his own mind, because without doing so he could not recommend such a large area to adopt any system. Since then he had been pleased to see the result of this dry system, and was still recommending it. Only yesterday, in Leicestershire, where he was sent for suddenly in order to meet the defects of the sewage system in a village, he found the only thing he could do to avert an impending outbreak of typhoid fever was to send at once for a number of these tubs, to replace the system which was really producing the fever, and until he saw a better plan he should continue to recommend this system. He had no interest either in this company or any other, but he simply wanted to see carried out a better system of periodical scavenging, and to see the sewage not taken to the soil before it had time to become so matured as to be of any material benefit to the land. He could not approve of any water-carriage system which so diluted the sewage as to make it perfectly useless. They all knew that a pound of rump steak would do any of them good, but if they were to wash it down with a gallon of beer, they could not expect any good to be derived from it. In the same way, if the sewage were washed down with gallons of water, it was of no value. They wanted the sewage concentrated and matured before it was put on the land, and then they would soon find the price of guano decrease.

The **Chairman** asked if Dr. Haviland was disposed to attribute the changes for the better in the death-rates mainly to the introduction of the dry system?

Dr. Haviland—Decidedly.

The **Chairman** asked which of these two maps would most accurately indicate that improvement?

Dr. Haviland—The fever map, certainly.

Mr. Woodward asked if the old midden system were the one in use in the village to which Dr. Haviland had referred?

Dr. Haviland replied in the affirmative. In reply to another question, whether he attributed any special virtue to the Goux principle beyond its being a dry system of removal, he said what he had found in practice was this, that the principle of the dry system was good, but the mode in which it was carried out was sometimes offensive. Moule's earth-closets were very excellent in principle, but he found in practice their having complicated machinery rendered them useless in villages. Wherever there was anything like complication there was sure to be failure. The simpler the article you provided the better.

The **Chairman** asked if he considered the particular kind of lining used to be advantageous?

Dr. Haviland said almost any refuse sufficiently absorbent would answer the purpose. At Northampton, and in villages near, they were going to use tan, and in other places stable litter would do. In the huts which were run up for the accommodation of the workmen engaged on railway works in his district he recommended them, as horse power was used to a great extent, to line the Goux tubs with stable litter. In Halifax shoddy was used, but anything which would absorb well and form a casing would answer the purpose.

Mr. Henry Robinson said he feared this system was being driven to death. There must be sewers to carry off the surface drainage, whether this system were in use or another.

Mr. Moore said that some twelve months ago he had to advise the authorities of a town of about 2,000 inhabitants what they should do with their drainage, there being much illness from defective sanitary arrangements, and the Local Government Board compelled them to do something. He came to the conclusion that a dry system of some kind was better adapted to their circumstances than a drainage system, and it was also a known fact that the germs of typhoid fever existed in the discharge from the bowels, and that if you could keep these out of the sewers you would eliminate that factor of disease which was most active. He did not oppose the water-carriage system entirely, because it was working very well in large towns, especially in London, and though it occasionally gave rise to evils it did not do so to any great extent, and those who had already provided sewers should not attempt to abolish them, but to render them perfect. Where, however, sewers did not exist, it was a different matter. His first idea was that earth-closets would be best, and in many places they acted admirably, but never, he believed, in a place of 2,000 inhabitants would it be possible, especially in a wet season, to get enough dry earth to work them. Finally, he recommended the use of tubs, as employed at Rochdale, with disinfectants in them, but a week after sending in his report, seeing a paper by Dr. Haviland on this very subject, in which he spoke of what appeared to be the marvellous result on the health of Halifax from the adoption of the Goux system —and he should recommend anyone interested in the question to read this paper—he determined to look further into it. He next saw a report by the Goux Company, in which the opinions of several medical men were brought forward, giving their experience in favour of the Goux closets, especially at Aldershot, and he, therefore, determined to inspect it for himself. It was stated in the report that there was there a heap of manure of about 40 tons giving off no smell at all, and he, therefore, accompanied by the inspector of nuisances and a large builder in the town, went over to examine into it. The inspector of nuisances rather laughed at the idea of the pail system, and the builder was opposed to it, because he thought he might probably have the contract to drain the town. They went all round the place, and visited nearly every closet in the north camp, and though it was a very wet day in November, they did not find what could be called a nasty smell in any one, and, in the great majority, if they had been taken in blindfold, they would never have thought that they were in a place of the kind at all. Those who accompanied him were of the same opinion, and the builder entirely gave up his opposition, and had adopted one of these closets in his own workshop, and consoled himself with the idea that instead of getting £500 out of the drainage he might get £200 out of the Goux closets. When at Aldershot he asked an old soldier whom he saw coming out of one of these places if there was ever any smell in the summer, and he replied that there was sometimes a little, but not half so much as in "them stinking water-closets in the south camp." He was not satisfied with this, but went to Halstead, in Essex, a small town where there had been an injunction against turning sewage into the river, and which had adopted the Goux closets. He was informed by the surveyor that there were 170 at work, and that there were no complaints whatever. Since then he had received a letter from the Medical Officer of Health giving the same testimony, though he said he liked the water-closets best, because they were less trouble. He was informed that there the tubs were lined with a mixture of horse droppings collected from the streets and sifted ashes, and he found the places where this was prepared smelt much like a stable, but nothing more. He went into about 50 of the closets, some new and some old, and in only one or two instances was there anything like a smell, and that was where the tubs had been allowed to overflow. They were collected about once or twice a week by men in a waggon; no annoyance was caused, and the cost was calculated to be 2s. 6d. per tub per annum. This was accounted for by the fact that there was a ready sale for the manure, which was carried straight off to the farmer and put on the land at once, or on their manure heaps. He had no doubt that in a short time a higher price would be obtained for it, because he heard on good authority that a farmer who used the Goux manure from the camp at Aldershot had taken a first prize for mangolds at a recent exhibition. On the whole, therefore, he thought this was the best plan of the kind, and recommended his sanitary authority to introduce it, which they did, and they were now trying it in the workhouse, where previously the closets had been very offensive.

Dr. Kenyon (Chester) said considerable stress was laid on the fact that with a dry system there was no risk of sewer-gas, but the answer was very plain that the Goux closets were never put inside houses but outside, so that to compare a water-closet inside a house with a Goux closet outside was rather unfair. Another point was, that in the experience of some speakers water-closets did not answer in a low class of population; but he had made careful inquiries some years ago, at Coventry and Warwick especially, and the evidence he obtained from the inspector of nuisances and officers of health was very distinct and clear, that they worked exceedingly well with the poorest people. It might happen now and then that one got blocked up, but after they had been in use a year or two this very rarely happened. They had lately been introduced at Chester, and they had no trouble at all with them, even with the lowest class.

Mr. Moore said this reminded him of one fact, that the surveyor at Halstead told him that one great reason why he approved of the Goux closet was that in the lower parts of the town the water-closets frequently got out of order.

The Chairman asked if it was the fact that the Goux closet was never used inside a house?

Mr. Pollard was not aware of any being so used.

Mr. Humphris (Cheltenham) asked how the fluid refuse was dealt with in moderately small towns and villages, such as had been referred to by Mr. Moore?

Mr. Moore said that with any dry system the slops and fluid refuse must be taken away. He recommended his sanitary authority to conduct it away by the ordinary drains. This might be done without any very great expense. Last week Dr. Buchanan told him that if you kept the solid excreta out of the sewers the slops might be taken away in a common drain-pipe.

Dr. Syson said it would be utterly impossible, on the ground of expense, to provide water-closets and sewers to every town and village throughout the country; and it must be remembered that in small places the adoption of water-closets meant also the use of cesspools.

The Conference here adjourned for luncheon.

Mr. J. B. Alliott (Manchester) said he had intended to give some account of the system in operation at Manchester, by dealing with the contents of the pails, and other refuse which came into the town-yard, such as street sweepings; but he found that had been dealt with in a paper by Mr. Le Neve Foster, and should therefore not need to go into it in detail. The system was that of the Universal Charcoal and Sewage Company, and that known as Fryer's system; the object being, in the first place, the thorough disinfection and disposal of the pail contents and refuse, and, in the next place, the reduction of the matter treated in bulk without loss of value. The treatment to which the contents were subjected was especially a treatment of the liquid contents, which underwent a process of concentration. The liquid contents were separated from the solids by running them over a grating, which allowed the liquid to run off whilst the solid material was dealt with separately. The liquid was run into an evaporating apparatus, where it was dried by the direct products of combustion, and the bulk reduced to about one-tenth. The concentration was effected at a low temperature, being entirely the result of surface evaporation, and the residue being about the consistency of treacle. The material employed was the contents of ash-pits and other refuse, such as usually went to tips. These materials were usually of sufficient manurial quality to be objectionable in themselves, but not enough to be worth anything as manure. Being shot into a furnace of special construction, they were burned, and the products of combustion passing over the surface of the liquid urine, concentrated it. Inasmuch as a large quantity of this material consisted of cinders and ashes, there was usually a sufficient quantity of sulphur present to cause the generation of sulphurous acid gas, enough to prevent the material becoming alkaline; and the lowness of temperature prevented any evolution of ammonia. In order to obtain definite information as to the fact whether ammonia was evolved during the process, an experiment of this kind was tried some time ago. Samples, both of the fresh urine and also of putrid matters from cesspools, were treated, a sample of each being taken, and a given bulk being concentrated to the highest density possible, and the resultant concentrated material then rediluted until it attained its original bulk. Samples were taken from that, and the two sets of samples were submitted to Dr. Angus Smith for analysis, the result showing that there had been no appreciable loss of nitrogen. Thus both the liquid material was reduced in bulk, and therefore rendered easy of carriage and worth, taking away to the land, which, after all, was the great difficulty. In all sewage they were the elements of value, but they were usually so much diluted with other worthless materials that they were not worth carriage. When you had succeeded without the introduction of any fuel which had to be paid for, but, on the contrary, by using up a material which was exceedingly desirable to get disposed of, in reducing the bulk of the product, you had a much more marketable material. The outburn from the furnace consisted simply of clinker, which was perfectly innocuous. This was ground up with lime, and sold for mortar at 4s. 6d. a ton. The deodorising, whether of concentrated manure or the pail contents, was effected by the use of charcoal, which was produced by the treatment of street sweepings, subjecting them to the action of a charring kiln, which, in like manner, greatly reduced their bulk, and instead of leaving them in such a condition that they were of no value to anybody, produced a material value as a deodorant, and which had been sold in Birmingham at 30s. a ton.

The Secretary here produced several samples, both of the charcoal and of the manure produced at Manchester, the lowest quality being sold at 12s. 6d. per ton. He was informed by Mr. Leigh, the Medical Officer of Health, that the samples of manure manufactured from the pail stuff almost entirely consisted of sulphate of ammonia and alkaline phosphates, and it was manufactured from the most liquid parts of the pail contents. No. 2 was made from the more solid part of the pail stuff, and contained much fæcal matter. No. 3 was charcoal made from carbonised refuse saturated with concreted urine, mixed with fæcal matter; whilst No. 4, the cheapest manure made, consisted principally of fish and animal refuse from the slaughter-houses and elsewhere, mixed with some urine and fæcal matter, and fine ashes. That, he believed, was the material they were actually making, and which was sold as fast as it was produced.

Col. Jones (Wrexham) asked if the whole liquid contents of the pails was evaporated, or whether any part of it was strained away into the sewers?

The Secretary said none of it went into the sewers; it was all evaporated in the yard.

Mr. Henry Robinson asked if there were any analyses of the materials produced?

Mr. Alliott said the analyses of the concentrated urine would be found attached to the specimens downstairs, which showed it contained nitrogen equal to about 9 or 10 per cent. of ammonia. The charcoal contained 18 per cent. of carbon, which would be considerably above the average result.

The Chairman said the Manchester system was apparently a very elaborate and scientific one, and he should like to know something of the expense of it, and what profit resulted.

Mr. Halliday said he had a statement in his hand, which was read recently by Mr. Whiley before the Manchester Scientific and Mechanical Society, in which the analysis was given, and also the cost per head, which was 1s. 2½d.

The Secretary said he believed Mr. Whiley's account was rather what it would be, not what it actually was. He had the actual figures of what it cost the town, which were as follows:—Collecting and disposing of the night soil, £44,000; receipts, £10,000; the cost of scavenging, which was a separate item, £18,417. This left the real cost about £34,000, and this was quite apart from the water-carriage system. In answer to another question, he said there was an expenditure, but they expected to have all the old middens and ash-pits converted completely into sanitary sifting closets in the course of a year and a-half.

The Chairman said they knew more or less, from the previous discussion, with regard to Halifax, what the cost of collecting excreta by the dry system was; but here was one of a different kind, because when the materials were collected they were treated in a different way; the component parts were resolved into various products, and the special question of interest was whether this particular mode of dealing with it was profitable.

Mr. Alliott did not think the figures, showing the cost of the work in Manchester, threw much light on the subject, inasmuch as the system at present was only dealing with a very small portion of the refuse. The expenses were chiefly those of labour, whereas the materials turned out in these instances were certainly more valuable, in the heart of a city, for having undergone the treatment. Whether that would be so in a village was a different matter.

General Scott asked what class of manure was aimed at; what per-centage of nitrogen, ammonia, and phosphoric acid?

Mr. Alliott said the amount of ammonia would depend on the extent to which it was mixed with less rich material, for the sake of carrying that material away. The concentrated urine would contain something like 9 to 10 per cent. of ammonia, but if it were mixed with a quantity of charcoal or of solid excreta, which might be less rich in ammonia, it was, of course, diluted.

General Scott asked how much they were obliged to mix with it to make it portable—what was the strength aimed at?

The Chairman said he understood there was a sale for the No. 4 manure at 12s. 6d. per ton.

Mr. Alliott said that manure was produced by a different process; much of it was slaughter-house refuse.

Mr. Haresceugh said he was at a yard at Manchester the other day, saw the whole operation, and brought away a sample, the analysis of which showed rather more than one per cent. of ammonia. The method adopted in Manchester was that of a cinder-sifter, placed at an angle of about 45 degrees, with perforations of half-an-inch, and it was supposed that the ashes passing down this would deliver a fine ash, and deposit it in the receptacle.* But in practice, this was found to be fallacious; it stopped up in the course of a day or two, and very few would use it. But having given the people the idea that this ash was to deodorise, they adopted a plan of their own, namely, pitching down a shovelful of refuse of any kind into the tub. The consequence was, if you examined the stuff that came into the yard at Manchester, it was no better than ash-pit stuff. Some was put into the machine, and when it came out it had to be riddled to get rid of the cinders and other rubbish. On analysis, as he had said, it showed rather more than one per cent. of ammonia, so that it would never pay for carriage as manure.

Mr. Alliott thought that was the result of the third or fourth operation on the solid excreta, which was subjected to treatment with lime or some material of the kind.

Mr. Haresceugh said he had tried some which realised rather better than two per cent.

General Scott thought there was some misunderstanding about this matter. If the urine was evaporated until it was reduced to one-tenth in bulk, and then mixed with sufficient charcoal to make a portable manufacture, it must be far better than Mr. Haresceugh stated. If Mr. Alliott could say how much charcoal cinder was added to the inspissated urine to make a portable manure, they would be able to form a better judgment as to its value.

Mr. Alliott said there had been some confusion in the discussion, because much of what had been said with regard to the price paid in Manchester did not refer to that made by this system. He could not say what quantity of charcoal was required, because that really was not what was being done with it. The products of the manufacture were not being tried in such a way as to enable him to answer the question. They were not putting charcoal to the concentrated urine and making it into manure, but were mixing the concentrated urine with other parts of the refuse not made on this system at all, with the object of increasing the strength of that manure, and therefore rendering it more saleable because better worth carriage. The No. 4 manure was not made by this system at all.

The Secretary said they must draw a distinction between Mr. Alliott's process and that now in use at Manchester. It was there used up to a certain point, and then other methods of their own were adopted for dealing with some of the products. Fryer's concretor was used for evaporating urine, and bringing it down to one-tenth of the original bulk; and they also had Mr. Forrest's machine, into which they put the strained fæcal and solid matter taken from the pails, and that they carbonised to a certain extent, and evaporated the moisture still in it. This was mixed up with the ground materials which Mr. Leigh mentioned in his report, and a certain quantity of the inspissated urine was added to make it up to the quality considered desirable for sale.

Dr. Syson said he knew Manchester and its systems very well, having been for five years medical officer of health at Salford. Some gentlemen seemed to forget that in any manure where you had ashes you liberated the ammonia. It was very nice to have an ash-sifting closet, and think you deodorised and disinfected; but it was a fallacy. All you did by adding the ash dust to the manure was to cover it, and cut off the air, and thus, to a certain extent, retard putrefaction; but the moment you got ashes saturated with urine, you at once got a stink—which was either sulphuretted hydrogen or sulphuretted ammonia—and you must have a loss. If you put 1 lb. of ammonia with 3 or 4 lbs. of ashes, you would produce chemical decomposition, and get a manure very poor in ammonia. In order to get a profitable manure, you must keep the ashes entirely apart. It might be useful, as a matter of convenience and cleanliness, to add ashes to the fæces, but it was not good economically. When the system discussed in the morning was given over, a gentleman took up the tubs and treated them on a patent of his own, the idea being to make the refuse of the town disinfect the contents. He ground up in a mortar-mill the liquid fæces with all the dry rubbish he could get, and added to the crude phosphates a certain amount of acids, his contention being that he produced a superphosphate, but the process failed.

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* A model of this closet was shown in the Exhibition downstairs. —Ed. S. A. *Journal.*

Mr. Alderman Taylor (Rochdale) said he understood the last speaker to say that the moment the ash went to the excrement a sulphur compound was formed with the ammonia, but supposing that to be so, how did the ammonia fly off; the two things were inconsistent, because sulphur compounds of ammonia were not volatile.

General Scott said it was manifest that the escape of ammonia could readily be prevented by the addition of a small quantity of acid.

The Secretary said when he was in Manchester he inspected a number of these sanitary sifting closets, and found them remarkably sweet for that class of building, and external to the house, though he did not mean to say that they were perfect, or what he should like to see in his own house.

Mr. Alderman Taylor said he had contributed a short paper. He did not think any one who had gone through the question would be an advocate of the dry system alone; they had never done it in Rochdale, although they were the first town, he believed, to adopt any dry system; and without being egotistical, he might say they were the only ones who had carried it out in a sensible manner. The true purpose had not been laid hold of. Taking the representation made by Mr. Pollard, of Halifax, it was easily seen how utterly they failed in their purpose. The dry system was to collect weekly, to give no trouble to the householder, or occasion any nuisance, and then to manufacture the contents into a manure which should be profitable, and not wasteful or costly. In Rochdale they had kept that in view, and had done it. But they were hindered by the same class of discussion occurring in the Town Council which had occurred to-day. They accumulated a large quantity of manure, and, because they did so, the cry went forth that it was a failure, which was not at all correct when the facts were understood. Even in the report made by Mr. Rawlinson and Mr. Clare Sewell Read, it was amazing how they had overlooked and misrepresented the facts. For instance, they said the cost was 8¾d. in the pound, but it was not so, since they included the expense of removing the old middens, which, if deducted, would leave the cost at 6¼d. They gave no credit either for the manure on hand, and went on the assumption that £2,000 worth of manure was of no value; but it had since been all sold at the price it was valued at, namely £1 per ton. In a good dry system they ought to do away entirely with the necessity of a tip, which was the curse of Rochdale, whilst Mr. Rawlinson and Mr. Read mixed up the Colley-Hurst tip at Manchester with the Rochdale. Another fallacy was that of a representation of the death-rate, which, unless it were taken very carefully, and over a long period, might easily lead to wrong conclusions. They had had this pail system at work in Rochdale and had taken, not particular districts, but the whole town, and they did find a considerable diminution both in death-rate and disease. The medical officer stated that diarrhœa was very much lessened by the introduction of this system. He had never advocated the use of ashes, or earth, or of any lining; they were useless. They tried the Goux plan at Rochdale for nine months very fairly, but it failed completely, and they had come to the conclusion to go on with the perfect system of manufacture. He warned the Town Council that if full facilities were not given for the manufacture, the loss would be from £2,000 to £4,000 per annum, and what was the result. For two full years they had been practically manufacturing as little as possible for a mere trial, and it cost £4,000, and the estimate for this year was £8,000, whereas it was £12,000 last year. People had the notion that if night soil could be disposed of by the mere admixture of ashes, that other systems were better than this, and especially because it was said farmers believed that by manufacturing you were spoiling the manure. They tried a number of experiments very carefully with a machine made by Mr. Firmin, which would be at work before the 1st of June, and would be able to manufacture a manure from excreta and urine for the value of £6 15s. per ton. This was not theoretical, but practical, the per-centage of ammonia being 8·1. What he wished to insist strongly upon was this, that when an earth-closet, or any admixture of any material such as Goux lining or ash was advocated, unless it invoked the addition of acid to fix the ammonia, a worthless manure was produced. It was also a fallacy to say that any lining would hold the ammonia; you must have sulphuric acid or some equivalent to fix it, or the manure was wasted. Although they were the strongest advocates of the pail system at Rochdale, they had taken a farm for the purpose of irrigating and purifying the sewage. The real difficulty was not in the manipulation or collection, but in this fact, that the landowners of this country seemed to be determined to levy black mail on the population of the towns. If they could have land at a farming rent all towns would irrigate as they ought to do. He might also say that at Rochdale they were further from the agricultural districts than in Halifax, and their town was equally hilly. One suggestion he would throw out, was that the Government, if it were so desirous that the public health should not suffer, might take a town, and try a fair experiment upon it of two or three different plans, to really ascertain which was the best. In Halifax, Manchester, and other large towns they could not look for a full supply of water, if water-closets were universal. The points to be looked to were, perfect manufacture, weekly collection, and thorough cleanliness of the pails when they were returned.

Mr. Moore asked why they gave up the Goux system?

Mr. Alderman Taylor said because they could not work it so cheaply and well as the other, and could not make any manure from it.

Mr. Baldwin Latham asked what was the death-rate at Rochdale? Was it not the fact that with the diminution in diarrhœa there was a corresponding increase in fever?

Dr. Wilson said there was no increase in fevers, but a corresponding diminution. The death-rate from fevers in England and Wales for 1876 was 4·43, in Rochdale 4·7; and taking the average for three years previously, the death-rate in England and Wales was 5·5, and in Rochdale 5·7, so that during the whole of these three years there had been a constant diminution. That equally applied to the death-rate for the last seven years.

Major-General Synge said he wished to put before the meeting one thought with regard to the dry treatment, which was orignal. It was a little difficult to follow the division of the distinct subjects, and to avoid mixing up the discussion of this with the water-closet system, because, in speaking of the dry system of collection, nobody really imagined that house-water was a dry substance. Very often the dry collection was spoken of as if those who advocated keeping out the excreta and urine from the admixture with water did not provide for the collection of the rain-fall in the street, or the slop-water of the house. He believed the universal impression of persons favoured by holding a high social position was, that it was luxurious, pleasant, and agreeable to put the out-come of their persons into water, and have it carried away, and he had heard enough that day to be confirmed in the impression that the water-closet was considered the right and proper thing to be used. Now, that very morning, it so chanced on his way to the meeting, being in the habit of mixing with all classes of people, that he was in a company where it was said "Oh, the Prince of Wales will never come to the throne," and so on. There was quite enough feeling of that sort in the world, without taking up scientific or sanitary questions, on the basis that what was right and proper for persons favoured in circumstances was not applicable to the poor. Therefore, he would say to every scientific and practical engineer, builder or chemist, that if the water-closet was the right practical thing, it was the sounder opinion which said the poor could use it, than that what was incidental to every man alike must be treated differently in different classes of society, and that what was suitable for the rich was not applicable to the poor. He was thoroughly convinced that you should not put a corrupting substance into water, from which you could not eliminate it again. The difficulty was at the beginning and at the end. If you took the connection with the house and the outfall, you had a difficulty at each end, and therefore, if you could show that you could treat and make universally applicable a dry collection, it should be adopted on its merits, rather than undertake to do things which had no abstract connection with the dry system whatever. He was amused not long ago, in that very room, at hearing it stated very definitely that the water-closet was very nice in a nobleman's mansion or in the metropolitan area, and therefore must be adopted; but that having water-closets, you must have sewers to convey the contents away, that you must not put that into the rivers, and therefore must construct something or other to go to the sea. Now, if this was true at all, it was true universally. If that was the right treatment, it was a logical conclusion that every town in the whole country, the outcome of every man's person, was to be taken into something which should take it to the sea. The basis upon which that was justified economically was, that there was no possible means of reclaiming it which did not involve a greater expense than throwing it away, but he remembered, when he listened with astonishment to this statement that England was only an island, and if it were true of us, it must be true of the Continent, and the world would be made very different to what it was as it came from the hand of its Maker, being permeated with sewers to take the outcome of the whole population of the world on to the sea-board. The land would be like a plank moored in a sewer, and the delight of the population at all the bathing places would be to float about in that material. It was not scientific, and not good reasoning, and he hoped there would be a tolerant and patient hearing for anyone who tried to show that this was not a correct conclusion. When he became convinced of the incorrectness of this theory some time ago, he worked it out for some years in an honorary way, but he found that nothing could be done unless it could be taken up commercially, and therefore committed himself to a commercial undertaking. On this account he felt some difficulty in speaking upon the matter, but he always endeavoured to keep the two things distinct. He had spoken of the theoretical principles, and now he wished to speak of the commercial undertaking which he conducted. The whole principle was that of keeping offensive substances out of water; but sometimes this was not understood, for he had heard an eminent authority declare that if this were so, he must drown himself. But that was not at all correct, because his object was to keep offensive matter out of the water. They kept the excreta out, and they endeavoured to keep the urine out, both in their simplest and most finished products, the commodes and closets. To show the completeness of the deodorising process, he might say, that when he was still serving in Portsmouth garrison, the contents of the closet of a workshop were handed round at a *déjeuner*, and nobody knew what it was; and those contents were placed in a frying-pan over an open fire without the slightest offence being caused, in a room with the windows closed. The deodorising power of charcoal might be absolutely demonstrated by any person for himself, by simply placing a little on any offensive substance. With regard to the collection, it was said you must not accumulate this refuse, but must carry it away frequently. If it were left in an offensive state, that was one thing; but if the liquid were allowed to drain off, it was different. The liquid was allowed to go off into hermetically sealed air-tight tanks, from which, by pneumatic carts, it could be removed. The chief expense incidental to the dry system was that of collecting, but a dry pit was as different as possible to a cesspool. A cesspool, in fact, was nothing but a sewer, only limited in area. The principle was, briefly, that of separation carried throughout, the application of deodorants to prevent the escape of gases, and the manufacture of manure by instruments which would come out in the next paper. The chemical treatment had no speciality in it.

Mr. Towle said he quite agreed that the rich ought not to benefit themselves at the expense of the poor, but he was prepared to give a water-closet to every house in every town, and one which could not be put out of condition. There was no other possibility of getting rid of sewage without nuisance. He was astonished to find several large towns adopted this tub system; and, as an old farmer, he might tell them that everything you put to manure spoiled it. Lime was good in itself, and all kinds of manure were good, but if you mixed them together you destroyed both. Most of the deodorisers consisted of copperas, and enough had been used in Oxford to deodorise the whole county, if spread over it; but you would never get manure good for anything where such stuff was used. They complained of the farmers that they would not buy these manures, but the reason was because they found they burned everything up. Unfortunately, he was prevented, by the rule which had been laid down, from explaining his proposed water-closet, and he considered it a most strange thing that nothing not already in practice was allowed to be brought forward.

Mr. Gilbert Redgrave, who had prepared a report on the pan and pail systems, said he had endeavoured therein, as briefly as possible, to put forward the different dry processes then at work in the chief towns in England; and secondly, the systems in actual operation for treating matters collected on the pail system. For convenience he divided the system of collection under three heads, and each had been amply discussed; pails without absorbents, pails with absorbents, and thirdly, the pails used for the joint collection of ashes and excreta. Looking simply at the sanitary question, he was unable to find that any real advantage had been claimed for the use of absorbents in the pails, though there might be certain sentimental benefits. But, as far as the actual operation of the pail system on the health of the users was concerned, he was unable to find that either ashes or other absorbents had any real influence. Passing to the second question, the treatment of what was collected in the pails, he found a very manifest advantage resulted from collecting the excreta in an unmixed form. At Manchester, where the system of manufacture was carried out on a large scale, there was this manifest disadvantage, that having collected the excreta and ashes in this mixed condition, by any drying system that could be made use of, it became necessary to deal with, and to dry up the whole of the ashes, so that you had to waste heat in raising the temperature of the whole bulk without any benefit being produced to the finished manure; the ashes, therefore, only acted as profligate associates, degrading the character of the manure that was made. The old-fashioned plan of mixing together excrement and ashes was now practised in many towns, and produced a manure which, some years ago, was considered valuable, being readily taken by the farmers, and it was still used in some districts. But where the population became more dense it was difficult to get rid of this weak manure, and the ash mixture was becoming a more serious difficulty every year. The result of his inquiries was, that in a very few years the time must come when this mixture of ashes and excrement would only be got rid of at a very great cost, and the serious question to be considered was, would it be cheaper to reduce the bulk to the smallest possible extent, by artificial means or by mechanical drying, and then carry the smaller amount of concentrated manure to the farmer; or had the towns better make up their minds to use no process of manufacture at all, but to carry to a great distance, and at a considerable expense, the solid and liquid refuse which they produced. Where a town had no means of selling the mixture, all they could do was to form those enormous tips, which would be universally condemned. This material was a most unfit thing to be used as a foundation for building, and must injure the health of the population. In Birmingham they employed General Scott's process, and at Manchester a process of concentration was in use on a small scale, and the result of the experience gained was that concentration must be the key-note of future action. They must set to work to reduce this pail stuff into the smallest possible bulk, and in that form he believed they could always rely on a market for it, and even if it cost more to concentrate it than it did at present to remove it, they must face that additional cost. The question was becoming more difficult every year, and really the only way to get over it was to determine on some system of concentration, and to carry that out on a sufficient scale to deal with the whole matters to be got rid of.

In reply to a question,

Mr. Redgrave said the kitchen stuff was carried into the sewers. He had not dealt with that point.

Mr. Milburn said the object of the paper which he had contributed was to describe a machine used for drying sewage refuse. It was not intended for any particular system of collection—such as either the Goux or Rochdale system—but depended on the exclusion of any adventitious matter, such as ashes or house refuse. There could be no question that the admixture of house refuse, or anything of that description, must be most disadvantageous to manure, because any oxidising agent must dissipate the ammonia; and if you used anything to fix it, it would require a larger quantity than without this foreign substance, and thus a needless expense was incurred. By the system in which he was interested, they produced a manure such as had not been made before in any quantity; and they showed, by Dr. Voelcker's analysis, that, with ordinary night soil treated with 30 lbs. of sulphuric acid to the ton, a manure had been produced in large quantities, and sold readily to practical farmers at £8 per ton. Different towns used different systems, and some would employ one kind of deodorant and some another; but if it were done with care, keeping in mind not only the deodorising of the refuse, but also the fixing of the ammonia, it would cost nothing, because you would get the value back again in the manure. The system of concentration to which Mr. Redgrave had alluded was the one which he more particularly advocated. His own firm had been some time engaged in making machinery for this purpose, though it was used more abroad than in this country; but, perhaps, their want of success had arisen because sewage [illegible] had mostly some method of their own. But they had shown in the Bilston works, which had now been carried on nearly two years, that a marketable manure could be made, which sold at £6 to £8 a ton, simply by the addition of sulphuric acid to night soil. If it were collected very frequently, it required less fixing, because the ammonia was then in the form of nitrogen and was not volatile. There was no doubt that the question of concentration would force itself on public opinion, and, before long, different corporations would adopt it.

Mr. Kidd described the machine which he had put up at Wrexham for the treatment of sewage sludge, which was illustrated by a diagram showing six large machines proposed for erection at larger towns. He proposed to adopt six machines, each of which was capable of turning out 30 tons of dry sewage sludge per week. In dealing with such sludge hitherto, too little attention had been paid to the advantage of allowing it to drain naturally, for if this plan were followed, one-third of the work would be done in two or three days, without any expense. At the end of that time, it would be stiff enough for a spade to cut through it, so as to open it out still further, when it would be carried on to a drying board, and it was then passed through the machine. One boy could readily feed two machines; the cost of six would be £2,000; £2,000 would be spent on building the shed; and this would be sufficient for a large sewage works. The labour required to attend these six machines would be as follows:—Three men would be sufficient to do all the day work; two engine-drivers, one for day and one for night, £2 10s; six boys at 14s.; and six men at 21s.; so that the total wages would be 15 guineas. and 5 per cent. on the £4,000 capital, and 12½ per cent. depreciation would be £3 17s. The machine was designed for the utilisation of waste heat, so that it was hardly fair to charge the fuel, but he had done so; and as each machine burnt about 12 cwt. a day, that would be equal to 25 tons of coal slack, which he put down at an average cost of 10s., though it did not cost that at Wrexham. That made the total expenses, with the interest of money, £42 11s. a week, and dividing that by 180 tons, the cost of the dry sewage sludge was 4s. 8d. per ton. The manure they were now making at Wrexham showed a value of 30s. per ton, but they were selling it at 10s., simply to compete with farmyard manure.

Mr. Bowing said there was no such thing as waste heat, though there might be wasted heat. In this particular case he should like to know what the waste heat was, and where it came from. If you took the water of the original mass and evaporated by heat, it required a certain quantity of fuel, which was generally equal to about one-fifth the weight of water. The heat must be generated somewhere by the oxidation of fuel, and it did not matter whether it was used directly for this purpose, or whether too much was used somewhere else, and this so-called waste heat, which he called wasted heat, employed.

Col. Jones thought the last speaker hardly understood Mr. Kidd's reasoning. His idea was to allow the sun and wind, when it could, to get the chance of driving off the greater part of the water, so as to leave only about 50 or 60 per cent. to deal with.

Mr. Kidd said that after the sludge was fed into the top of the cylinder, it was carried round and emerged at the bottom as a dry pulverised finished manure. The temperature in the chimney was about 700° or 800°, but when the manure came out it was about 140° to 160°; and the dry manure, perfectly pulverised and put into a heap, would lose considerably more moisture in cooling down.

Col. Jones said there might be a little confusion between the actual results obtained at Wrexham, and the proposal made by Mr. Kidd to have these six large machines side by side, and he thought it was safer to go by the actual results of the small machine now at work. He could corroborate what had been said to this extent, that an engine with one man and two boys had been at work at it since it was put up at the end of February, and had turned out about 70 tons of manure, which the neighbouring farmers were very glad to get at 10s. per ton. He thoroughly believed in Dr. Voelcker's report, because, judging by the analogy between theoretical prices and the market value of farmyard manure, he reduced the theoretical value of sewage manures by about one-half, to show their practical value to the farmer. Being a farmer himself, he had no desire to take in his neighbours, and therefore he began selling it at this low price, which at present was just the cost of production. The wages came to £6 3s. 4d. for a week of six days, working 24 hours each day, and the coal to 2 guineas, the product being 18 tons 6 cwt. 3 qrs., which produced £9 5s., leaving nearly £1 for wear and tear and incidentals. But it was reasonable to suppose that with a larger machine it could be worked more advantageously, because one boy had not enough to do in feeding the present machine, and could certainly attend two very easily, whilst one man could take out the stuff from four or five; so that he thought there was a margin for profit. Comparing it with any other machines he knew of, such as Milburn's, the only opportunity he had had of arriving at any details was at the Oldham Carbon-Fertiliser Company's works. He learnt from the books there that the average production of five machines for four weeks, previous to the time of his visit, was from four to five tons for each machine. He did not know the condition of the stuff when it was put in, but comparing that with the average he had named from Mr. Kidd's, which was actually sold over the weighing machine, the latter appeared to be about three times the amount. He had seen some accounts in the paper by Mr. Milburn giving better results.

Major-General Synge said he conducted the affairs at Oldham, and he could only say that the information stated by Colonel Jones was given without any warrant or authority, and any servant of the company who was known to give such information would be dismissed. He did not wish to know who had given it, but it must not be taken to be authoritative. He had always declined to furnish any information as to the results of one machine to those interested in another, and therefore, though he had furnished Messrs. Milburn with a return of the working of the machine, he should decline to give it to any one else.

Colonel Jones said he inspected the works at Oldham with the permission of Major-General Synge, and the information was given to him most readily by the clerks in the office.

Major-General Synge said the results of the machine must depend, to a great extent, on the kind of material put in.

The Chairman said he thought they could not afford time for a further discussion of the relative merits of two machines, though it might be very interesting. He must now call on the Conference to discuss the second subject on the Agenda, namely, "Water-carried Sewage; new facts about sewage farms," &c.

Mr. Humphris (Borough Surveyor of Cheltenham) said he had explained very carefully last year the course adopted at Cheltenham, which he need not recapitulate in detail, but it would suffice to say that they had continued the same process then carried on, namely, the separation, as far as posssble, of the solid matters in tanks, and the ultimate disposal of the fluid sewage on the land. Last year he gave the expense of the working of the tanks during the previous five years, and he had now furnished the results of the subsequent year. He might add that the gain from the sewage farm had been rather more than the average of the preceding years; but in using that word he wished to qualify it, because in connection with the statement then made, he distinctly remarked that the value of the ashes was not taken into account, or it would show a slight loss. The sewage farm account showed a deficiency of £55, whereas the yearly deficiency on the whole six years would be £92. The process had continued to work satisfactorily, but he had before remarked that they were very favourably circumstanced at Cheltenham, and were thus able to do what could not be done in many other localities. They were very anxious to get more land; and an arrangement was on the point of being concluded with a neighbouring proprietor. But there was a clause in the Rivers Pollution Act which made it very difficult for him, under legal advice, to steer perfectly clear of legal consequences, and therefore the arrangement had not been carried out. In that Act it was provided that no new channel should be constructed for the passage of sewage matter into rivers without certain special precautions; but no definition of the words "sewage matter" was given. A difficulty thus arose in the mind of the legal adviser of the landlord, and consequently the arrangement had not been carried out, and they could hardly hope, therefore, to extend their operations until some clear judicial interpretation had been given to the words "sewage matter." Until this was done, it would be unsafe for local authorities to incur outlay on sewage irrigation works.

The Chairman said the interpretation, in all probability, would be that the sewage matter must not be turned directly into the stream.

Mr. Humphris said the Local Government Board were appealed to, but declined to interpret the words.

The Chairman remarked that it would be beyond the province of the Board to do so, since it was only the judges who could give legal interpretation to Acts of Parliament.

Mr. Rogers Field, Mem. Inst. C.E., inquired the acreage of the Cheltenham sewage farm?

Mr. Humphris said they had 20 acres of their own, but, in addition to that, there were 200 or 300 acres of land on which the sewage was allowed to pass, by means of outfall sewers beween the tanks and their own farm.

Mr. Baldwin Latham, as a member of the committee which had charge of the Croydon Sewage Farm, said that during the past year, the sewage farm there had resulted in less loss than the previous two years, the whole cost for the manipulation of sewage being less than a rate of 2d. in the £ per annum. They had to pay a rent of £12 an acre for the land, and in working that farm they had lost £2,227 during the last year. At Norwood, where they had 60 acres, both last year and the previous year they had made a profit, last year over 10s. an acre; but then they were paying £10 an acre; they were not, however, likely to make that profit in future, for the simple reason that the landlord was about to raise the rent from £10 to £20 per acre, and, in consequence of that, the Local Board had determined that for South Norwood district they would make an arrangement with the West Kent Drainage Commissioners to carry their sewage into the Thames. This would apply to that portion of the district which now discharged at Norwood, containing a population of 8,000 to 10,000, and it would only be done in consequence of this exorbitant sum being charged for rent, because they found it would be far cheaper to pay a moderate taxation to the West Kent drainage system, than to put so much money into the pockets of the landlords.

Mr. Alderman Taylor said he supposed that, with a farming rent, they would make a good profit on both farms?

Mr. Latham said certainly.

Mr. Halliday asked why the rent was to be so much increased? Was it the greed of the landlord, or in consequence of the nuisance?

Mr. Latham said he presumed the rent was to be raised because they were in such a position that they could not go anywhere else, and had spent a large sum in adapting the land to the purpose of sewage. He should say, however, that the present landlord had paid something like £400 an acre for it, and it might be said to be building land, for which purpose it would be worth £20 an acre; but it was not worth so much as farming land. It was being let at 18s. an acre when he originally laid it out for irrigation.

Mr. Chesshire asked if the increase on the value of the land had arisen from the sewage operations, or from the increase of value for building purposes?

Mr. Latham said the increased value was partly due to the increased rent paid by the Local Board for the time being, not that the sewage itself gave it an increased value. The land happened to be in a particular district where it was commanded by gravitation, and they could not get suitable land anywhere else within a considerable distance.

Mr. Chesshire inquired if the neighbouring land fetched a similar rent?

Mr. Latham said a large piece adjoining it had recently been sold for a cemetery. It was only fair, however, that land close to a large town must naturally realise a much larger sum than land elsewhere; this was especially so in the neighbourhood of London, and though they had to pay a rental of £10 an acre, they got a corresponding advantage by having a good market in the immediate neighbourhood. Those who paid £2 or £3 an acre in the country had the chance of losing money by not having a good market for their produce.

Mr. Rogers Field inquired if the whole population of Cheltenham was dealt with on the sewage farm?

Mr. Humphris said yes; and on the adjoining land.

Mr. Woodward asked if a large portion of the sewage was not thrown on the adjoining land?

Mr. Humphris said there was a good deal of adjoining land on which the sewage was run.

Mr. Woodward said he had understood that a considerable portion flowed direct into the River Chelt.

Mr. Humphris said that none flowed in unpurified.

Colonel Jones asked if there not overflows for the storm waters?

Mr. Humphris said there were, but they did not act, except under very considerable pressure.

Mr. Halliday said he was in the neighbourhood of Cheltenham last year, and found more than two-fifths of the sewage came direct into the Chelt, because there was more sewage than they had land to utilise it upon.

Mr. Woodward said he could confirm this fact, because he happened to be in a peculiar position with regard to the gentleman who rented the sewage farm. His doctrine was that you had much better have the land in excess of the sewage than the sewage in excess of the land, and that, if he were to take the whole of the sewage, it would be very much in excess of the land.

Mr. Halliday asked if there were any complaints in the neighbourhood of the sewage farms at Croydon?

Mr. Latham said there had never been a single complaint with regard to either the Norwood or Beddington farm. During 1875 and 1876, when there was an epidemic of fever in Croydon, the whole sewage of that large area was used, and many of the wells were probably supplied with nothing but the purified effluent; but there was not one single case of enteric fever in the whole valley of the Wandle below their sewage farm.

Mr. Chesshire asked if there were any storm outlets in the course of the sewers?

Mr. Latham said such a thing was not known at Croydon; every drop of water went on the farm.

Colonel Jones asked if they had not endeavoured to separate the storm water from the sewage?

Mr. Latham said in some places they had special drains to lead the storm water to the neighbouring streams, but in the districts where there was a liability to pollution, the whole of the storm water and the refuse from the houses went into the sewers.

Dr. Wilson asked if the figures showing the death-rate from fever and other diseases in Cheltenham could be given?

Mr. Humphris said Dr. Wright would be present the following morning, and he would give the figures asked for. They had had no complaints of any nuisances arising from the sewage farm for several years.

Colonel Jones next referred to the short paper he had contributed giving the result of his sewage farm at Wrexham. The conclusion he came to was that if you could get the sewage of any town brought to the highest point of any neighbouring land suitable for its disposal, it was well worth a farmer's while to deal with it, and to be responsible for the absence of any nuisance. It was then said that his was an exceptional case, and that he had not taken any account of his own labour, or else the farm would have shown a loss. Since that, however, a very excellent paper had been read at the Institute of Civi Engineers, when Mr. Chalmers Morton came forward with a statement regarding the Earl of Warwick's sewage farm, from information derived from his agent. That farm was now paying a rent of £2 10s. an acre, and £450 a year rent for the sewage pumped up to it from Leamington. Besides that, it was paying full interest on the capital invested in laying out and levelling, which had been done at an unnecessary expense. The case of Doncaster was mentioned at the same meeting, where a lease for 14 years had been taken at the rental of £800, or more than £3 an acre. His experience had shown that the results were about a mean between the extravagant estimates of early enthusiasts, and the worthlessness attributed to the system by other. He quite agreed that towns could not expect to make a profit out of the sewage, because he considered it their duty to take the sewage where it could be made away with, and they might be very thankful to find some one who would be answerable for it. He then proceeded to explain more in detail the balance-sheet which he had given, showing the profit at the Wrexham farm, and showed how the totals, taken from the cash-book which he had carefully kept from the beginning, corroborated the profit and loss account. The total profit for five years was £1,480, which was more than most farmers would expect to get under the most favourable circumstances, when they paid £5 on account for their land. This showed that, although towns could not expect to get a profit, farmers might be found who ought to be able, not only to pay a fair rent for the sewage, but to pay something for the sewage when they knew how to use it.

Mr. Kemson said he had made some inquiries with regard to the Earl of Warwick's farm, and found that its condition had improved continuously up to the present, and there had been no complaints of any nuisance arising. He was satisfied that the reports made by the agent were perfectly trustworthy. The stock-taking was done by agricultural agents, who thoroughly understood the subject, so that there was every reliance to be placed upon the figures. It was as good a specimen as he had yet seen of such farms; it was very expensively laid out. The system of cropping pursued was to grow rye grass or mangolds for two years, supplying the land freely with sewage, then to shut it off entirely for one year, and take a crop of corn, after which it was put under sewage again.

Mr. Moore saying he did not quite understand Colonel Jones' balance-sheet, that gentleman again explained it in detail, and repeated that he should be very glad if some agricultural accountant would examine his books and verify the results.

The Chairman said the account seemed to be quite correct, because, although to a great extent the balances were matter of estimate, the estimate of one year was corrected by the actual figures of the following one, and the corrections amounted to a very small sum indeed, besides which the cash-book returns corroborated the general result. He next called upon the meeting to discuss the subject of "Effluent Water."

Mr. Chesshire said it was very difficult to keep this subject separate from some others, because the question of sewer-gas was involved in the condition of the effluent water. But, with regard to the effluent water question, he wished to say that whatever process were adopted, whether subsidence, filtration, or precipitation, the condition of the effluent water did not prove that the sewage of the town had been utilised or intercepted to any extent whatever. Take the town of Birmingham. ten years ago; they constructed the first sewer-tank, which, at the request of Sir John Ratcliffe, he inspected, and came to the conclusion that it would not be effectual. But now the Corporation were constructing 16 other tanks, and the effluent sewage passed into the river Tame. It was his misfortune to live on the banks of that river, which was more foul now, with all the precipitation going on, than it was five years ago. When he first went to live there, if his dog went into the river, he came out sweet; but if he went in now, he could not bear him. Still, the effluent water that went in was fairly sweet. The town of Birmingham had 35 storm outlets in two main sewers; and they represented an area eight times as large as the area of the two sewer outlets. They were all self-acting, and all at the top of the sewers, so that when the sewers were filled up with the storm, they instantly came into operation, and all the fæcal matter, and paper, and other things which collected in the house drains, were carried down into the sewers, rose to the top, and passed through these storm outlets, until, by the time the water got to the sewers outlet—and he had been in the sewers himself, and knew exactly what their condition was—there was scarcely any fæcal matter remaining in the sewage at all. The Corporation were really tinkering with this question, and leading the public to believe that in these 16 tanks, which had cost £200,000, they were dealing with the excreta of the population. But it was quite a fallacy. All the dry or solid matter lay in the house drains, and did not pass into the sewers in ordinary times. When an architect built a house, he took the greatest care to carry all the surface drainage into the house drains—into the same drains which carried the refuse from the water-closets—because he knew there was no other way of getting the solid matter out of the drain; the little drop of water which passed down when the closet was used had no power of removing solid matter. The soil-pipe, for a certain portion of its course, was horizontal, and in that portion the solid matter collected, and there it was that the sewer-gas generated, and the whole mischief originated. The current of air was backwards from the sewers, because, as the sewage passed out, the air must rush in, and the consequence was, it came back from the sewer into the house drain, and into the interior of the dwellings. That was the evil of the whole underground system, and unless something could be done by which the solid portion of the excreta could be intercepted before it passed into the sewers, nothing on earth would overcome the sewage difficulty.

Dr. Vacher (Birkenhead) asked how often the storm outlets were brought into action?

Mr. Chesshire said that was very difficult to answer. It depended upon the weather. During the last seven months they had had nothing but rain. If they could make arrangements with the sky that the rain should come every half-hour, as it was wanted, it would do very well; but the rainfall being so uncertain, caused the whole difficulty. The sewage of Birmingham was put down at 16,000,000 of gallons, but it was nothing of the kind. Sometimes it might be that, and sometimes it might be fifty times as much. He was prepared to maintain that statement that the rainfall over the whole area of a town like Birmingham or London would increase the amount of sewage at least fifty times.

Mr. Austin said it was evident, as a consequence of what Mr. Chesshire had said, that there ought to be some means of intercepting the solid matter before it entered the large conduits. If the house drains had a proper slope and dimensions, everybody knew they could be cleared by the water that came from the house; but with the large conduits there was very little possibility of giving them sufficient fall, and the solid matter accumulated, and did not go down to the outlet until there was a flood. If it never entered these large conduits that nuisance would not arise, and if it were collected and taken away daily from the house the effluent would be tolerably pure. There would be then only the fluid secretions, which would not produce a large amount of nitrogenous matter—only 12 grains to the gallon, and taking 30 gallons per head of the population, that would not be very much, and a good deal of that would be dissipated before it got to the outlet. Eleven years ago he had invented, and had since superintended, a process of straining sewage and preventing it entering large conduits; and on no occasion during that time had he found the effluent water containing more than eight grains of organic matter per gallon, and rarely more than four grains. That was obtained merely by a mechanical process of straining. If you get rid of the solid matter from drains, and the kitchen stuff, which was the very worst portion—for the fat and soap which came from the kitchen created a worse nuisance than anything else in the drain, seeing it fermented for a longer time, and kept giving out its deleterious influences—the effluent water would be tolerably pure. The effluent water could be very easily filtered, either in canals filled with water plants, or by passing it over a very small quantity of land before it entered the natural water-course. The great consideration was, by mechanical means, to keep the solid matter out of the main conduits.

The Chairman asked where it was proposed to intercept the solid matter?

Mr. Austin said it was done at the junction of the house drains with the main conduit. A system must be so arranged that the drainage from every 2,700 or 3,000 persons must converge to one point before it entered the main sewer, and there the solid matter was intercepted, and deposited itself in an iron box, which was detached from the extractor, with the valve closed, and lifted up by a crane. It was then covered hermetically. There was a box for every day, and at the end of the week, the seven boxes were carted away to a field, a hose was attached to the bottom of the box, the valve was opened, and it was then run into a trench, which had been prepared in the field; the stuff from the first box was run into the trench, and, as it ran through, a man continued to trench and to mix up the earth with it, and it very soon became absorbed with the soil, because, at the end of the week, it was more or less dissolved in the quantity of water that remained mixed with it.

The Chairman asked where the dilution with water took place?

Mr. Austin said the box was taken out of the drain, and had a current of water passing through it to deposit the solid, and it was never moved again after the valve was shut. This process could be seen in operation at West Worthing, where there was a population of about 700 people.

Mr. Chesshire said this intercepted the solid matter at the end of the drain; but he did it at the beginning, and thus prevented the house drains being contaminated with fæcal matter.

The Chairman said this plan seemed very ingenious, and might, with a considerable prospect of success, be applied in a new town; but it involved the house drains being laid with a good fall, and all the drains in a certain district converging to a particular point, so that where sewerage was already established, it would be difficult to introduce it.

Mr. Chesshire said his plan could be applied by every individual under the control of the Local Government Board.

Mr. Monson said he did not think it was fair for Mr. Chesshire to contend that the amount of pollution which got into the river at Birmingham came from the storm overflows, because, according to his observation, they did not act once a year. He had one in his parish, and he did not think it had ever acted. He had noticed this year an extraordinary quantity of sewage foulness; but they could not say, because something had got into the river, that it came from the house drains. He thought the Birmingham system one of the best in England.

Mr. Russell asked if the effluent water would deposit after being in the river a couple of days? It did not follow because it looked clear that it was purified; as he understood, as it passed out of the tank it would be clarified, not purified. It would be probably better if they could use irrigation, but he did not see how the sludge and filth could get into the river in the way Mr. Chesshire had named.

Mr. Rogers Field said he could confirm what Mr. Austin had said, that the kitchen stuff was quite as filthy as excrementitious sewage. He had had to drain several large institutions on a system, which architects adopted a great deal, of separating excrementitious sewage from the slop water, and carrying it into separate cisterns, and he found in every case that the cisterns which contained slop water were unmistakably more offensive than the others.

Dr. Vacher said there was no doubt that the amount of organic matter in slop-water was considerably lighter than in that from the closet.

Mr. C. Wollaston, C.E., then explained the system he had adopted at Hurstpierpoint, as stated on the paper he had contributed, by which they obtained an effluent which was very free from the tendency to after decomposition; but what produced this fact he must leave the chemists to decide. He had estimated the previous day that the quantity was about 90,000 gallons in the 24 hours, and the result was very satisfactory.

Mr. Halliday said he had examined some of the effluent from the Manchester sewage some six months ago, which was mechanically filtered, and then finished with charcoal made by the Manchester Sewage Company. It was taken from the mouth of the sewer, and it went into the River Irwell. The water was mechanically pure, but chemically it was not so. In his opinion, there was no necessity, in dealing with sewage, for going to any great distance; it might be dealt with at the mouth of the sewers, at a cost of about three halfpence per thousand gallons, by mechanical means. Of course chemically it would not be pure. He also wished to state that local boards and corporations were too apt to take advantages of ideas submitted to them by scientific men, and then carrying them out independently, without making any recompense to those who had spent time and labour upon the subject. The consequence of this must be that individuals would be very careful how they put their propositions before corporations or local boards. He had made a proposition to one of the suburbs of Manchester to deal with the sewage in such a form that it should be put into the river at a cost of £2,000; but his offer had not yet been accepted. He hoped it would be, however, and that by next year he should be able to give some definite information as to the results.

The Conference was then adjourned till the following morning.

SPECIAL MEETING.

Tuesday, June 5th, 2.30 p.m., the Duke of Buccleuch, K.G., in the chair. Among the delegates from Agricultural Societies were Mr. P. McLagan, M.P. (Scottish Chamber of Agriculture), Mr. Knowles, M.P. (Cheshire Chamber of Agriculture), Capt. H. Townshend (Chairman of Warwick Chamber of Agriculture), Mr. T. Bell (Newcastle Farmers' Club), Mr. J. Trask (Hampshire Chamber of Agriculture), Mr. E. Scriven (Banbury Chamber of Agriculture), Mr. Mechi (President of the Farmers' Club), Mr. W. A. Wooler (North Yorkshire Chamber of Agriculture), Mr. Dark (Newbury Chamber of Agriculture), Professor Voelcker, F.R.S. (Chemist to the Royal Agricultural Society), Mr. Clare Sewell Read, M.P., Mr. W. Beach, M.P., Professor Bentley (Royal Botanical Society), Dr. Maxwell Masters, F.R.S.

The paper read was—

ON EXTIRPATION OF INJURIOUS INSECTS.

By Andrew Murray, F.L.S.

I presume it is unnecessary for me to inform any one present that this meeting has arisen out of a letter addressed by the President of the Privy Council to the different agricultural societies throughout the kingdom, covering a copy of a communication that I had made to my Lords, recommending steps to be taken for the extirpation of insects injurious to agriculture, &c. That communication was simply a letter drawing attention to the amount of damage done by insects; to the fact that isolated action was powerless against them; while in many cases their extirpation, or, at least, a great reduction in their numbers, might be effected with ease by combined action; and recommending that my Lords (as the department more especially connected with agriculture) should make a tentative experiment with that object. Anxious not to injure my proposition by making too bold or radical suggestions, I timidly limited it to one or two garden pests peculiarly open to attack, and to three counties—Lancashire, Derbyshire, and Cheshire—that had something of a peninsular or semi-isolated character. The reply of my Lords was, that though they were of opinion that it did not fall within the province of the Science and Art Department (to which my communication had been officially addressed) to take action in the manner suggested by me, yet they felt that the subject was one which well deserved the consideration of agricultural societies in the United Kingdom, and that to them copies of my letters would be sent.

The reply is somewhat Delphian in its utterance, and may be read in more ways than one. To some it may seem to be merely a civil way of shelving a difficult question, and others may regard it as an invitation to the societies to favour them with their opinion on the subject. This is naturally the interpretation that I put upon it. It seems to me to say, that I have either not applied to the right department, or the right branch of the right department, or have not suggested the right remedy or the right mode of its application; but that, if deemed by those most interested to be of sufficient importance to call for the intervention of my Lords, they would then be willing to take up the subject, with the view of providing a remedy in the right way and through the right department.

It is with the view, then, of obtaining the opinion of those most interested in the subject that this meeting has been summoned, and having been asked to open the discussion with a paper, I propose to take advantage of the opportunity to examine the subject from some points of view which I did not touch upon in my previous letter. I feel that the weak part of that communication was the tentative remedy that I suggested. It was only touching the fringe of the evil. I shall now regard it from a more extended point of view, and endeavour to show how it may be dealt with in a more comprehensive and efficient manner.

I begin by making one or two assumptions, which I presume will be granted me, but which, if disputed, can be easily proved. I assume that, besides the occasional great injury done by insects, by which whole districts are ravaged, a continual drain is constantly kept up by them which constitutes a very perceptible per-centage of deduction from the cultivator's profits. I say that much of this is preventable, and I assume that, where it can be prevented at less cost than the loss it occasions, it should be prevented.

So far, I imagine, we must all be at one, but we may not be all at one as to the possibility or means of prevention, or at least of prevention except at a price greater than the loss that would be sustained by leaving matters as they are. I do not mean mere money cost—that would be easy to deal with, for whenever you come to actual figures you can cipher them out, but I mean the interference with a man's liberty of action in conducting his own business. That is the critical point of this question. How far it would be wise, and under what precautions it would be desirable, for the general benefit to interfere with the inalienable privilege of an Englishman to do what he likes with his own. None of us are so Quixotic as to maintain that there are no bounds to this right—but as a body, Englishmen are pretty decided in their aversion to paternal government; and, before accepting any proposition tending in that direction, they would require not only to be satisfied that the object was really for the general interest, but also that it can be attained in no other way. That the object is for the general interest is one of the assumptions that you have permitted me to make, and that it can be attained in no other way than by entrusting power to some executive authority (it matters not whether that authority be the actual Government or another Government instituted for the purpose) will be plain, if we consider for a moment the nature of the work contemplated. If we wish to rid a district or a country of an injurious insect, and if, as is very generally the case, we have the power of doing so by attacking it at a particular date, and in a particular manner, it is obvious that, to be effective, the attack must be simultaneous and combined, for to what purpose would it be if I cleared my farm while my neighbour did not clear his, or if I cleared mine one year and he cleared his another? We should each preserve an ample reserve of our pests to replenish the cleared fields of the other. A central authority, therefore, a power to which both he, and I, and every other farmer in the district, must bow, is needed to secure united action, and what is such an authority but paternal Government, compelling us to obedience for our own good.

As to the advantage of the general principle of stamping out, and the necessity of an executive authority to direct it, there cannot, therefore, be much difference of opinion, but there remains the more difficult question, how much and what kind of interference may be tolerated, and by what safeguards it should be surrounded, and how far it is workable or not? The administrative machinery by which it should be carried out need not concern us. If Government resolve to interfere, it must fall to them to make their own plans, but as a contribution towards elucidating the various points which they would have to consider, I think I may usefully draw the attention of the meeting to a few of the different ways in which interference might be beneficially exercised,

The simplest, the most powerful, and the most efficient of these is what I may call county or district rotation of cropping. Farmers know well enough the advantage of a rotation of cropping (or its equivalent) on their own farms. By long-continued growth of the same crop on the same land the soil becomes exhausted of some of the elements necessary for the proper development of that kind of crop, and a change of crop brings other elements into use, and relaxes the demand upon those that have been too much drawn upon.

Exactly the converse of this takes place with regard to certain insects. The great majority of vegetable-feeding insects do not feed on all kinds of plants indiscriminately; most of them are restricted to one kind of plant, and if by cultivation of that plant its numbers are enormously increased, so will naturally be the number of the insects that feed upon it, while, if we should cease to grow that plant, the number of the insects would correspondingly diminish. Thus, for instance, if a district is almost entirely in pasture, there will be very few wheat-feeding insects in it, but if it is turned into a wheat country, they will be in myriads. If these numbers reach such a pitch as to deteriorate the crops, the remedy is plain. Change the rotation, and grow some other crop instead of wheat. Allow me to illustrate this by an actual example. There is nothing like a real instance for bringing a fact home to our minds. Last summer I spent the month of July at Broadstairs. In my rambles about the place I was immediately struck with the wheat crops. At a little distance they looked tall and strong, but on examining the ears I found them so ill-filled that I should have said they were only three-quarters filled. The blade or leaf was throughout almost entirely white and dry, and I have no doubt that if I had asked any farmer what was the cause of the poor ears he would have said drought, as shown by the bleached and dried-up leaves. Mr. Mechi informs me that this is what is commonly known as blight; but there may be more than one kind of blight, and blight from more causes than one. I shall, therefore, not stand upon its name; whether it be blight or not, it seems to me plain that, if the farmer's assumption that the bleaching of the leaves was due to drought had been true, his conclusion would have been quite right. It was the deficient action of the leaf that stayed the flow of nutriment to the ear. There is not much fear of the farmer making a mistake upon this point. He, at least, ought to be (or, if not, he is not master of his craft) perfectly alive to the fact that, if you want a good crop of any kind, you must have abundant and healthy foliage. Try to grow any plant, and see what kind of crop you will have if you constantly deprive it of its leaves. But, although he would be quite right in describing the deficiency of weight in the ear to the failure of the leaf, he would, in this instance, have been wrong, in ascribing the failure of the leaf to drought. It was due to the mining of the larva of a small fly, named *Agromyza graminis*, which lays its eggs under the skin of the leaf at its tip. From thence the young larvæ mine downwards, feeding on the parenchyma of the leaf, leaving nothing behind them but the empty husk, consisting of the upper and under walls of the leaf. If the leaf is small, they entirely consume the interior; if large, they may not reach entirely to the bottom of the leaf, but will have consumed about three-fourths of it before they pass into the pupa state—as may be seen from some leaves which I have preserved, and which I hand round for examination. The diagram shows this, and the place where the insect lies is indicated by a darker spot. Now, of course, I cannot tell what amount of damage this insect did. Had I guessed that I was likely to be now reading a paper about it to the Society of Arts, I would have got the ears dried and weighed, and endeavoured to give chapter and verse for a specified proportion. But not having done so, all I can do is to leave those who are familiar with the subject to work it out for themselves, merely premising that almost every blade in the whole district seemed attacked. Still, for the purpose of my next point it is necessary for me to make some estimate of the proportion of loss. I have said that the ears seemed only three-quarters filled. They continued so until reaped. Let us suppose that this is too much by half, and take an eighth. This would give a loss of upwards of 12 per cent. on the grain crop, and to make the margin still wider, and the figures manageable, let us reduce it to 10 per cent. The actual per-centage of loss is not of much consequence if I can satisfy you it was considerable, and my object is less to show the amount lost than where it falls.

Now we all know that the total yearly produce of a farm has to be distributed between three accounts—one is in repayment of the cost of cultivation; another is in payment of rent; and the third is the tenant's profit. It is plain that no reduction can be got either from the expenses of cultivation or the rent on account of this insect damage. The tenant or cultivator has to lose the whole of it, and you will also see that although the loss on the whole crop may be only 10 per cent. that is by no means the per-centage of the loss on his profit. Ten per cent. loss on the whole crop means, of course, 30 per cent., if all thrown upon a third of it. If, for example, we suppose that the tenant's profit on the entire produce is one-third, and that the total gross produce of the wheat crop was £500, 10 per cent. loss on that is £50, but 10 per cent. loss on the tenant's profit would only be £16, whereas a deduction of the whole £50 would be equivalent to upwards of £30 per cent. You will thus see that this, in its present stage, is entirely a cultivator's question. The landlord (not a cultivator) has only a prospective interest. If arrangements could be made by which such insect damage could be annihilated, no doubt, as leases terminated, a re-adjustment of rent suited to the improved production would take place, but in the meantime it is the tenant who suffers, and who will be first benefited by stamping out such insects.

Now a change of crop, if carried out over a sufficiently wide district, supplies an easy and effectual cure for the attacks of this insect. Its habits lend themselves to such a remedy. It feeds only on wheat and a few allied pasture grasses. At Broadstairs there were crops of barley and crops of wheat growing side by side, the only separation between them being a footpath, not two feet in width, running through the field; and while, as I have said, every wheat blade was mined, I could not find one touched on the barley, which, by the way, had correspondingly escaped damage. Furthermore, the insect is only an annual. If it could be banished for one year it would be banished entirely, or until reintroduced. Now if there were a controlling authority in that district, what would be easier than to say to farmers, "Gentlemen, in the common interest you will substitute barley for wheat in your next year's rotation." The fly, deprived of its proper nidus, must then either lay its eggs in an unsuitable place, where they will perish, or have recourse to the pasture-fields for *Triticum repens*, or other suitable grasses. By this, of course, the fly would not be exterminated, but its numbers would be so reduced as to render it comparatively harmless, at all events, for a time, when, if it again reappeared in force, the same means of defence could be again resorted to. Nay, it might be so arranged that two or more counties might brigade themselves together, so as to establish a permanent see-saw, by which they should play into each other's hands. But you will observe that no single man can carry out such a rotation. He may try it upon his own fields, but they will be replenished continually from the fields of his neighbours, unless they at the same time are compelled to follow the same rotation. Gentlemen, it is for you, who know the respective capabilities of soils, and the relative returns of wheat and barley, to say whether you would prefer to suffer a heavy yearly per-centage of loss, or to submit to the substitution of barley, or some other crop, instead of wheat for a single year.

And if you thought it desirable to do so, can there be any difficulty in carrying it out? Are we so uninventive and destitute of resources that we cannot contrive some means by which the necessary power should be put in action? I could suggest half-a dozen ways. Power might be given to the Lords of the Privy Council to carry it out at their own discretion and *ex proprio motu;* or to carry it out on the requisition of the county authorities; or on the requisition of a committee of the farmers of the district, appointed for the purpose of dealing with insect pests and similar questions; or on the initiation of the agricultural societies of the district; or an inspector might be appointed for every county, with the requisite power and authority; or a central board of experts might be appointed for the same purpose, but with wider jurisdiction; or each county might have a board for itself. Any man can plan out a scheme for it, but I think no man will maintain that there is any insuperable difficulty in devising means that will answer the purpose.

Before leaving this point, let me remind the meeting that the plan of excluding for a year a particular crop from the cultivation of a district will apply to almost every crop that we grow, whenever the insect is an annual (that is, does not live over one year), and this includes by far the greater number of injurious insects.

The next means of extirpation to which I shall advert is burning the nidus in which the insect, in whatever stage, passes the winter, and I may take as my example the species of a small fly belonging to the genus Chlorops, which specially attacks barley, although it also sometimes attacks wheat, rye, &c. The larva maks a channel in the stem of the ear, causing abortion of the pickles, and gives it a twisted, stripped-looking appearance (as shown in the diagram), which, on a superficial examination, might be taken for the work of sparrows. The fly remains about the ear for many weeks after it is thrashed, and may be found in great numbers in winter in a semi-torpid state among the chaff. Now, is it not an intolerable abuse of the privilege of doing what a man likes with his own, that my neighbour should be allowed, for the sake of the small profit he can make out of his chaff heap, to preserve such a focus of infection to destroy my future crops. He should be compelled to burn it. In like manner we want some one to compel the burning of the heaps of couch-grass and weeds gathered from foul land, instead of keeping them to rot into manure. These are the focus and shelter-place of wire-worms and other pests, and contribute largely to their spread.

To the same class of remedies belongs the local treatment which I recommended for the onion fly. The plants attacked are readily distinguishable from those that have escaped—the former are sickly, flaccid, and yellow, the latter firm, erect—and green, and those attacked can easily be picked out and burned. Each plant attacked contains a nest of larvæ in the stem or bulb, as shown in the diagram. If these are destroyed the whole future family is annihilated. The carrot plants attacked by the carrot fly are equally easily distinguished and destroyed—but it is not certain that the grubs in them always keep to the same root. But both with them and similarly destructive insects that infest the cabbage and turnip, a year's avoidance of that crop throughout the district will relieve it from them.

Now comes the remedy, in the shape of some application that is fatal to the insects. This is the plan adopted in America for the destruction of the Colorado beetle, where Paris green is dusted in powder or sprinkled in solution over the larvæ on the potato plants. It is the plan used by our horticulturists to get rid of the red spider in their hot-houses, where sulphur is the medium. Manufactured into Gishurt compound, or made up into some soapy solution, sulphur is also largely used by them to destroy green fly. Sulphur has also been successfully used on a small scale against the hop fly, and might be advantageously used on a large scale. There are various other supposed specifics (such as hellebore for the gooseberry caterpillar, &c.) which are more or less in favour with different individuals. As a remedy, however, such applications seem better adapted for individual protection than combined stamping out, although it would be foolish to forego the advantage of using them where they seem to meet the requirements of any special case. Such a case most certainly is the destruction of what are called ticks and lice upon sheep. Every one knows how readily such vermin can be communicated by contact or even proximity, and it does seem a very hard case that a man, who has kept his flock clean by taking proper precautions, should be liable to have them infected by a neighbouring neglected flock, by stray sheep, or even by sheep passing along the road. I have no personal knowledge on the subject, but I am told that, *cæteris paribus*, the difference in value between a sheep that has been kept clean for the season and one that has been worried by vermin will be 20s. If that is so, I wonder that sheep farmers have not long since clamoured for some supervision.

The picking and gathering of the individual caterpillars, or perfect insects, is a remedy that has been tried largely on the Continent, but without any marked success. For ordinary crops it is much more clumsy than a change in the rotation, and for crops which cannot be so dropped out of rotation, as fruit or forest trees, it is almost impossible to collect the larvæ efficiently. At the same time it is right to add that this *échenillage*, or caterpillar collecting can scarcely be said to have ever (any more than any other plan) had a fair trial, it having generally been conducted without regular system or combined and simultaneous action over a wide extent of country.

There remains the last refuge of all invaded countries, namely, destroying the resources of the country before the invaders, that they may perish for want of food. This can rarely be necessary, but beyond doubt it will be the proper course to follow should the Colorado beetle gain a footing in this country. In that event the first that we shall hear of it will be that the larva has appeared in some potato patch near Cork or Londonderry, Liverpool, or Glasgow. The instant this is perceived, the vines of the potato field should be cut to the ground, and Paris green scattered over the field.

But that is not a course that can be adopted, even in a case of such urgency and importance, unless there is some central motive-power having the necessary authority to act; for the notice that the Colorado beetle will give will be very short. The larval stage, in which alone it can be successfully encountered, only lasts about a fortnight, and, if no previous preparations have been made, I leave any one who knows the slow grinding of our administrative mills to say what chance there is of the larva having grown big enough to be noticed; of somebody having noticed it and reported it; of the report being considered and a course of action resolved on; of officers or agents being appointed to act; of their providing the necessary apparatus; and of their reaching the spot and putting them in operation—all within the short space of fourteen days.

I have nearly exhausted the list of my suggestions, but there is one which I must not forget. It is very small, but, in my view, very important. If you erect a great pump, with costly steam engine and machinery, and omit to put in a fang, all your pains and expense will be abortive for want of a little bit of leather. So here: power may be given to the Privy Council; you may have your committees and officers all ready to work as soon as an insect appears; but they may sit expectant and useless from one year's end to the other, unless some one comes and tells them that the insect has appeared, and where it is. They are in exactly the same position as the firemen and fire-engines of our fire brigades. There they are at every station, horses, men, engines, fire-escapes, and everything ready to start at a moment's notice, but of what good would all this readiness be if no one came to call them? and if they left it to chance, or to the owner of the house on fire, they might never be called until it was too late. What they do is not to trust to that, but to offer a reward to the first person that brings news of a fire. It is only a trifle that they give, but it answers the purpose. Let us follow their example by all means, call on the cultivator to give notice as soon as an injurious insect appears in any numbers on his farm; but do not trust to him. Promise a reward to the first person who shall communicate the intelligence of such a pest appearing. There are more entomologists scattered about the country than you think of. It may be that you would have some erroneous and some false reports, but proper precautions against deception could be taken. Specimens of the insects might be required to be forwarded; and even although some deception and cheatery did take place, it could be endured. The fire brigade does not cease to offer its reward for first notice, although some incendiaries have set places on fire for no other purpose than to claim it.

The above are suggestions relating to the machinery by which the extirpation of injurious insects might be effected. There remains another point which, supposing you to go in the main along with me, must also be considered, and that is, what the action of this Conference should be in regard thereto. If I might offer an opinion, it humbly appears to me that its office is rather to give a general verdict upon the importance of the subject and the practicability of dealing with it than to enter into the discussion of details which should more properly be left to the Government, who will be responsible for them should they resolve to deal with the subject. I have had to enter into details for the purpose of making my meaning clear to you, but I hope I have not committed myself to anything beyond general principles. On these I own that my opinions are very decided. I believe that no one has any adequate conception of the amount of loss that agriculturists suffer every year from insects. I cannot give any statistics on the subject because there are none. But although I can give you no statistics, we have the evidence of our own eyes for the existence of a vast amount of preventable loss. I know that it has been said that any attempt to control insect damage is visionary and unworkable. To some men everything that is troublesome or difficult is impracticable. But I am speaking to men whose boast and character it is not to make difficulties but to conquer them, and it is for them to say wheter there is anything in the views I have had the honour to lay before them that is either visionary or unworkable.

DISCUSSION.

The Chairman said this subject was certainly a very important one, though some people out of doors thought there was a great piece of work made about a few insects. Many a time he had noticed on riding from Richmond to London, or the other way, early in the morning, he had been nearly blinded by the multitude of small insects in passing through some of the market gardens in that district, when he could not but wonder what the state of the gooseberry bushes would be in the afternoon; but many even of these pests had enemies in other insects, as for instance the fly which infested the hops. He had heard a farmer say, when these flies are about, "We shall be all right now there are the lady birds," the fact being that those little bugs preyed on this particular fly, which did so much damage to the crop. He believed that all through nature it would be found that when there was an excess of animal life of any kind, there was some other animal which preyed upon it, and then there were many things provided by nature if men would only avail themselves of them. For instance, the innumerable quantity of small birds would do much to keep down insects; but it was too much the fashion to kill them. People said that they did a great deal too much mischief; that they could not keep currants on the bushes; and that the birds pulled up a great deal of seed. So they might; and, generally speaking, the seeds were sown too thick, and if they could sow a smaller quantity of seed and produce an equally large crop, it would be better for all, especially at a time when grain was at such a high price. He was a great disbeliever in the theory that little birds were very injurious to gardens. They could easily be kept off by boys, or by netting, and all the time when there was no fruit they did an immense deal of good by destroying the insects. He had opened the crop of one of these little birds, and found an immense quantity of insect larvæ within. He quite agreed with Mr. Murray that in this country people were very jealous of paternal government, and he thought that in all these things we could take better care of ourselves, if we were forced to do so, than Government could do for us. But if a man would not help himself it was no use having any help at his elbow. Still, if any department of the Government could assist by spreading information, or in any other way, we ought to be thankful to them for it. For instance, on this occasion the President and Lords of the Privy Council had brought this subject under the consideration of the Agricultural Societies of the kingdom, thus making it more public and bringing it before the eyes of those interested. That was a matter of great importance. The Government did not come down with paternal advice, saying there is this evil existing, we will tell you how to meet it, we will not trouble you to think about it yourselves, because we know what ought to be done; but, on the contrary, they brought it under the notice of the different Agricultural Societies, that they might consider in what manner this evil might best be met. That was the object of the present Meeting, and he hoped that it would not separate without producing some good practical recommendations. Whether the rather startling plan of Mr. Murray, that every now and then they should change the whole system of cropping, should be recommended, he was not prepared to say—no doubt it would be very effectual, but it would be rather difficult to carry out. He begged leave to move tho first resolution:—"That thanks are due to the President and Lords of the Council for having brought the subject of insect damage under the consideration of the Agricultural bodies of the kingdom."

The resolution was then put from the chair, and carried unanimously.

Dr. Maxwell Masters F.R.S., moved the second resolution:—"That much of the loss occasioned by insects is preventable, and ought to be prevented." He said this resolution lost much of its force by the fact that Sir Joseph Hooker, the President of the Royal Society, who had intended to be there to move it, was unavoidably absent: but in his absence he had much pleasure in moving it. Although he could not speak with the authority of some of the gentlemen present, yet in his own department he had had many opportunities of seeing the large amount of damage done by insects, both in gardens and fields. He had but a small garden of his own, and no fields at all; but in the course of his vocations he had constant opportunities of looking over other people's, and seeing the large number of fields and gardens not only in this country but on the Continent; and besides that, he was day by day, and week by week, receiving almost every post specimens of insects which had done injury or were supposed to have done so, with the effects that they produced. Not being an entomologist himself, it was his duty to distribute these insects amongst those whom he knew to be most competent to deal with them. His friend, Mr. Murray, was a great help in that respect, Mr. McLachlan was another, and Professor Webster was the greatest of all, and he might mention many other entomologists to whom he was daily under obligation for information on this subject. There could, therefore, be no doubt that the extent of the injury had not been over but under estimated; and on the other hand, he was quite clear, as a journalist of several years' standing, that one of the greatest necessities of the times was increased information on these subjects. Farmers and gardeners did not know what was beneficial and what was harmful, and he laid great stress on this point, because they ran the risk of destroying that which was useful, and leaving unhurt that which was prejudicial. Only a day or two since a case came before him of a certain kind of slug which should certainly not be destroyed in gardens, because it was one which fed on insects, and was altogether a benefit to the gardener rather than the reverse. He had no doubt that amongst insects also there were many which were decidedly beneficial, inasmuch as they preyed upon others which were injurious. There was, therefore, a case made out for greater information, which could only be given by competent entomologists; but if they were not to be left behind in the race, they must be always progressing, and this matter was one which should not be longer neglected. In America they were much wiser in this respect, for in the various States they had State entomologists, whose duty it was to collect information regarding insects, describe them, and make known their habits and the best mode of dealing with them when injurious. Such a thing was greatly wanted in this country. The scientific committee of the Agricultural Society, which met once a fortnight during the summer, had a great deal of its time taken up with questions of this kind, and only to-day had had before it an illustration in the case of the larch in the Forest of Dunkeld. He had, therefore, much pleasure in proposing this resolution in behalf of Sir Joseph Hooker.

Mr. McLachlan, as a colleague of Mr. Murray's on the scientific committee, seconded the resolution, though he did so entirely on his own account, and not as the nominee of any society. No doubt there was a large amount of damage done by insects to plant life generally, but there was one point he thought Mr. Murray had scarcely sufficiently touched upon. In talking of the wheat plant he said that nine out of ten farmers, if they were asked what was the matter with the plant, would say it was affected by the drought, and he was not sure that they might, to a certain degree, be right, because he did not attribute all the damage supposed to be done by insects actually to the insects themselves, and for this reason, that the greatest preventive of damage by insects was first of all a healthy condition of the plant. If it were strong and healthy, it might in a considerable degree withstand the injury done by the insect; but if in addition to the attack of the insect there was a previous unhealthy condition, then the insect naturally caused the death or utter uselessness of the plant in a much shorter time than would otherwise be the case. He might illustrate that from an arboricultural point of view. Lime trees, especially round London, suffered enormously from the attacks of a small beetle which made little channels under the bark, and the popular opinion was that this beetle was the cause of that damage to the tree. He must say that he was of a different opinion, however, because he thought the tree was first of all in an unhealthy condition, and then the beetle stepped in and completed that which the unhealthy condition of the root had already commenced. He quite agreed, however, with the idea of the resolution that much damage was done which ought to be prevented, and had much pleasure therefore in seconding it.

The resolution was put and carried unanimously.

Mr. Mechi moved the next resolution:—"That it properly belongs to Government to provide the necessary means for protecting cultivators from this loss, as it is only by combined and simultaneous action over considerable districts that it can be effectually done; and Government alone possesses or can obtain the requisite means of enforcing such action." He said it was rather a sweeping assertion, but he did believe it to be the true one. All great calamities, and insect calamities were very great, could only be arrested first by thorough education and knowledge of the circumstances by the parties interested, and then by the central power exercising its authority to remove the evil. An instance of this was given by the cattle plague. At first this matter was left to local management, or mismanagement, and the result was an enormous loss to the country, but fortunately a wiser system had been adopted, the central authority had been exercised, and the result was the plague was, they hoped, for a time stamped out. No doubt farmers were very jealous of interference with their affairs, because they thought themselves very independent men, and were very fearful of an additional rate, which they always thought would follow anything new. In the case of statistics they knew it very difficult to get them made up by farmers in England. Not so in Scotland, because there they were educated 300 years earlier, thanks to John Knox. No doubt this arose from an absurd fear that their affairs would be known, and that the profits of farming, which everyone said were so small, would become known to the landowners. He entirely agreed that the loss occasioned by insects was far greater than most people supposed. He knew of districts where the wheat crop was almost ruined by the wire worm, on light land; and sometimes a whole field of wheat was almost destroyed by slugs on heavy land. When they considered that only one shilling an acre on the 47,000,000 of acres under cultivation amounted to two and a quarter millions of money, it was easy to imagine what would be the loss occasioned by destruction amounting to some pounds per acre.

He feared that this question had hardly been considered worthy of notice by agriculturalists as a rule. Wire worm and slug were preventable. They knew what the wire worm did. It ate into the centre of the wheat plant, and always operated in light land, and never heavy land. That proved that the solidification of the soil would prevent its action, and as he should suffer from it unless he watched it very closely, he always looked out, and before it done much damage he examined the plant, and if he found one or two wire worms he immediately put a heavy Crosskill roller over the field, and solidified it by working it two ways, and if necessary salted it with a bushel or two of salt besides. In this way a crop probably worth £15 per acre was saved, which otherwise might be reduced to £5 or £6; but it was quite clear that solidification was the remedy, because it prevented their runs. The worms were obliged to come out, when the birds took them. That led to another question, on which he felt very strongly as a practical farmer of more than 35 years, that the birds are the farmers' best friends. He had two or three hundred fowls, which had free access to the whole of his fields, and he had noticed them, when he had only drilled a bushel an acre of wheat, scratch between the rows the moment it was put in, searching, as he thought, for the seed, but in reality it was for the insects, and he found practically that the thickest wheat crop was always grown within 30 yards of the hen house. It was only by observing the habits of these creatures, opening their crops, and examining the contents, that you could arrive at safe conclusions; but there was abundant evidence of the value of birds. A neighbour of his had a garden which was so full of insects that it produced nothing; but, after putting some poultry in, the insects were destroyed, and he could get there good crops. Last year, he heard from Mrs. Wood, in the Tyrol, there was an enormous quantity of butterflies which came from Italy, almost like a snowstorm in appearance, on to the cabbage grounds, where a deal of cabbage was grown for the supply of the cows. Butterflies themselves did no harm, but they deposited a little bunch of eggs on the leaves, which, if not removed, would produce 300 or 400 caterpillars, which would speedily eat up the whole of the cabbage. Mrs. Wood wrote to say that those who adopted the plan of removing the deposit of eggs saved their cabbage, and by a butterfly net they killed some thousands. He had no doubt that if a calculation were made of the cost of such measures, and the amount it saved, a very large profit would be shown. As regards the motion he had proposed, he felt that it was right in principle, but the carrying out of it in practice would be for wiser heads than his. He, however, believed that a time would come when farmers would become so enlightened that they would readily submit to any measure necessary to stamp out these pests. A friend of his had brought up some insects with him which had come from a wheat crop, and he should like to know what they were. Mr. McLachlan said that they were the larvæ of the "daddy long legs." Mr. Mechi said that last year the London-fields, at Hackney, had been planted with grass seed, and a very fine crop was produced, but it was entirely eaten up by these insects, so that it had to be ploughed up and again sown.

Dr. Voelcker, F.R.S., in seconding the resolution, said he was no entomologist, but next, perhaps, to Dr. Masters, he had more insects submitted to him than anyone he knew of. As Chemical Officer of the Royal Agricultural Society, he was naturally expected to be ready with chemical means of destruction, at all times of the year, against every kind of insect, the very existence of which was not even known to him, and about whose habits he knew nothing whatever, and thus he was found in a strait to know what to do, and he therefore felt the necessity that something should be done. He perfectly agreed with Mr. Murray that the Government had much more power of doing good in the way of imparting sound instruction about insect life than any private society; but, at the same time, he thought it highly desirable that the great national Agricultural Societies should follow in the wake of the Horticultural Society, which really did excellent work, as he could testify from having attended the meetings of the scientific committee as often as it was in his power to do so. Very valuable information was often brought forward at those meetings, but it was lost to the agricultural community for want of publicity. The Highland Society, he believed, had more money than it knew what to do with; and the Royal Agricultural Society had something like £23,000 invested, the interest of which would very well pay another officer, who would especially devote himself to the study of entomology, and whose duty it would be to go about the country gathering information and imparting it to farmers. Perhaps, after all, this office might be better performed by some head officer, to whom the others would look up as a great authority, who should arrange on the part of the Government matters of detail, and suggest the proper means of carrying out certain measures in practice. He did not think the time had yet come for enforcing such strict regulations as the change of cropping suggested by Mr. Murray. It was no doubt the most effective means of destroying certain insects, but he feared it could not be carried out, because the farmers did not understand the question. On the Continent it was different. Continental farmers were sometimes twitted for their readiness to put up with restrictive measures; but the fact was, that they did not feel the restrictions to which they were subject, because they were instructed in the matter, and did not feel it onerous, if certain pests entered their barns, to take certain measures to stamp it out. It must be confessed that there was a great excuse for the farmer, for he had already too many restrictive measures imposed upon him, and if he were told that he was not to grow wheat in a certain order, he would naturally think that was a return in the wrong direction, and that he would next be told what he must do with every field on his farm. The Government might do a great deal by the appointment of State entomologists, and he could endorse fully what was said by Dr. Masters of the action of the United States Government. Some of those State entomologists were exceedingly industrious and clever men, who had a great reputation amongst the practical farmers, and did a great deal of useful work amongst them. Their publications, indeed, were of the highest scientific and practical value. As Dr. Masters had said, our knowledge of insect life was very limited. Mr. Mechi had just pointed out that consolidating the soil by rolling it prevented the ravages of the wire worm; but there were two sides to every question, and he might be allowed to say that loosening the soil would do more for the destruction of the wire worm than anything else he knew of. Mr. Mechi was perfectly right if he had only gone a little more into detail. The fault was in not ploughing up the land in the autumn, but leaving it as long as possible, when the wire worm fed on all the organic matter in the soil and got fat and strong, and then when the land was ploughed up in the spring the farmer complained of the wire worm. If the land were well ploughed up in the autumn, and then consolidated in the spring, you did on a large scale what the gardener did on a much smaller scale when the frost had left the root of his plants. He gently patted them down a little to give the roots a firmer hold, and therefore Mr. Mechi was quite right in rolling the ground in spring so as to encourage the growth of the roots, and in that way the wire worm would not get the better of the plant. This would explain the value of another of the remedies which were suggested for this pest. Rape-cake was well known to be greatly used to counteract its ravages, and the theories about its operation were rather peculiar. Some said that the wire-worm disliked the mustard-like taste of this cake, and others maintained that he was so fond of it that he fed upon it in preference to the roots of the crop. His own belief was that rape-cake, being a powerful manuring agent, encouraged the growth of the young cereal crop to such an extent that it soon got beyond the ravages of the wire worm, and was not affected to the same extent. In conclusion, he hoped that this would be taken up, not only by the Government, but by the Agricultural Societies, and that the agricultural community would press upon the bodies which represented them the necessity of appointing duly qualified entomologists.

Mr. Mechi said he ought to have said, in explanation and justification of the Royal Agricultural Society, that in their volumes, which every farmer ought to have to read, there were some most valuable papers on entomology, by Mr. Curtis.

Mr. Clare Sewell Read, M.P., could not agree with the resolution that it properly belonged to the Government to provide the necessary amount for protecting cultivators against these pests. He would not discuss the theory of the British Constitution, but in this country, generally, they did by voluntary effort a great deal which was done by the Governments of other countries, and he believed they were perfectly right in so doing. He would say, also, that whenever Government did interfere, it generally did so to the serious detriment and loss of those whom it was supposed to help. With regard to the cattle disease which had been mentioned, he was quite positive that was the case, and, therefore, instead of saying it was the duty of the Government to provide the necesssary means for protecting cultivators from this loss, he would rather say it properly belonged to our leading Agricultural Societies to suggest these means. He did not really see what Government was to do in the matter, and for his part he did not believe they would interfere in any way whatever. Dr. Voelcker had expressed his dissent from some of the views announced by Mr. Mechi, and following suit, he might also say that he could not agree with what that gentleman said, that you never found wire worm on stiff land. He knew, particularly at this season of the year, that if you took a ride through Essex, and went farther north into Suffolk and Norfolk, on the cold clay lands, there the wire worm was doing incalculable injury to the barley, and although what he had said with regard to consolidation was all very well, that process might be carried to the extent of killing the barley while it extirpated the wire worm. With regard to the theory as to the application of rape cake which had been advanced, he would say that he believed other manures would assist the growth of the plant much more effectually; nitrate of soda, for instance, was quicker in its action, and would be greatly more advantageous to the plant in the early stages. He remembered when a boy, there was a man who went round the country telling the Norfolk farmers that he had a receipt for exterminating the turnip fly; he wanted a shilling in advance for the receipt, and a great many were fools enough to give it to him. When the receipt was obtained it was simply this:—"Do not sow your turnips until the month of August, and then the turnip fly will be gone." He did not mean to apply that to the propositions which had been made there, but he thought altering the system of rotation of crops was a very strong measure. He did not quite understand either whether it was proposed that they were to burn the chaff in order to extirpate some of these insects. He supposed Mr. Murray meant to burn the dust, not the chaff itself.

Mr. Murray said that was his meaning, and only to chaff where insects were known to be present.

Mr. Read said the chaff was a very valuable source of food. With regard to burning all vegetable matter in the soil, he had always understood that the more such matter you could put into the ground the more profitable would be your cultivation, and therefore it was quite possible that the remedy might be worse than the disease, if all these instructions were followed out. At the same time he felt much obliged to Mr. Murray for being so good as to prepare this paper, but he hoped the Government would do nothing in the matter even if they were asked.

Mr. Hale said it was a very general feeling that a line ought to be drawn as to where Government should interfere, and it was time enough to ask for such interference when they had more knowledge on the subject.

Mr. Wooler said there were insects which injuriously infected animals as well as plants, and in many cases these would be much more easily destroyed; for instance, warbles in cattle might might very easily be stamped out. There was also the tapeworm, which produced what was called "sturdy" in sheep. He had two places, one where there was a footpath through, where he lost about 4 per cent. from this cause; but on the other, where there was no footpath, and dogs could not get up it, he never lost one. Then there was the maggot again, which he kept down to a considerable extent by hanging up a piece of meat over a pond, upon which the bluebottles deposited their eggs, and when the maggots grew to a certain size they dropped into the pond, and there was an end of them.

The Chairman, in putting the resolution, said that if the Government were asked to take any steps which involved the question of money, there was a certain financial secretary who looked very closely after these things, and therefore, there need be no fear of any hasty measures being taken. He then put the resolution, and declared it to be carried, though several gentlemen voted against it.

Mr. P. McLagan, M.P., moved the next resolution, as follows:—"That the President and Lords of the Council be informed of the opinion of this meeting, and urged to take the subject at once into their consideration, with a view of providing a remedy." He said, whenever an agricultural subject was discussed, there was always a great variety of opinion expressed. He was far from considering that a disadvantage, but thought it one of the greatest benefits of such Conferences, that they had the opinions of various gentlemen ventilated, and he trusted some good would arise from this discussion. Dr. Voelcker very properly said, that the time had scarcely arrived for taking the very energetic measures suggested by Mr. Murray, namely, stamping out insects by means of altering the rotation of crops. But the time had not arrived, simply because agriculturists were not educated up to it. The first thing to do was to gather information on the subject, and in due time he believed these measures, stringent though they were, would be readily responded to. No one a few years ago would ever have supposed that farmers would so tamely have submitted to the restrictions placed upon them with regard to cattle, and yet they, though the most independent body of men in the country, had submitted with a good grace. In the same way, when they found it to their advantage that insects should be stamped out by such severe means, they would submit as readily to it as to the regulations imposed by the Privy Council with regard to the cattle plague. In such a case as this prevention was better than cure, and no doubt nature had established a balance amongst the families of animals in the world. If you destroyed one family of animals you were sure to have an increase in those upon which they preyed. He did not wish to produce discord in the meeting, but it was well known by the over-preservation of game certain animals were killed, and by their destruction, others, which were regular pests to the farmer, were allowed to live; for instance, game-keepers took great pains to destroy hawks, whilst wood-pigeons, and other birds of that class, were allowed to live, and did great damage to the farmer. In France small birds had been destroyed to such an extent that a law had to be passed to prevent it. Then, again, one tribe of insects destroyed another, and if you destroyed one tribe which fed upon the smaller ones, the latter got the upper hand. Thus, by attending to little modifications in our management—for instance, by preserving those birds which the Chairman had referred to—it was quite possible that such stringent measures would not be required. He quite agreed, however, that the stamping-out measures were the best. Not long ago he had a conversation with Professor Agassiz, with regard to the Colorado beetle, when he told him he had come to the conclusion that the only cure was to stamp it out by not growing a potato crop over perhaps a whole district. Another important subject was with regard to the effect of manure upon plants, in enabling them to recover from the ravages of insects, and he remembered when guano was first introduced the wire worm disappeared altogether from a district in which he was farming. That arose from top dressing the crops with guano, not that it destroyed the wire worm, but it gave the plants such vigour of growth as to force them through the stage when the wire worm attacked them; but if farmers would attend to these small details they would be able to prevent a great deal of loss. This subject was of great importance at the present time, when, owing to the ungenial weather of the last few months, there was every prospect of the crops being inferior, and not only so, but being two or three weeks late. Not long since he heard from a gentleman in the grain trade that if the crop was delayed two or three weeks, the result would be very serious, because they did not know where to get wheat to make up for that interval. If to this disadvantage of ungenial weather they added the ravages of insects, it was quite time for the agriculturists to be taking up the question, and that something should be done either either by the Government or by agricultural societies. He differed somewhat from Mr. Read with regard to the advantage derived from the action of the Privy Council with regard to the cattle plague, for he thought it had done a great deal of good. Possibly the resolution might have been made more general, and included a reference to agricultural societies, but he was inclined to take it as it stood. The last clause left a very wide field, and he should say the best thing the Privy Council could do would be to send down these various questions to the agricultural societies and ask them to offer suggestions.

Mr. Mechi—Or to a Committee of the House of Commons.

Mr. McLagan said it was better to have a Royal Commission of scientific and practical gentlemen, who would take up the whole subject because the House of Commons were not in a position to give advice. In the Privy Council they had a central power which could collect opinions from practical and scientific men, and bring all the information collected into one focus. It appeared to him there was only one body which had the power of doing that, and that was the Government through the Privy Council.

Dr. Lowe seconded the resolution. He said he remembered many years ago in Scotland noticing in the corner of a very large field, a heap of turnips from the previous year's crop collected together, and found on approaching that it was perfectly alive with the turnip beetle, and he could not but think what an immense amount of injury those creatures would do to that farmer or his neighbours the next year, and how easily a cartload of lime would remove the evil. He quite ageed with the observation of Mr. Maclagan, that if plants were kept in vigour the visitations of insects would not be so great. He thought the case of injury to the human race from fever and such like diseases, and the injuries done by insects to sickly plants, were strickly analogous cases. It might be that he was biassed on this question from his professional training, but any person in good health from having good air and good food would generally escape unharmed from the presence of pestilential effluvia, whilst those who had been injured by impure water or insufficient food, or other causes, fell victims. In the same way, if plants were kept in vigour, the injury done by insects would be comparatively small. But because people were vigorous they did not neglect to remove nuisances and causes of sickness, and the Sanitary Commission had done an immense deal towards the preservation of health in that way. Following the same course, they should not only aim at promoting vigorous vegetation, but also at attacking the insects themselves. The time would come when certain Government measures, which were clearly ascertained by experience to be most valuable, would be readily submitted to, but he should be sorry to see the movement commence by legal enactments. They should first endeavour to educate the farmers, and then, when they were trained by close and patient observation, they would themselves ask for legislative measures. With that feeling, he could not imagine a wiser thing than the appointment of entomologists as a preliminary measure.

Prof. Bentley said he had voted against the previous resolution, because he believed that the great Agricultural Societies of the country had been to some extent lost sight of, and he should also have to vote against the present resolution, unless it could be amended. He was not in a position to speak with any knowledge on this subject, but he confessed he should have entirely agreed with what fell from a previous speaker, that it would have been advisable, in the first place at all events, to call the attention of the great agricultural societies of the country to this question, and urge them to take some steps upon it. He hoped the resolution could be amended in this direction, or a further one passed.

Capt. Townshend (Chairman of the Yorkshire Chamber of Agriculture) said he was about to propose an amendment referring the matter to the Agricultural Societies of the United Kingdom instead of to the Privy Council. They all knew from personal experience that farmers required a certain time before they could comprehend these matters. This subject had not been brought before the Chambers of Agriculture, who, he believed, could find much better means for dealing with it if it were discussed there during a year or so, than the Government could.

Mr. Murray said the fact seemed to be overlooked that the Lords of the Privy Council did send copies of his communication to the Agricultural Societies, but they had taken no notice of it.

Mr. Wilson (of Leicestershire) said he could not agree with this statement, inasmuch as the Chamber he represented had written to the Duke of Richmond, very much approving of it, and he thought the Agricultural Societies were much more likely to suggest practical means than a Government department.

Mr. Mechi observed they had already passed a vote of thanks to the President and Lords of the Privy Council for having brought the subject under the attention of the Agricultural Societies.

Mr. McLagan, M.P., remarked that they were summoned as a Conference of representatives of the different agricultural bodies; for instance, he was requested to come as representing the Scottish Chamber of Agriculture, and no doubt other gentlemen represented similar bodies. He therefore thought the proper course was to go as representatives of those societies to the Privy Council and ask them to take the suggestion into consideration with the view of providing a remedy.

The Secretary said they had invited representatives from every Agricultural Society in the kingdom to attend.

Mr. Wilson said the Lords of the Privy Council in their circular to the Agricultural Societies distinctly stated that they could do nothing in the matter.

Captain Cragie hoped Captain Townshend would insist on his amendment, because some of those who had voted against the previous resolution would like to give some effect to their views by suggesting the alternative course he proposed, and he knew many would prefer a voluntary course to an official course. There was no hostile action in the matter. It was merely showing that they took a different view of the same subject. They all had the same object, but many he knew believed that no reform began chiefly by Government would be so likely to produce good results as one arising from voluntary effort.

Mr. Mitchell said he had watched this movement with great interest as a journalist, and begged leave to recall to the meeting the steps which had been taken, in order that they might clearly understand their position. Mr. Murray had drawn up a resolution which was forwarded to the Lords of the Privy Council, in which he suggested that action should be taken. The Duke of Richmond thought the right thing was to refer the matter to the Agricultural Societies, and Mr. Murray's proposition was printed and sent round to those bodies for their information. That was done, he believed, the first week in April, but during the whole of April and May nothing was done. That seemed to show that they did not think it worth paying any attention to, and naturally Mr. Murray and his friends considered what was next to be done. The Society of Arts, which is always willing to do anything tending to the practical benefit of the country, then arranged for this Conference, and it seemed to him it would be rather absurd for the representatives of these Agricultural Societies to pass a resolution recommending themselves to take the subject into consideration.

Capt. Townshend remarked that in the Chamber of which he was chairman, the subject had been brought up two or three times, but as they only met once a month, and there had recently been other matters, such as the Valuations Bill, which were of more pressing importance, they had not yet had time to deal with it. It was no use to think that farmers could be got to comprehend such a question as this in two months, or even in three, but he was quite certain the proper way would be to leave it for the consideration of the Agricultural Societies for a year or so before going to Government upon it.

Mr. Mitchell remarked that in the report issued by Mr. Riley, State Entomologist for Missouri, it was stated that in that State, Arkansas, and Minnesota, during the last year, Acts had been passed for the compulsory destruction of insects.

Mr. Maclachan said he believed that related more especially to the Rocky Mountain locust, though perhaps the wording might apply to others. Happily, in this country, they did not suffer from locusts to any appreciable degree. He would take the opportunity of urging on all the agriculturalists present the importance of not destroying small birds. There had been handed round a little box of the larvæ of the daddy long-legs, which a short time ago were so plentiful that, at Blackheath for instance, on taking up a handful of earth, you might find more larvæ than earth; and anyone who had watched starlings at work, would have seen them coming down on a grass plat or meadow, and flying back with a large bunch of this larvæ in their mouths. There could not be a better proof of the absolute necessity for respecting the lives of small birds.

Professor Bentley entirely agreed with the amendment that had been proposed, thinking the Agricultural Societies far more likely to carry out the object which the Conference had in view than the Privy Council. Before sitting down, he wished to express the great pleasure he had had in listening to Mr. Murray's paper, and he thought that if Government would only consult such gentlemen more frequently, great benefits to the country would result.

After some further discussion, Mr. McLagan, M.P., accepted the suggestion to add the words, "and the Agricultural Societies," after "the Lords of the Privy Council," and it was then unanimously agreed to.

Dr. Voelcker then proposed a vote of thanks to Mr. Murray for his excellent paper, which brought the proceedings to a close.

The following communication has been received from Mr. J. B. Lawes, F.R.S.:—"The insects which damage the crops of the farmer are the following:—Wire worm, turnip fly, insects which, under the general term blight, destroy leguminous crops, such as peas, beans, clover. It appears to me that if the meeting is to seek for some remedy for the injuries done to our crops, some distinction should be made between the insects which feed upon plants in their healthy state, and those which feed upon them only when in a state of disease. I have no knowledge of the habits of insect life but from observation, and should say that I should fear no injury to beans, peas, or clover, provided they remained in a perfect state of health; and I should expect that the state of disease, which appears to be most favourable to insect attack, is brought on more from unfavourable circumstances in connection with climate than from the influence of manure. Beans which have been growing rapidly, under a high temperature, with proper rainfall, are almost certain to be affected by blight if such weather is followed by a sudden and considerable fall in temperature. The injury done by wire worm varies greatly in different years; but the loss each year in the aggregate must be set down to a very large annual sum. As a rule, the amount of wire worms in land would appear to depend upon the amount of organic matter existing in the soil throughout the year. The corn crops, following arable land, which has been laid down to same soil for two or three years, are frequently destroyed by wire worm; on my own farm I have had three corn crops in succession recently destroyed by this cause; and the complete destruction of all food by means of a summer fallow appear to be the only remedy. It is somewhat singular that in one permanent wheat field, which has been under experiment for thirty-three years, and a permanent barley field, now in its twenty-sixth crop, no injury has ever been done by wire worm; this is probably due to the freedom of the land from weeds, and other sources of winter food. The turnip fly is the second great enemy which the farmer has to contend against. The insect certainly lives upon the plant in its most healthy state; and, when once a field is attacked, it is only a question whether the growth of the plant is more than equal to the destruction of the insect. Innumerable remedies have been proposed, but it is probable that none are so cheap as an increase in the quantity of seed usually sown."

MISCELLANEOUS.

SUGAR GROWING IN JAPAN.

Consul Robertson stated that the provinces where sugar is mostly grown are Isè, Owari, Totomi, Suruga, Aki, Ku, Awa, Sanuki, Tosa, Hizen, and Satsuma. Sanuki has the name for producing the best kind of white sugar, and Satsuma for the better quality of the darker description. Sugar-cane, which is obtained from seed, is said to attain to a height of about ten feet in Japan. It is not known to bear any flower. The mode of cultivation is as follows:—At the commencement of the cold weather small bundles of sugar cane roots are planted in rows, stem down and roots upwards, on a slope of about 45 degrees. The following spring they are taken up, and about two inches of cane, both above and below the joint, having been cut off, they are planted out in proportion of about 900 lbs. weight of cane to one quarter of an acre of ground. The soil is well looked after in the spring, and a quantity of small holes dug here and there. Into these the lees of oil are poured, and they are then filled up with earth, in which the cane-slips are now planted out, that is, so soon as the cane-slips show signs of budding or of having taken root. When planted, a little liquid manure is applied. After the lapse of fifteen days the slips or roots will have attained to a growth of about seven or eight inches. At this stage fish manure, mixed with the lees of oil, is applied. In droughty seasons the ground is also watered. There are three kinds of insects which do much harm to the sugar-cane in Japan, and against the ravages of which some precaution has to be taken.

During the winter, the canes that have attained the highest growth are either broken off just above the roots, or are cut with a sickle. The canes are then stripped of their leaves, and are made up in bundles, each of about 80 lbs. weight. A quarter of an acre of ground will produce about 10,800 lbs. of cane, and this quantity of cane will turn out from six to seven piculs of sugar. The sheds in which the cane is crushed are generally about twenty-four feet square, and in each there are three crushers worked by oxen. The teeth of the crushers are kept constantly fed with cane, about four or five being inserted at a time. A workman stands behind on the watch for any canes that may slip through the crusher without being caught in the action of the mill; and canes that have so passed are handed to a third man who feeds the mill from the opposite side. The mill having a reverse action, it thus results that no one cane is lost. The cane juice is now removed to a separate place in quantities of about 200 lbs. weight at a time, and the mill is cleansed after each such removal. The syrup then goes through no less than four refining processes, and is afterwards removed to where it is to be made into sugar. The working up of about 2,220 lbs. weight of cane is considered a fair day's work. As regards the further process with the syrup, about 133 lbs. weight are poured into two tubs, each tub containing half of the above quantity. Fires are then lit under the boilers, and the contents of one tub poured into the boiler. A small quantity of lime is then mixed with the syrup, which is skimmed when at boiling point. The clearness of syrup will be the test of its having been sufficiently boiled. If the syrup is thick, or in any way impure, it shows that either too much or too little lime has been put in.

The syrup is now placed in a tub, called by the Japanese "sumashi oke," in which it is allowed to settle, fresh syrup is again poured into the boilers, and boiling goes on as before. As soon as the syrup is once more at boiling point, that which has been already boiled is poured in and mixed with it, the white froth being skimmed off and placed in an empty tub. The syrup is now divided between the two boilers, and allowed to simmer for about two hours, being constantly skimmed during this time. In order to ascertain the amount of boiling which the syrup has undergone, a bamboo is inserted, and in withdrawal the drops are allowed to fall into a saucer containing water. If the drops congeal rapidly, the fires are at once withdrawn from the boilers, the syrup promptly poured into coolers arranged in sets of four, and constantly stirred. So soon as it has sufficiently cooled, it is poured into tubs, one man attending to each tub. To make the very best quality of sugar, a picul of ordinary sugar is divided into nine parts, and each is wrapped in a hempen cloth; they are then placed in receptacles, pressed down with heavy weights, and are thus sweated for one night. On the following morning the sugar thus sweated is placed on a table and kneaded for about two hours, after which it is again wrapped in cloths and the same process gone through for three successive days and nights. On the fourth day it is placed in clean receptacles, and is now termed first quality sugar. To obtain a superfine quality the sweating and kneading is gone through for an extra day. A picul—or, say, 133 lbs. of ordinary sugar—will thus be made to yield about 50 lbs. of first quality sugar; the remaining 80 lbs. are, of course, not wasted, but from it are obtained about 40 lbs. of a sugar known to Japanese under a particular name, and the residue also finds its way to market. Second quality sugar is known as "jui-mai," and is made by sweating a certain quantity of coarse sugar.

Sugar is generally known to the Japanese under three headings, white, black, and candied, but the two former are again known under a variety of names. A good deal of black sugar is produced in the Loochoos, in Sakurajuna, Araki, Hanaoka, and Jaramidzer. Any marked difference as to good or inferior kinds of black sugar depends on the quality of the cane and the skill of the workmen, but the above-mentioned places have always well sustained a reputation for providing the best sugars. Sugar candy is made by boiling down a certain quantity of best quality sugar and adding the white of egg. Split pieces of young bamboo about an inch in length are then put into the syrup, which crystallises around them. A good deal of sugar candy is made in Osaka. Either Japan sugar cannot compete with that produced in China, or the supply is not equal to the demand, for the import of China sugar is always an important item in the import returns.

NOTICES.

MEETINGS FOR THE ENSUING WEEK.

Mon.... Royal Geographical, University of London, Burlington-gardens, W., 8½ p.m. Bishop Crowther, "Journeys up the Niger, and Notes on the Neighbouring Countries."

British Architects, 9, Conduit-street, W., 8 p.m.

Social Science Association, 1, Adam-street, Adelphi, W.C., 8 p.m. Mr. J. B. Phear, "Codification of Law in Connection with the Administration of Justice in India."

Tues.... Photographic, 5a, Pall-mall East, S.W., 8 p.m.

Anthropological Institute, 4, St. Martin's-place, W.C., 8 p.m. 1. Mr. W. Knowles, "Further Discoveries in the Neighbourhood of Portstewart." 2. Mr. H. H. Howarth, "The Ethnology of Germany. Part II.—The Germans of Cæsar." 3. Dr. John Rae, "Customs and Legends of Indians of New Caledonia."

Wed.... National Health Society (at the House of the Society of Arts), 4.30 p.m. Mr. Ernest Hart, "Coffee Taverns for the People."

Aëronautical (at the House of the Society of Arts). 8 p.m. Mr. F. W. Breary, "Aërial Navigation," and other Papers.

Royal Literary Fund, 10, John-street, Adelphi, W.C., 3 p.m.

Royal Society of Literature, 4, St. Martin's-place, W.C., 8 p.m.

Thur.... Royal, Burlington House, W., 8½ p.m.

Antiquaries, Burlington House, W., 8½ p.m.

Society for the Encouragement of the Fine Arts, 9, Conduit-street, W., 8 p.m. Lecture by Mr. Barrett.

Royal Historical, 11, Chandos-street, W., 8 p.m. 1. Dr. Sandon Gutteridge, "Ancient and Modern Political History." 2. Rev. Charles Rogers, "Historical Memorials of the Abbey of Coupar."

Zoological, 11, Hanover-square, W., 5 p.m. (Davis Lectures.) Prof. Flower, "Whales and Porpoises."

Mathematical, 22, Albemarle-street, W., 8 p.m.

Fri....... Philological, University College, W.C., 8 p.m. Mr. J. H. Hessels, "The Teutonic Words in the *Lex Salica*."

Royal Botanic, Inner Circle, Regent's-park, N.W., 4 p.m. Professor Bentley, "Plants, with Reference to their Life and their Organs of Reproduction." (Part 2.) "On the Organs of Reproduction." "Calyx and its Modifications." "Corolla and its Modifications." "The Essential Organs of the Flower."

JOURNAL OF THE SOCIETY OF ARTS

No. 1,282. Vol. XXV.

FRIDAY, JUNE 15, 1877.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

CONVERSAZIONE.

The Society's *Conversazione* is fixed to take place at the South Kensington Museum, on Wednesday, the 27th June. The cards of invitation are in course of issue.

HEALTH AND SEWAGE OF TOWNS.

On Friday, May 4th, the chair was taken at 11 o'clock by the Right. Hon. JAMES STANSFELD, who called upon Dr. Wright, of Cheltenham, to give the statistics of the death-rate in that town.

Dr. Wilson said he wished particularly to have the figures of the death-rate from fever during the third quarter of last year.

Dr. Wright (Cheltenham) said he should wish to be accurate about this matter, and, as he had not these figures with him, asked leave to defer the information for a short time.

Mr. Adam Scott was next called upon to state the method employed in manufacturing "poudrette," which he said was the culminating process of the Liernur system. He said that, since the first Conference, this manufacture had been in operation in Holland; but, as it was not only applicable to the Liernur system, but also to any pail system where the excreta were collected in a comparatively undiluted state, it might be of use to some towns in this country. Probably, the best course he could adopt would be to read some extracts from an official report to the Vice-President of the Local Government Board in Ireland, by his private secretary, whom he sent to Holland for the purpose of examining this process. The early part of the report referred to the Liernur system itself, upon which he pronounced favourably, and he then described going to the central engine station when the manufacture was in operation. He said:—"A slight smell was perceptible on approaching the building, which was stronger on entering, just sufficient to give one an idea of the nature of the works without being offensive. I was assured that this could be considerably obviated, some of the pipes being out of order." This was a mistake on the part of the commissioner, the slight smell perceived being caused by the last stage of the operation being left open for the purpose of inspection. His description of the process was as follows:—"The manufacture of 'poudrette' is carried on in one large building or room containing a high-pressure steam-engine, boiler, and furnace, two receiving tanks, upper and lower, each about seven tons capacity. There are three tubs or boiling vats, through each of which the material passes in succession; then a third tank, and two revolving cylinders. The removal of the material from one tank or vat to the next is accomplished in every instance by a pneumatic process, and the operations are carried on in vacuo until the last stage of the proceedings. The material having been received from the street tanks into the lower tank in the engine-house, is then driven into the upper tank, where it receives a small supply of sulphuric acid, I think about one per cent., to fix the ammonia. After being left a due time for mixing, the material passes through the three boiling vats in succession. In each of these there is a spiral copper tubing, through which the waste steam from the engine circulates, and gives the heating power by which the moisture is evaporated. During this process the condensed water from the material can be drawn off and examined. At the third vat what I saw was quite clean, but not free from smell. A chemical test was here used to prove the water free from ammonia. Small circular plate-glass windows are introduced into the sides of these vats, so that the process may be watched, which is done by lighting a jet of gas at an opposite window. The material having passed through the three boiling vats has now become a pulpy substance nearly black, and is driven into the last tank, underneath which is a circular iron cylinder in a horizontal position, about three feet in diameter and six feet long, which revolves once in about two minutes; alongside the length of the cylinder runs a wooden trough, close above which a long roller revolves, just touching the surface of the cylinder; on the opposite side of the cylinder is another roller or rather circular brush. The trough is supplied from the tank above with the pulpy material, which is taken up by the first mentioned roller, and applied to the outside of the cylinder. The iron cylinder is heated by steam passing through it, so that the pulpy material adhering to its surface rapidly dries, and by the time the slow revolution of the cylinder has brought it to the opposite side, it is free from moisture, and encountering the revolving brush, falls into a box below, and has become 'poudrette.' Two revolving cylinders, each having the apparatus described, are at work at the same time. I obtained a small jar of 'poudrette,' which was manufactured before me. The agricultural value, by analysis, according to the component parts, is said to be £9 10s. per ton. The Local Government Board gave samples of this part to Dr. Edmund W. Davy, Professor of Agriculture in the Royal College of Science, Dublin, who reported to the Board as follows:—'One hundred parts, by weight, of this manure contain the following substances in the proportions indicated:—

Organic matters and ammoniacal salts	54·31
Soluble phosphates	1·20
Insoluble phosphates	5·65
Alkaline salts	18·64
Sulphate of lime	2·40
Sand and earthy matter	1·94
Water	15·86
	100·00

The organic matters and ammoniacal salts contain both together 6·32 of nitrogen, equal to 7·67 per cent. of ammonia, which this manure is capable of yielding. These results show that this 'poudrette' is very superior in its quality to many manures hitherto manufactured in different localities, and from the considerable proportions of ammonia, phosphates, and alkaline salts it is capable of supplying to the soil, as well as its being in a condition very suitable for employment as manure, I have no hesitation in strongly recommending it as an excellent general fertiliser. And I may further add that, from the present market prices of its manurial constituents, I estimate its value at about £9 per ton." So far with regard to the report to the Irish Local Government Board, but he might also add that the magistrates at Dordrecht had an official analysis made of this material, and the nitrogen according to their analysis was 7·02 per cent., phosphoric acid 2·20, and they valued the manure at £9 15s. 10d. per ton. For his own part, however, although these valuations were given by competent persons, he did not believe that such a high price could be obtained for it. As to the cost of this process, especially as applied to the pail system in this country, judging by experience at Dordrecht, and estimating the price of coal at 20s. per ton, the cost of evaporating and producing one ton of manure would be 25s, whilst the cost of the sulphuric acid added would be 8s. 7d., or a total cost of £1 13s. 7d., for materials. He excluded labour because it was different altogether in Holland, and everyone could judge for himself what the labour would be. There were only two men engaged, an engineer and an assistant. The sulphuric acid used in Holland was less in quantity than would be required in England in the pail system, because the liquid collected is in a fresh state, and the nitrogen not yet converted into ammonia; so that a less quantity of sulphuric acid would prevent this change than was required to fix the ammonia after it had been produced. With regard to pail systems, Mr. Scott remarked:—It might be interesting to the Conference to know that the Government Board of Sanitary Officers of Holland had been studying the question for many years past, and in 1869 they delivered an official report. Since then they had issued no report until lately, but they had carefully watched the different systems of sewage at work in England and elsewhere, in order to arrive at some conclusion as to what they should recommend. In October last, they had their final meeting on this subject, and their conclusions were worth recording, especially as they spoke strongly about the pail system, and made recommendations which were somewhat at variance with the practice in English towns. They condemned the water-closet system utterly, and recommended the Liernur system for the whole of Holland; but, where the population is sparse, as it would be too expensive, they recommended the sanitary pail system. In connection with that they said this:—"Only in cases where the population or the area should be less, the introduction of the pail system might come into consideration for financial reasons, provided that it complies with the following conditions:—(*a.*) The cesspools or middens for which the pails are put in ought to be carefully cleaned, and filled up with fresh clean sand; the existing connecting privy sewer pipes ought to be removed as far as possible. (*b.*) For every privy are required two pails marked in such a manner that, only by great carelessness, other people's pails can be put in the privy. (*c.*) The pails ought to made of enamelled iron, and provided with well-fitting iron covers; the use of wooden pails ought to be prohibited. (*d.*) In order that a good application of the pail system shall meet all sanitary requirements, it is necessary that the changing of the pails should take place daily; in no case that changing be postponed longer than to every other day, and it must be done daily in all extraordinary cases—that means when typhoid fever, dysentery, or Asiatic cholera is raging in the town or in its neighbourhood. (*e.*) The water that has been used for the cleansing of the pails may flow off in common water-courses, but not before it has been filtered through large filter beds (for instance, fine gravel and sand, or animal or vegetable coal), the contents of which filter beds, after saturation, have to be mixed up with the compost of the town. (*f.*) The general dung-pit of the town, where the compost is made and stored, must be at a distance of at least 300 feet from the nearest dwelling."

Mr. Baldwin Latham wished to draw attention to a few facts regarding this question of evaporating manures. It was well-known to every engineer that only a certain amount of duty could be got out of coal. The Admiralty had instituted most searching investigations as to the evaporating power of coal; and the highest duty which was ever obtained from 1 lb. of coal was the evaporation of 10 lbs. of pure water, and, ordinarily speaking, not more than 5 lbs. was evaporated. At page 624, in Dr. Voelcker's admirable paper, the composition of urine, which contained most of the materials of value in fæcal matter, was given, and there to begin with, it would be seen that urine contained 97 per cent. of water, so that 100 tons would only contain $\frac{7}{10}$ths of a ton of ammonia, and those $\frac{7}{10}$ths of a ton would be worth about £20, when mixed with other materials of no particular value. Now, taking the proportion of 1 to 5, that is, that 1 ton of coal would evaporate 5 tons of water, it would take in round numbers 20 tons of coal to produce this $\frac{7}{10}$ths of a ton of ammonia, and it was easy to see that, to say nothing about labour, acid, and evaporation, besides the difficulty of evaporating a material which was not pure water—because water which contained salts was much more difficult to evaporate than water itself—if you took 30 tons of coal to produce $\frac{7}{10}$ths of a ton of ammonia, it was impossible, even dealing with urine itself, that any such system could pay.

Alderman Taylor said he would not call in question the scientific facts just stated, but he thought they would tend to mislead those who had not studied the question. Suppose they took it as Mr. Latham said, there was nothing in it when all the circumstances were considered. For instance, the fuel at Rochdale was not bought; the cinders which were separated from the collected refuse being the fuel used. They never used any coal whatever, either for steam purposes or for evaporation. Then, as Mr. Latham put it, this was evaporation to dryness which was not at all required. If the water were reduced to 10 or 12 per cent., that is if say 75 per cent. of water was driven off, that was ample for all manurial purposes. These theoretical laboratory statements were quite correct, no doubt, but they were sometimes misleading on points of practice. At Rochdale they bought no fuel and sold cinders as well.

The Chairman asked how much more coal per ton of water to be evaporated would be necessary towards the end of the process?

Mr. Latham said he could not say, but he supposed it was as with pure water, in which, of course, the same proportion would hold good throughout the process. He believed Professor Way was present, who had stated 25 years ago everything that was known now with regard to this question, and he hoped he would give his experience.

Professor Way fully agreed with Mr. Latham, and was sorry to hear Mr. Alderman Taylor say we were to consider this point apart from the question of principle.

Mr. Alderman Taylor said he agreed perfectly with the theory or principle, but contended that it was not suited to the circumstances of the case.

Professor Way said the word theory was often a stumbling block, but there were certain questions of principle which could not be got over provided they were well settled. Mr. Latham had mentioned that 25 years ago he was connected with this matter, and as he had been engaged on it more or less ever since he could speak with a certain amount of knowledge. He was a member of Lord Essex's Commission when the whole subject was gone into, and though the pail system had taken its rise lately, the same principle which applied to the dealing with sewage in the liquid state applied also more or less to the pail system. The conclusions they came to after a careful inquiry were that no system of collection of sewage could possibly pay as a mercantile transaction at the same time they acknowledged that there wer many methods which met sanitary necessities more o less, such as precipitation, and so on. It was perfectl clear that you could not take even the solid and liquid excrements and dry them up with any prospect of remuneration, or of their even paying their own costs. Mr. Latham had properly said that urine was the type of the highest possible chemical manure, and directly you put the fæces with it there was a reduction of the manurial property. There were dozens of places, such as railway stations and others, where urinals were placed and vast quantities of pure urine might be collected, but nobody had ever found it worth while to take it and boil it down, although everybody knew the value of it. It was a slur on the common sense of enterprising people to suppose that if it were practicable to do this at a profit it would not have been done before now. He did not believe it could be done, however, and if it could not, certainly diluted matter of any kind could not. The real question at issue was the way in which a town could get rid of its objectionable matters at its cheapest rate. It had long ceased to be a question of profit, for no profit had ever been obtained from any dry system, and he doubted whether it had been obtained, over a long series of years, by application to the land, though that was the only possible way of using sewage profitably. The expense of carriage in any other way than by water was far too great to allow any chance of remuneration. Looking at it in a practical way, as a question of getting rid of the sewage matter at the least expense, he believed the best and cheapest method was water distribution; but, if a town were so circumstanced that it must collect its fæcal matter, there was no doubt that the pail system was the best economically, but even in that case it was a great mistake to suppose that a valuable manure could be prepared at a low cost. The best that could be done was to render it portable, so that it could be carried a short distance into the country. He did not think Mr. Alderman Taylor could say that he could make a manure at Rochdale which would bear carriage of 50 or 100 miles, or even 20 miles. It must be taken a short distance out of a town, and, therefore, the cheaper the method by which it could be converted into a portable manure the better. If by mixing it with ashes it could be taken out at a nominal price, that was far better than any expensive manipulation and evaporation. That was the decision at which men had arrived who had studied the question from all points of view. Of course, any town which took up one system was anxious to make it succeed and to look favourably upon it, but a man—like himself—who stood quite neutral, had a fairer opportunity of forming an impartial judgment.

Mr. Alderman Taylor said Professor Way had put the question as one of profit, but the word "profit," like the word theory, was misleading; it should rather be *least cost*. It was, however, a fact that they did send their manure more than 100 miles There was a farmer in Huntingdonshire, which he believed was over 100 miles from Rochdale, who for five or six years had sent for this manure and paid the carriage. It was also sent to Lincoln and Cheshire and other parts of the country. He had always said that their error was in having too weak a manure, and they had now made it stronger. A considerable portion of their urine was sold to manufacturers, and what they did not sell they proposed to manufacture, because they could get fuel without cost practically, and it would enable them to increase the strength of their manure to any reasonable extent, which might be seen on reference to the results of the experiments with Firman's machine, as stated in his paper.

Professor Way said he thought Alderman Taylor had shifted the matter from one point to another. If the manure were sent 200 miles for five or six years, he could only say he was sorry for the farmers who bought it,—it only showed that they were ignoring the question of principle. If one thing was plainer than another it was this, that the value of a manure depended on the ingredients in it, and at this moment so convinced was everybody except the manufacturers of cheap manure of this that all manures were bought on chemical analyses. Farmers would not buy unless they knew the analyses. If manures contained only 2 or 3 per cent. of ammonia, it was out of question that they could bear the cost of carriage for 100 miles with advantage to the farmer.

Mr. Alderman Taylor said the farmer he referred to had tried the manure and knew the value of it. He quite agreed that the value of a manure depended on the analysis, but Professor Voelcker said it did not, and put it on the question of what it would fetch in the market. If then manure was analysed at 25s., Dr. Voelcker said it was only worth 8s. or 15s., or whatever it might be. The only question was, was chemical analysis to be the foundation or not.

Professor Way said eventually it would.

Alderman Taylor said then their prices would go from 15s. up to £1.

Dr. Syson asked if he correctly understood Professor Way to say that the urine was the most valuable part of human excreta?

Professor Way said it was so.

Dr. Syson said that hardly appeared consistent in Professor Way's analyses, as quoted in Dr. Voelcker's paper, because it showed that the fæces contained a considerably larger proportion of ammonia.

Professor Way said there was much more urine passed in the 24 hours than solid fæces.

Dr. Syson did not see how that affected the question. If 100 parts of urine contained so much ammonia, 100 parts of fæces would contain so much more, and therefore must be more valuable.

Professor Way said this was an analysis, quoted by Dr. Voelcker made some 25 years ago, but that was of the fæces just as it was received from the body. Directly they were mixed with water or urine, the proportion of ammonia was considerably lessened. He was speaking of a practical question, and the urine of the two was the most valuable product when dried down. Taking the solid and liquid excrements without any kind of manipulation, four-fifths of the value of the whole would be found in the liquid.

Dr. Syson said in that case these analyses must be struck out. His own opinion was, the same as Professor Way's, that the liquid part was the most valuable, but according to this analysis the quantity of ammonia in urine was ·71 per cent., and in fæces 1·82 or 1·83, whilst the phosphoric acid in urine was ·040 and in fæces 1·07, therefore, in the chemical point of view, the urine was less valuable than the fæces.

Professor Way said they were talking of the practical value of the solid and liquid excrement, and also talking of them as the result when dried down. Now 100 parts of fæces contained less water, and consequently when brought to dryness would contain less nitrogen present than that which contained more water and less solid matter, because the nitrogen was in the small quantity of solid matter. There was 74 per cent. of water in fæces, and 97 per cent. in urine.

Dr. Syson said he only wished the apparent discrepancy to be explained.

Professor Way said there was no discrepancy; there were three or four pounds of urine voided per day by each individual, and only about half a pound of fæces, consequently the urine was much greater in quantity.

Dr. Syson said they were discussing its value, weight for weight.

Professor Way said weight for weight was not the practical point, because there was no weight for weight.

Dr. Syson asked if Professor Way had no experience as to the use of urine in the process of making the superphosphates, in other words, adding it to crude phosphates to convert them into superphosphates?

Professor Way said if that were proposed to any manufacturer he would say it was out of the question. You could not afford in making the manure to evaporate. In making superphosphate of lime, the acid was used of a strength that when mixed with the phosphate it became solidified; if the least evaporation were required, they could not meet the market.

Mr. Adam Scott said he would remind Professor Way that the manure he had been speaking of contained 7·48 per cent. of nitrogen, and 2·65 of phosphoric acid.

Professor Way said that was a concentrated manure, and if they could produce it at a reasonable price, of course it would bear the cost of carriage.

General Scott said it was very difficult to make calculations while one was speaking, but he would try to do so, as he thought Mr. Baldwin Latham was somewhat in error in the statements he had made with reference to evaporation. He was not prepared to say that evaporation was the proper plan of dealing with urinous liquids, but he thought Mr. Latham was wrong in his calculations respecting the value of the products obtainable by the process. In the first place the analysis to which he referred showed ·71 of ammonia per cent., instead of ·5, so that in 100 tons of liquid there would really be nearly three-quarters of a ton of ammonia. The coal was taken at £1 per ton, and it was said that 20 tons would be required to evaporate 100 tons of water, so that £20 would be the cost of evaporation, but from that would be produced three-quarters of a ton of ammonia, not sulphate of ammonia, but *ammonia*. Now he quite agreed with Professor Way that the whole value of a manure depended on the fertilising elements it contained, and he should like to ask him before proceeding what was the value of one ton of ammonia in a finished manure, that they might all be taking the same data to start from.

Professor Way said a ton of ammonia could be obtained in the form of sulphate, which was really the best indication of value, at the present time for about £70, sulphate of ammonia being worth about £17 per ton. But you could not boil down urine alone to dryness; you must add something to it.

General Scott said that was quite possible, but at present he was dealing solely with the question of the value of the ammonia to be got out of it, and taking a ton of ammonia to be worth £60 only (to be quite within the mark), three-fourths of a ton would be worth £45, and therefore, according to Mr. Latham's statement of the cost of the necessary fuel to evaporate 100 tons of urine, there was a margin of £25, instead of £5, to work upon, which was a very material consideration. As to the relative value of the urine and solid fæcal matter of a man, no doubt Professor Way was right in saying that the value in the urine was far greater than the value in the solid matter, always supposing that you could collect all the urine, but that was never done in practice. Alderman Taylor was not speaking of some 40 or 48 ounces of urine per man per diem, but of something like 16 ounces, and taking 100 tons of pail stuff, the solid fæces would amount to 20 tons, containing about five tons of solid matter, which Professor Way would allow to be worth £6 per ton. Supposing you could dry these fæcal matters, the value of such matter would be £30 for 100 tons of the compound. They had already seen that the value in 100 tons of urine would be something like £45, and as 100 tons of pail stuff contain only 80 tons of urine (the other 20 tons being solid fæces), the value of the ammonia of the urine in 100 tons of pail stuff did not exceed £36, so that really the value of the solid matter, as it was collected in the pail stuff, was not much less than that of the urine, and the total value obtainable out of the 100 tons of pail stuff was, on these data, £66.

Mr. Baldwin Latham said he had not been perhaps sufficiently explicit in the way he had stated it. It was quite correct that there was this amount of ammonia in the sewage, but there was something else as well; 100 tons of urine only contained three tons of sold matter, of which ·71, or not quite three-quarters of a ton, was ammonia, which was the only part which was of value. Taking that as £45, that was the value of the ammonia, plus the other matters which were in the urine, which were of no value or very little. The ammonia was degraded in value by admixture with inferior materials, and the whole, after allowing for loss, could not be valued, in his opinion, at more than £20, and in order to get this value, £20 worth of fuel must be used.

Mr. Towle said, early in the present century, he knew by experience the value of manures, for he was then in the habit of going into Nottingham with his father's waggon, and if they succeeded in emptying a midden and getting a waggon-load of stuff, and paying £1 for it, they were very glad; and their experience was that, if on one part of the farm they put this Nottingham manure, and on the other straw-yard manure, whilst in the latter case they had a very poor crop, in the former they often had to turn the sheep into it to keep it from being "proud," as they called it. It was not the case with them only, but all round the country the farmers competed with one another which should get the town manure. They knew nothing about ammonia in those days, or how many tons of nitrogen or ammonia there were in so many tons of manure; they only wanted to get hold of the stuff. At that time an extra quarter of wheat was worth from £8 to £10, and, therefore, it would pay for a load of manure if they could get a good crop. But now wheat was so much cheaper, manuring did not pay so well. His opinion was that the sewage ought not to be run into long main sewers, which might poison a whole town in one night, but ought to be collected in one continuous drain, and pumped up to a great height, and thrown on to the land, which he found, from the report of the Commissioners, was a plan now being adopted in Berlin.

Mr. Adam Scott said it might be assumed, from what Mr. Latham had said, that it was impossible to evaporate manure except at the rate of 20 tons of coal for every 100 tons of manure. But this was not so, for at Dordrecht one pound of coal evaporated ten pounds of water out of urine. That was done in connection with Captain Liernur's process; but he had a letter from Mr. Duncan, an eminent sugar refiner in the City, who showed that, by the use of a vacuum, they could evaporate as much as 14 lbs. of water with every pound of coal from a mucilaginous mass like sugar, which had very much the same consistency as manure.

Mr. Gilbert Redgrave said he understood Mr. Latham to say that, according to the analysis which they had been talking of on page 37, in three tons of dry solid matter there would only be ·71 parts of valuable fertilisers; and, therefore, these three tons would be worth only the ⅓rd of the value of that ·71 per cent., so that the three tons would be worth £15; and Mr. Latham summed up by saying for £20 of coal you only get £15 worth of manure. But you got really three tons of manure, worth £15 a ton; and, therefore, you still got £45 worth. But there again he was taking a wrong conclusion, because in that three tons of manure there was not only the ammonia, worth at a low estimate £45, but also the phosphoric acid, alkaline salts, and potash; and if Professor Way would kindly add up the value of these salts in a finished manure, he believed he would find that, instead of the manure being worth £15 a ton, it would be worth more likely £20; therefore, taking only the question of coal, for £20 worth you produced £60 worth of manure. But that was not the real point. The fact was, it was being done, and was carried out at a profit. He had himself seen a factory in Paris where, every week, ammoniacal liquor was being distilled in a coffee still, and sulphate of ammonia was being made. The sulphuric acid used in the process could be got cheaper here than in France; but it was found there to be a paying process. It might be there was great neglect in not collecting and utilising the urine, for he certainly thought it could be made to pay; and the evaporation of pail stuff, if it could be done without offence, might also be profitable, but not so much so as boiling down pure urine. The manufacturer he spoke of was paying the City of Paris 10 centimes per cubic metre for this weak ammoniacal liquor, and, by making from it sulphate of ammonia, was earning a profit of 25 centimes on every cubic metre. That was apparently very small, but it was sufficient to pay for wear and tear of machinery, and all expenses, and he was quite willing to treat a much larger quantity if he could get it. If, therefore, liquor containing only ·2 per cent. of ammonia could be distilled successfully, other modes of obtaining valuable salts from concentrated excreta hold out still better prospects of success.

Mr. Latham said that the whole quantity would be worth £45, if you merely valued the ammonia, and assumed that you got out of every 100 tons of urine ·71 tons of ammonia. When, however, ammonia was mixed with a perfectly valueless article, say sand, you had a larger quantity of the same theoretical value in the bulk, but practically of very little value.

The Chairman said this discussion was very interesting, but he must now call on Dr. Wright to give the statistics of the health of Cheltenham, and they would then take up the question of sewer-gas.

Dr. Wright said that he was able to give a very satisfactory report as to the death-rate from fever in Cheltenham; in fact, it was the town of all others most free from fever. He had practised there for 42 years, amongst all classes of society, having been 15 years one of the dispensary surgeons, and 20 years hospital surgeon, and, therefore, he knew the inner life of the place as well as any man living. A town more free from noxious diseases did not exist. In 1876, the deaths from enteric fever numbered ten, namely, four under five years of age and six above five; and there were only five cases from simple continued fever. He gathered from the report at Whitehall that morning, that there was a slight disparity between his figures and the return of the Registrar-General, but that arose in this way, that when persons went to register a death they sometimes registered a case of scarlet fever simply as fever, and thus it got into the wrong column. He at once found there were five cases of that kind, which made the return of deaths from fever more than it was in his report.

Dr. Wilson said he drew attention to this point from the fact that the Registrar-General, in his third report last year, spoke of Cheltenham as having a death-rate of over one per thousand from fevers, excluding scarlet fever, of which he believed there had been a severe epidemic.

Dr. Wright said that was quite true; scarlet fever was an epidemic which did not depend on sewer-gas, although an unhealthy district would greatly tend to propagate the disease, and would probably convert simple cases into complicated ones. Sewer-gas, however, would not develop scarlet fever, but it would typhoid fever; and, therefore, in a sanitary point of view, it was important to keep the distinction in mind. The deaths in Cheltenham during the whole year, according to the Registrar-General's report, were 21 from typhoid fever, and that was in a population of 42,000, which was a very small proportion indeed. The deaths from scarlet fever were much more excessive than they need have been, entirely arising from the condition of the school attendance, and the great neglect on the part of managers of the schools in not separating the sick from the sound.

Mr. Hempson Denham (Southsea) asked if Dr. Wright could give the number of cases of enteric fever, as well as deaths?

Dr. Wright said he could give the returns of scarlet fever cases, which had been returned to him from the district medical officers of the Board of Guardians, and also of those attended by the dispensary officers, and the public institutions of the town. Of course he could not give any returns of those which occurred in private practice. The scarlatina cases were—deaths under five years of age, 63; and above five years, 33; making a total of 96. The cases of scarlatina attended by district medical officers were 69 of children under five, and 94 in children of five and upwards. The cases attended by the dispensaries were 106 under five, and 65 above five. He got those cases with a great deal of trouble from the Board of Guardians and the medical institutions. He could not give the cases of enteric fever, but very few occurred in the practice of the district medical officers, and none were registered; only two were registered among the dispensaries. Enteric fever was a very rare disease in the town; it generally occurred in houses where there had been some imperfect condition of the sewers, and in the practice of private practitioners, so that there was no regular record of it. They had the deaths, but not the cases of sickness.

The Chairman said it was now time to take up the question of "Sewage Gas in Dwellings," and called on Mr. Rogers Field to open the discussion.

Mr. Rogers Field said a great deal of what he had to state might appear very elementary; but he brought it forward purposely, because the more he worked on this subject the more he was impressed with the great amount of misconception that prevailed, and convinced that the only way in which progress could be made was to clear up these misconceptions, and get the right principles fully understood. He then proceeded to explain at greater length the various points indicated in his printed paper, which he illustrated by large diagrams, showing the ordinary method of direct connection between sinks and closets with the sewers, and also the system of "disconnection" which he recommended. He dwelt especially upon the fact that sewage gas passed through the water in ordinary traps imperceptibly, being absorbed on one side of the trapping water and given off on the other, as he had proved practically to be the case both at Uppingham and elsewhere. It was, therefore, quite a mistake to suppose that water-traps of themselves were a sufficient security against the escape of sewage gases into houses. The only reliable method was to sever the direct connection between the sewer and the house. This severance of direct connection should extend to water-closets as well as to sinks, baths, &c., and he especially recommended the plan of disconnection shown in one of the diagrams, in which there was a large manhole outside of the house, and in this the drain was fully exposed to view. An additional precaution, very desirable where the drains run underneath the house, was to have a similar manhole at the back, and if the drain were then once made thoroughly good it would never be necessary to disturb it again, because its condition could always be seen, and any stoppage or defect remedied. The plans of disconnecting soil-pipes which he proposed could not be said to be novel, because he found that Professor James Thomson, of Glasgow, had carried out a somewhat similar arrangement ten years ago, and explained it in a public lecture. It must not be supposed, however, that disconnection would cure all the evils of bad drainage. If the internal arrangements were faulty, these must be remedied. In illustration of this, he explained the evils of the common "pan" closet and D-trap generally in use, which he altogether condemned. Lastly, he referred to the bye-laws which had been made at Uppingham with regard to house-drainage, and said that their publication had already produced a marked improvement in the drainage of the houses in that town.

Dr. Thorne Thorne (Medical Inspector to the Local Government Board) said he desired to bear testimony to the extreme value of the points brought forward by Mr. Field. The details were comparatively trivial, but he was convinced that the principles embodied were of extreme importance to the health of the towns. On looking through the report, he found in numerous instances that sanitary authorities were taking some credit to themselves, because they had put up ventilators to ventilate the house drains, but the usual plan adopted was to put a pipe, often unfortunately far too small, and this again very often took so circuitous a route before it got to the top of the house, that little or no air would pass up it; and even granted that the foul air did pass up, the construction of such a ventilator was not always an unmixed good. He knew of one house where, by the upward prolongation of the soil-pipe, one was put up, and when he went to the top of the house he found, to his amazement, a perfect torrent of most fetid air coming up it. In this instance the soil pipe was enclosed in a wooden casing inside the house, and as it was well known that soil pipes at times decayed and became almost as thin as tissue paper, it often happened that the foul air flowing up them passed into the house itself. The action of this ventilating pipe, therefore, was to carry a large volume of foul air all through the house, and out through the top; but if there was any defect in the pipe, it might, by escaping into the house, do far more harm than good. Very frequently, the house drains, especially in London, went under the house, and were no more air-tight than they were water-tight, and in such cases the soil beneath the houses gradually became charged with foul air. But if the means of disconnection referred to were introduced, the house would be made perfectly sweet. The present arrangements for laying on the foul air into the house were very similar to that by which coal gas was laid on for the purpose of illumination, except that in the latter case you had taps which were tolerably secure, whereas the traps at the end of the drains were very inefficient. The point he wished specially to mention was this; he had doubted whether the foul air would not pass up the ventilating shaft recommended by Mr. Field, which generally in London opened in an area just underneath the kitchen windows; but on examining several which had been in existence for years, and were put in by common builders, he had never found any smell. Mr. Field said he believed the cases of a bad smell from this cause were more imaginary than real, but he was convinced that they were absolutely imaginary, and perfectly unreal. He had placed a light at the opening, on the surface of the ground, and found that it was an influx for pure air, so that, where the sewer passed underneath the house, you now got a current of fresh air passing through it; and this showed the value of having the ventilating pipe of large diameter. Having talked the matter over with Mr. Rogers Field, he went with him and inspected the man-hole system, and was himself shut up in one of these man-holes for some time. He went there at a time of the day when the sewers were probably the most foul, namely, between ten and eleven in the morning, when the house drains would have received a large amount of sewage, and all the slops thrown down by the housemaid; and he could assure the meeting, that anyone entering one of these cavities blindfold would have no conception that he was within a hundred miles of a sewer, for the air was much better than it was in that room yesterday afternoon. In that manner the interior of the house was absolutely separated from the sewer, and so far one might defy any amount of poisonous excreta flowing down the drains.

Mr. Hempson Denham asked how Dr. Thorne accounted for the downward pressure in the ventilating shaft, and the upward current in the long pipe?

Dr. Thorne said he could not explain it, except that perhaps the air was warmer in the house drains than the atmospheric air. He asked leave to say one word on a matter which he ought to have mentioned yesterday. It was several times inferred incidentally that slop-water might be considered different to sewage with excreta in it, and might be dealt with differently. He was convinced, however, from what he had seen, that we had no right to look upon slop-water as different from sewage, and the time when the so-called slop-water was most likely to be dangerous was precisely the time when we ought to avoid confounding the two, namely, when disease was prevalent. To show the importance of this, he might mention a case within his own experience. He was sent by the Local Government Board into the North of England to inquire into a very sudden outbreak of typhoid fever; it was in a square of houses, two-thirds of which were affected, two-thirds of the inmates also being down with the disease. There had been no previous typhoid fever in the square, which had an absolutely independent system of drainage, having no connection with any other houses. It was perfectly clear that the outbreak was not due to the water supply, and for some time he was completely baffled; but he found out afterwards that a man had had typhoid fever at some considerable distance, and some kind neighbour, who had a little wash-house in this square, had washed some of the linen. The linen was very much soiled by his extremely liquid evacuations, he having been in a state of insensibility; they had been wrung out, and it was supposed the exceeding foulness had been washed off. They were then sent to this place and washed, the slop-water ran down into the drain which ran right round this square, and within 14 days of this so-called slop-water passing into the drain the whole place was down with typhoid fever. It was especially, therefore, when cholera, typhoid fever, and infantile diarrhœa were prevalent, that there ought to be no difference made between slop-water and sewage. That might be said to be an argument in favour of the water-carriage system, but he did not think so at all. It was frequently said—If you have the dry system, you must have sewers also. But he would reply to that—If you have a water system, you must still have scavenging. It was only a question which way the solid excrement was to go—with the scavenging, or with the slops.

Lord Alfred Churchill said he had recently altered his own house at Rutland-gate to the system described by Mr. Field. Originally, there were the old-fashioned arrangements, and the smell was frequently most offensive, particularly in the basement. It was now altered very much as Mr. Field described, with a ventilating pipe 3 in. in diameter; but the soil-pipe was trapped at the bottom before it went into the drain, so that there was no pressure of gas within the main which could force its way readily through. He should, however, adopt a second ventilating shaft behind the house, so as to have a free current of air underneath.

Dr. Thorne said he had forgotten to mention that in the square of houses he had been referring to every house was in direct communication with the drains by means of the sink pipes.

Mr. Humphris said it was necessary to take the greatest possible care to put any traps in the main drain from the houses where they were readily accessible. In the diagram shown by Mr. Field, the trap could be easily cleared out; but unless this were carefully provided for, it was better to omit the trap altogether, because it might be stopped up.

Dr. Vacher (Birkenhead) said a system very similar to that now described was advocated long ago by Professor Reynolds, where the close pipe rose perpendicularly from the bend, by which means the trap could be readily flushed and cleansed, and he thought that rather an improvement.

Dr. Syson also thought it better to have the ventilating shaft over the trap. Professor Reynolds, in 1872, proposed a plan by which he did away with all traps inside houses, and even with the water-closet trap itself, because even that might become a nuisance. He had heard some rather peculiar pneumatic experiences as to the current which went in at the opening and up the ventilating pipe, and he thought, generally speaking, the current would be downwards rather than upwards; at any rate, to make it perfect, there ought to be an extractor at the top, which would insure a current of fresh air always passing up. Professor Reynolds, in his book, which was published by Macmillan, said that in the normal state of things the air was coming down the ventilator, and going into the house, because the air being warmer there sucked it in. He observed that the drainage and ventilation of the cellar was not shown in the diagram, probably because it would have been rather awkward to do so. If he was not mistaken, Dr. Parkes, in connection with Dr. Burdon Sanderson, some time ago, made some experiments at Liverpool, and found in all cases that the current of air through those ventilating pipes went into the sewer instead of from the sewer upwards; and therefore, to make the system safe, it would be necessary to have a cowl at the top, otherwise it would be quite possible with such a system as was shown by diagram No. 4 to get some gas into the house. It was unnecessary to dilate on the evils of sewer-gas, but the suggestions about bye-laws, he thought, were very valuable. But as far as his experience went, however, they wanted power given them by Parliament to make bye-laws, because it was with the most extreme difficulty you could make any bye-law to meet the case of existing houses. They wanted a national building Act, which should deal with such simple questions as those of drainage, because by attending to these matters, typhoid or drain fever might practically be shut out of out houses. It was something like the irony of fate that those engineers who had laid on sewer-gas to houses for some years, now came forward to teach people how to cut it off.

Mr. Ainley (Medical Officer of Halifax) said he had been for five years engaged in this work, and he thought the question really was how to keep the gas out of the house. It must go somewhere. It was not quite clear to him whether the air came down the main pipe or down the other one, but certainly the gas was in the sewer, and must get out somewhere. In Halifax, for some years, they had adopted a plan called the Stock system of extraction, which consisted in connecting the main sewers with the boiler fire of a furnace. Of course this could not be applied in villages, but in large towns, where there were numerous factories, it might be easily effected. There was an air-tight connection between the sewer and the furnace and the fire, and during the working hours of the day there was a constant draught from the main sewer, taking off the pressure. He had frequently measured the amount of air going through, and found about 1,000 feet per minute pass through the fire. Whenever they had any complaints of bad smells in any particular neighbourhood, they immediately put in one of these ventilators, connecting the sewers and the furnace, and the smell was entirely removed. At night, when the damper was down, it did not act so freely, but still there was always enough draught to keep the fire burning. He had generally found with all these systems that the fault was not so much in the the plan as in the mode in which it was carried out, especially in the connections of the pipes underneath the houses, which were generally made in the most slovenly manner. He thought outlets in the streets were sources of danger, for they had traced a great deal of scarlet fever to children playing about these outlets.

MISCELLANEOUS.

MEDICAL RELIEF IN THE METROPOLIS.

By Sir Charles E. Trevelyan, Bart., K.C.B.

A meeting, under the auspices of the Charity Organisation Society, was held in the Great Room of the Society of Arts, on the 17th of April. Amongst those present were **Dr. Acland**, Regius Professor of Medicine at Oxford, and President of the Council of Medical Education, who presided; Earl Stanhope, Lord Dunsany, Sir William Gull, Sir Rutherford Alcock, Sir Douglas Forsyth, Sir Graham Briggs, Sir Joseph Fayrer, Mr. Prescott Hewett, Mr. Erichsen, Mr. Ernest Hart, Dr. Fairlie Clarke, Dr. West, Dr. J. H. Bridges, Dr. A. P. Stewart, Mr. T. Holmes, Dr. Guy, Dr. R. J. Lee, Mr. A. H. Hill, the Hon. Reginald Capel, Mr. Jabez Hogg, Mr. R. Brudenell Carter, Mr. Andrew Johnston, Mr. Hamilton Hoare, Mr. F. D. Mocatta, Mr. Meysey Clive, Mr. Acland, Lady Trevelyan, Miss Florence Hill, Mr. G. A. Spottiswoode, Mr. Hansard, Mr. Courtenay Boyle, the Rev. M. F. Kitto, the Rev. R. J. Simpson, the Rev. J. D. McGachen, Dr. Langdon Down, Mr. W. M. Wilkinson, Mr. Danby Fry, and fifty-seven others. The paper was as follows:—

The radial lines of the metropolitan police district, drawn from twelve to fifteen miles round Charing-cross, include a population of upwards of four millions. Of these, upwards of one million, or one-fourth, receive gratuitous medical treatment, and in the inner circle of London, where free dispensaries and out-patient departments of hospitals abound, the proportion so assisted is still larger. It may be said, without exaggeration, that in the interior of London, including its great eastern and southern quarters, nearly all below the middle class, and some even of them, are provided with medical attendance and medicines by private charity, with some assistance from the Poor-law. This is the central fact from which many unfortunate results naturally flow.

The main object of securing proper medical treatment for the working classes, who form the majority of our people, has not been, and never can be, attained in this way. A vast population is encouraged to throw itself for medical aid on a few central points. Hence overcrowded waiting-rooms; the exhaustion of the strength of the patients by delay; mutual infection among large numbers of persons brought into close contact in a susceptible state; the vitiation of the air of the hospitals themselves; and, more than all, the mockery of medical relief, owing to the impossibility of giving sufficient time to each case. This last result is so widely and painfully known, that I forbear to dwell upon it. The main characteristic of this system of medical relief is that our population is dealt with gregariously, instead of being broken into manageable groups, or, best of all, treated separately at their own homes.

The next result is a great misdirection and waste of charitable funds. Dr. Meadows, and five other medical men, experienced in the work of London hospitals, recorded their opinion, in 1870, that "the probable income of half the number of out-patients may be estimated at from £1 to £1 10s. per week, and of one-fourth at more than this." In 1874 a thorough investigation was made into the social position of out-patients of the Royal Free Hospital, and they were reported to be divisible into two sections: 1st, those who might reasonably be expected to pay something for their medical relief; and, 2ndly, those who ought to be referred to the Poor-law. This abuse of medical charity is largely promoted by the practice of issuing subscribers' letters, which are too often distributed without proper inquiry, or given avowedly as a matter of personal favour; and many employers contribute to hospitals with the object of providing medical assistance for their servants and workmen at a cheap rate, so that men with two or three pounds a week expect to be furnished with "letters" to the neighbouring institutions for themselves and their families, and are thus relieved from the necessity of joining benefit societies and provident dispensaries. This is the true explanation of the lamentable appeals constantly made to save our medical institutions from insolvency. No funds that could be subscribed would overtake the emergency, because the gratuitous medical treatment of the entire working-class, and of a considerable margin of the lower middle-class, is a greater burden than private charity can bear, and the pressure is continually on the increase, as additional numbers become habituated to dependence.

To hundreds of thousands this system of medical relief is the entrance-gate to those habits of dependence for which our London population is unhappily distinguished beyond the rest of their countrymen. Everyone stands in need of medical assistance at some time or other, while in family life it is a matter of frequent recurrence, so that, by the general application of the eleemosynary principle to our London hospitals and dispensaries, they have been converted into schools of pauperism. Our people are educated by them into improvident and mendicant habits, being entirely relieved, as regards this requirement of civilised life, from all necessity for forethought and thrift. Subscribers' letters are specially conducive to fraudulent mendicancy. Women collect them by begging from house to house, under pretence of wanting them for their own use; they beg at other houses on the evidence of the distress which the "letters" are supposed to afford; and, after all, they sell them, for they have a marketable value, which ought to go in aid of the expenses of the institutions. All the arts of deception flourish in connection with misapplied charity. Mr. W. H. Smith stated that 20 per cent. of cases selected by him for investigation, from among the out-patients at a large hospital, "had given false addresses, so that it was impossible to trace them."

The last evil result of this system to which I shall allude is that it deprives the medical profession of its just and necessary remuneration. Medical men are expected to do, at hospitals and dispensaries, an amount of unpaid work unknown in any other profession, although the majority of the persons gratuitously treated are perfectly able to pay a moderate charge. Both ways, therefore, medical practitioners suffer. A totally disproportionate share of the burden of public charity is thrown upon professional persons dependent for their subsistence upon the exercise of the skill derived from an expensive education; and, by the same arrangement, they are deprived of a large portion of the practice which would otherwise fall to to them. The depression of this important profession reacts to the detriment of the public in many ways. Unpaid labour, or labour which is all but unpaid, is sure, in the long run, to be badly done. Compare the slipshod work of the out-patient departments, at the rate of a minute a patient, with the careful manner in which medical men see their patients at home, at the rate of five or six an hour at the outside. In poor and densely-populated districts, where medical aid is most needed, the weakness of the eleemosynary system has been made apparent by the absence of an adequate supply of well-qualified practitioners, and by a growing disinclination to accept appointments in free dispensaries. No expenditure is grudged to give our military officers a fair day's pay for a fair day's work; and the national interests are certainly not less concerned in maintaining the professors of the healing art in proper efficiency.

But this part of the subject has deeper roots than I have now time to trace; and those who wish to pursue it further would do well to read a paper in the *Medico Chirurgical Review*, entitled "The Limits of Unpai Service." It will there be seen that this is not merel a question of professional remuneration, but also of social position, and of the spirit with which the exigencies of a life of duty among the suffering poor may be expected to be faced.

The first combined effort to remedy this state of things dates from March, 1870. At a meeting presided over by the late Sir William Fergusson, at which 156 members of the medical profession were present, the following resolutions were passed:—

"That this meeting is of opinion that there exists a great and increasing abuse of outdoor relief at the various hospitals and dispensaries of the metropolis which urgently requires a remedy;" and "That, in the opinion of this meeting, the evils inseparable from the system of gratuitous medical relief administered at the outdoor department of hospitals and in free dispensaries can be in great measure met by the establishment, on a large scale, of provident dispensaries, not only in the metropolis, but throughout the kingdom, and by improved administration of Poor-law medical relief."

A large committee was then appointed, which apportioned the subject among four strong sub-committees on General Hospitals, Special Hospitals, Dispensaries, and Poor-law Medical Relief, of which Dr. Meadows, Dr. J. E. Pollock, Dr. Stewart, and Mr. Spencer Wells were respectively chairmen. These sub-committees thoroughly sifted their several branches of the subject, and made reports, to which I shall frequently have occasion to allude.

The next move was made by a society which, having for its object the improvement of the permanent condition of the poor, soon came to the conclusion that one of the most powerful of the causes by which their condition had been depressed was this system of gratuitous indiscriminate medical relief, and that every other arrangement for their benefit must fail in producing its full effect while this evil remained unremedied. In March, 1871, the Council of the Charity Organisation Society appointed a committee to act as their advisers in all that relates to medical relief. In the following October this committee made a report, pointing to "a large development of the provident principle" as the appropriate remedy for the abuses of the medical charities, and submitting model rules for the management of provident dispensaries based upon the experience of those institutions; and in December a conference was held, presided over by Mr. W. H. Smith, and attended by Mr. Stansfeld, President of the Local Government Board, Lord Josceline Percy, Dr. Acland, Dr. Guy, Mr. T. Holmes, Dr. Meadows, Dr. Fairlie Clarke, the Rev. Harry Jones, Mr. Gurney Hoare, and many others, at which the resolutions come to in the preceding year by the professional committee were discussed in the enlarged point of view of the Charity Organisation Society, and re-affirmed.

In April, 1875, the following memorial was presented to the President and committee of the British Medical Association, with the names of 303 members of the profession, of whom 195 were from London, and 108 from the country. Of the metropolitan practitioners, 92 were connected with hospitals, and 103 were general practitioners, many of whom held dispensary appointments. Among the former were Sir William Fergusson, Sir William Jenner, Sir William Gull, Sir Rutherford Alcock, Mr. Prescott Hewett, Mr. Erichsen, and other leading men in the profession:—"To the President and Committee of Council of the British Medical Association. —We, the undersigned, members of the British Medical Association, and others, beg most respectfully to request the Committee of Council to take into its consideration the relation of the medical profession to the hospitals and free dispensaries throughout the kingbom. Your memorialists are convinced that the manner in which these institutions (with some few exceptions) are at present conducted inflicts a serious injury upon many most deserving members of our profession; while the indiscriminate (or almost indiscriminate) bestowal of gratuitous medical relief upon all applicants lowers the whole scale of our professional remuneration, it is far from being a real boon to the working classes themselves, and cannot fail, in the long run, to have a prejudicial influence upon the nation at large. The question to which we venture to draw the attention of the Committee of Council has been much discussed, of late years, both in the medical press and in the lay periodicals. It is not necessary, therefore, that we should enter into any details respecting it. We may, however, mention that there are three facts which have a very important bearing upon it, and which make the present time particularly opportune for entertaining it. These are :—1. The improvement which is now rapidly taking place in the social and political condition of the industrial classes; 2. The amendments which have lately been made in the administration of parochial medical relief; and 3. The increase, within the last few years, in the length and expense of medical education. These facts are admitted by all; and their concurrence has led, we believe, to a very general opinion among those who are conversant with the working of the free dispensaries and hospitals, that some changes are necessary, in order to bring these institutions into harmony with the altered conditions of the present day. As it is desirable that any changes which may be necessary should be duly weighed by a body which fairly represents the medical profession, and should be recommended by high authority, so as to carry allong with them the assent of the lay governors of the 'medical charities,' your memorialists pray you to take this important subject into your consideration."

The presentation of this memorial was followed by correspondence. A decided expression of opinion from a body so largely representing the professsion as the British Medical Association would have great influence; but the matter has got beyond the stage of inquiry and report, and, as the ablest medical men have least leisure, and lay managers are sensitive about interference with their rights, I cannot advise any proceedings which would provoke the extreme advocates on both sides to further controversy and delay. The governing bodies of the different institutions, lay and professional, have been sufficiently informed by the discussion, which has been going on all round the field since 1870, and I had rather trust to the unimpeded action of their sense of responsibility than to any external official pressure. The subscribers to the charities, who hold the purse strings, have also, to some extent, become sensible of their responsibility. We are now in the seventh year since Sir William Fergusson's committee, and the public interest in the question has never flagged during this long interval. Public opinion is far in advance of the point from which we commenced, and solid material progress has been made, although it has been of a varied and desultory kind. Evidently the time has arrived for reviewing our position, and making a fresh departure upon a well-understood plan.

The out-patient department of St. George's Hospital has been placed upon a footing which allows of three provident dispensaries being successfully carried on in its immediate neighbourhood, besides a fourth which is in course of formation at Brompton. In the words of their report for 1875, "in 1868 the whole of the out-patient department was made free, and this has enabled the executive to exercise much more control over the admission of applicants than when they brought governors' letters, when it was difficult, under such circumstances, to refuse any." On each of the four ordinary out-patient days, forty new cases—twenty medical, and twenty surgical—are admitted by the resident medical officer, after which their names, addresses, occupations, and any other information that may be required as to their social position, are given; and the secretary freely avails himself of the assistance of the Charity Organisation Society, should there be any doubt as to their being suitable objects of charity. The cases admitted are, therefore, limited to the number which can be effectually dealt with; and they are selected with due reference both to the nature of the professional aid intended to be given at hospitals, and to the means of applicants, care being taken that no really urgent case is rejected. Students assist at the out-patient work, which is considered a valuable part of the hospital teaching. The number of out-patients in 1876 was as follows :—

Ordinary out-patients	7,398
Eye patients	790
Aural	294
Orthopædic	346
From in-patients	171
Dental	1,448
Casualties	4,216
	14,663

The two last are exempted from the rule which requires information to be given as to name, occupation, &c. Arrangements have been made on the same principle at King's College Hospital, by the appointment of a registrar to classify the out-patients and refer doubtful cases to the Charity Organisation Society, and although the number admitted has not been subjected to any fixed limit, it has diminished, under the influence of this revision, from 33,866 cases in 1873 to 21,347 in 1876. In the words of the report, "the whole of these alterations have been carried into effect, to the manifest increase of the comfort of the patients, and the good order of the department." At the general hospitals in the East and South of London, a different principle is apparent from the numbers admitted, which were, according to the last published reports :—

St. Bartholomew's Hospital	137,318
London	40,717
Metropolitan Free	39,968
Guy's	75,804
St. Thomas'	61,824
	355,631

the in-patients in the same year (1875) having been only 21,370. No provident dispensary is possible in the districts under the influence of these institutions.

The special hospitals have, to a great extent, acted upon the recommendation of Sir William Fergusson's sub-committee, "that all patients who can afford it should contribute to the support of the hospital. The sub-committee think that if this plan were carried out, advantage would accrue to the general practitioners, for, the attendance of out-patients at hospitals being lessened, such patients would find their way to the various medical men in the neighbourhood." While these hospitals are entirely free to the necessitous poor, a large proportion of them receive, in some form or other, payments from patients who, although they cannot afford the usual professional fees, are above the necessity of purely gratuitous aid. In this way only could such a large amount of truly charitable work have been done, both for those who could, and those who could not, pay something, and that without injury to the independence and self-respect of the patients. The district committees of the Charity Organisation Society give all the assistance in their power to special as well as to general hospitals; but, that difficulties may not arise from the investigation being carried further than is necessary in hospital cases, the inquiries are limited to—1st, the amount of the applicant's income; 2nd, the number and ages of the family dependent on the applicant; and, 3rd, whether the applicant is in receipt of Poor-law relief.

The pressure upon the out-patient department of the Ormond-street Children's Hospital, and the certainty that a large proportion of the applicants were not suitable objects of gratuitous relief, induced the managing committee to arrange with our society that they should not be admitted to a second visit until their letters had been stamped by the organisation committee of their district. Upon this it soon became apparent that more than half belonged to the large intermediate class between those who can pay the usual professional fees and the necessitous poor; and that, although willing to make a moderate payment according to their means, they did not like to be treated as objects of charity, or to incur the inconvenience and waste of time caused by inquiries into their circumstances. The scheme finally proposed by our medical committee is, that those who are willing to make a small payment should be admitted at once, but that those who claim gratuitous relief should have their means investigated before they are seen a second time. In other words, that an alternative should be offered—payment or inquiry. So numerous are the claims upon the charity of the public in the present day, that institutions which have made arrangements for giving only to those who are really in need certainly ought to be preferred to those which give without discrimination.

We now come to provident dispensaries, the increase of which, in due proportion to the population, is the key to the solution of the complex problem before us. The first conclusion arrived at by Sir William Fergusson's sub-committee was:—"That a very large proportion of the out-patients of general hospitals (variously estimated at from three-fifths, to nine-tenths of the whole) consists of trivial cases which do not require any special skill, and might be properly left in the hands of ordinary medical men. An inordinate number of trivial cases wastes the time of the consultee, wearies the attention of the students, and fosters a habit of hasty diagnosis and careless observation, which tend to erroneous and ineffective treatment. In fact, out-patient work, as generally conducted, neither conduces to the sound advancement of professional knowledge, nor to the advantage either of the students or the public. And, bearing in mind that the staff consists exclusively of consultees, and that clinical teaching is one of the most important advantages derived by the public and the profession from the institution of public hospitals, the sub-committee are of opinion that some special claim ought to be made out for perfect gratuitous hospital advice, such as sudden emergency, surgical requirements, long-continued ineffective treatment, peculiar, obscure, and complicated disease, unforeseen and unavoidable distress, or some other special cause, making it desirable that the attention of a consultee should be given to the case. . . . . As the hospital staff consists of consultees, not general practitioners, it is only consistent that their services should be asked for chiefly in cases of peculiar difficulty, prolonged anxiety, deep professional interest, &c., and it is altogether unreasonable to call upon them to treat case after case for many hours together, without, it may be, the occurrence of any single point of interest. . . . . The sub-committee therefore believe that the foundation of a series of provident dispensaries is a necessary condition of any improvement in the out-patient department of our public hospitals. The law has, in their opinion, amply provided for the careless and improvident, and the funds contributed by the benevolent should be given in preference to the assistance of those who are inclined to help themselves."

The real question, therefore, is how to provide for the ordinary medical treatment of the lower middle and working class. The hospitals will always be open to serious and difficult cases, but these bear a small proportion to the everyday class of trivial ailments (including those of women and children) which must be properly attended to if our population is to be maintained at a high average of health. The first condition of success is that the payments should be suited to the circumstances of the patients. The slender resources of a working man are soon broken down by "doctors' bills," but there are few who cannot afford a small continuous payment made from month to month on the principle of mutual assurance. For this each family obtains, not as an act of charity, but by right, medical attendance and medicines at their district dispensary, or, if need be, at their own home; and they also have the privilege of selecting their own medical attendant from among the officers of the dispensary. Not the least advantage of this system is that the homes of the people are brought by it into just prominence. Much has been said of late years about the salutary influence of a trained nurse upon a working-class *ménage.* The practised eye of a well-instructed medical officer from the district provident dispensary, in the numerous cases better treated at home than in any institution, would not be less efficacious, and, besides giving useful support to the nurses, would much promote the object we all have at heart, of providing improved dwellings for the working class. The advantage to medical men is, that there are no bad debts, and no small bills to collect, all the payments being made in advance, not to the doctor directly, but to the secretary; and that all the patients who are well enough are seen at the dispensary, where the medicines are provided. If the mass of our people are to obtain willing service from highly educated men, the conditions must be adjusted to the feelings and habits of the practitioners, as well as to those of the patients.

Provident dispensaries are impossible in the interior of London, in the face of unlimited gratuitous relief at the out-patient departments of hospitals and at free dispensaries; but it will be seen, from the statement prepared by Dr. Ford Anderson, that they have made considerable progress in the suburbs, where such competition is felt in a minor degree. Of the twenty-seven provident dispensaries now existing within the Metropolitan Police District, fifteen have been established, or converted from being free dispensaries, since Sir William Fergusson's committee.

It is agreed on all hands that the ordinary medical treatment of the destitute should be left to the Poor-law authorities. This has of late years been greatly improved in the metropolitan district. Indoor medical relief is now based upon a system of separate infirmaries, which are really well-appointed hospitals under suitable regulations, having each its staff of infirmary officers and trained nurses. When the bread-winner, or any member of his family, becomes disabled by sickness, the quickest way of being restored to health and the power of self-support, is to go into the infirmary for the necessary time. Outdoor medical relief, although curtailed of some of its abuses, is still given on the same liberal terms as before, including not only medical advice and medicine, but also a liberal diet for the support or restoration of the health of the patient; and it has been reinforced by the establishment of fifty-seven Poor-law dispensaries, at which patients and medical officers meet to give and receive the benefits provided. This action of the Poor-law authorities has greatly facilitated the reform of the entire system of medical relief; for, as the upper and middle classes take care of themselves, while the lowest class is now satisfactorily cared for by the Poor-law, the question has been narrowed to the working class, who can all contribute something towards a common purse for their medical treatment.

All who desired the reform of this vast system of medical relief looked forward with hope to the Hospital Sunday Council. The funds already available for medical relief, including the vast resources of the endowed hospitals, were more than sufficient if they were properly applied and properly reinforced by payments from patients well able to pay; and in this central representative body, armed with the power of the purse, an authority was recognised capable of restoring the financial equilibrium by suitable administrative arrangements. These hopes have not been realised. The grants made by the Council are based upon the average expenditure of each institution for the last three years after making certain deductions, with this important reserve, that the merits and needs of each institution are to be fully inquired into, and the award is to be determined according to the judgment of the Distribution Committee upon them; but this great influence has not been used to induce the institutions to act in concert upon a well-arranged plan, without which there can be no general improvement in the system of medical relief.

On two points the action of the Council has been distinctly retrogressive. One of Sir William Fergusson's sub-committees reported that "the system of admission by governors' and subscribers' letters is radically wrong as regards out-patients, and ought to be abolished. This practice is one of the chief sources of hospital abuse." And another remarked, "There is often a difficulty in the poor procuring a letter of recommendation; and, besides, when obtained, it is generally after many hours spent in walking, which may materially increase their malady, and hinder that very recovery they are striving to secure." A great extension was given to this practice by the distribution of letters by the Council in proportion to the amounts collected by them, which has been only partially corrected by limiting the letters to half the number claimable by annual subscribers.

The first Distribution Committee reported that "a large number of the inhabitants of this great metropolis apply annually for gratuitous medical relief, and it is scarcely possible to refrain from expressing the hope that the time is not far distant when very many of these applicants may be induced to associate together to secure for themselves efficient medical relief in time of need, as a matter of right, rather than to be so constantly dependent upon purely charitable assistance. The great step in this direction would appear to be to make a large number of our local dispensaries self-supporting to a great extent, if not entirely "provident dispensaries."' The disappointment, therefore, was great when the list appeared with full grants to the free dispensaries, while the provident dispensaries were stinted to a proportion based upon that part of their income which is contributed by honorary subscribers. This was the unkindest cut of all, because it seemed to be directly aimed at the provident principle. The object of provident dispensaries is to encourage habits of forethought and independence, by inducing our people to rely for medical treatment rather upon their own thrift than upon the charity of others,* whereas, instead of helping those who help themselves, the grants of the Hospital Sunday Council varied in the opposite ratio, growing larger as the eleemosynary principle was developed, and smaller as self-support was exhibited, until they vanished altogether. The remonstrances made against this decision were so far successful that, according to a revised rule, "payments made by, or on behalf of, patients, are left to the discretion of the Distribution Committee, to be dealt with in each case as they may see fit;" and the footing on which the matter now stands is, that while grants in aid of institutions on the eleemosynary principle can be claimed as a right, they can be hoped for only on sufferance, and by favour, when the object is to help those who help themselves. The provident dispensaries also seriously suffer in this way. An annual sermon used to be preached on their behalf in the churches of their respective districts, which not only produced more than they get from the Hospital Sunday Fund, but brought the wants of the local institutions periodically before the inhabitants of the neighbourhood. In the absence of this, there is an increasing difficulty in obtaining fresh subscribers in place of those who die or leave the district, and many refuse on the ground that they give to the Hospital Sunday Fund.

The principle of the Hospital Saturday Fund is, that those for whose benefit hospitals and dispensaries were established should contribute towards their maintenance and have a share in their management. We cordially welcome the working men of London to the consideration of a question which concerns them more than any other class. No solution of it which is not manifestly to their advantage can be solidly based.

The sums actually distributed from this fund among the hospitals and dispensaries have been as follows, 1874, £4,508; 1875, £4,010; 1876, £4,250.

But this partly consisted of contributions from the general public, and the whole was obtained at the cost of an extraordinary expenditure of time, labour, and money. "That the work was not a light one" (I am quoting from the report for 1874) "is attested by the fact that, since the origin of the movement, no fewer than 76 public meetings have been held in aid of the fund; over 100 deputations from the Council waited by appointment on various societies and employés of large firms; while the Council and other meetings in Leicester-square numbered 106, independently of the meetings held by the local committees in the various districts." And the report for 1875 says:—"The magnitude of this year's work may be understood in some measure by consideration of the fact that there have been 11 Board, 21 Council, and 126 Committee meetings; that the chairman, treasurer, and one of the honorary secretaries were in constant attendance; and that the honorary assistant-secretary has devoted the whole of his time to the duties of his office." The real nature of the undertaking is described in the following striking words from the report for 1876:—"To induce a class to recognise and perform a duty which had been previously ignored is a task of no mean difficulty. This is so, no matter how small the community, but in one covering 225 square miles of ground, and numbering 4,000,000 souls, the difficulty is almost insurmountable."

It is remarked in the report for 1874 that "the surest way of protecting charitable institutions from imposition, and to ensure their being suitable in every respect for the requirements of the poor, will be for the subscribers to hospitals to elect working-men representatives on the boards of management;" but it does not appear that any progress has been made in this direction, nor does the plan of the Association lead in any direct manner to it.

The plan contemplates that each institution participating in the distribution shall place in the hands of the Hospital Saturday Council hospital and dispensary letters equal to the amount allotted. In the report for 1875 regret is expressed that the collection had not been larger, "as the Board only receive from the various institutions 'letters' *pro rata* to the money they are enabled to allot," while continuous applications are received for them; and in the report for 1876, notwithstanding some help from gifts of additional letters, "much difficulty and anxiety" is stated to have been felt by the Council, "whose resources, so far as 'letters' are concerned, are much overstrained."

All these conditions would be changed for the better if, instead of a general collection from a single centre, and a general distribution among all the London institutions, the working men took the matter into their own hands, and established any requisite number of provident dispensaries.

It is stated in the first report of the Hospital Saturday Council that, on a moderate computation of the working population of London, a subscription of a halfpenny a week from the males, and of a halfpenny a month from the females, would produce £69,530. Only a small proportion now contribute, for the majority are not alive to merely public considerations, and the few pay for the many, the industrious and thrifty for the idle and improvident. But if the responsibility were fixed upon the persons benefited, leaving each family to pay for its ordinary medical treatment on the mutual assurance principle, the income of two or three well-supported provident dispensaries would equal the annual sum collected by the Hospital Saturday

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* "There is no class of medical institutions which are truer charities, for they help the poor to help themselves, and they call out and foster one of the best instincts of human nature, viz., the desire of independence."—*Quarterly Review* for April, 1874.

Council, and their larger aggregate estimate of £70,000 would gradually be attained, the payment being made at the different dispensaries at the commencement of each month by a self-acting process, without any begging, or any of the waste of money, or still more valuable time and labour, which now takes place. Instead of exercising an imperfect general influence, by giving or witholding grants and denouncing shortcomings, the London working men would then have institutions of their own, which they could adapt to their wants and habits by arranging that the patients should be seen at hours convenient to them, and in other ways. It is unreasonable to expect that the portion of our population for whose benefit hospitals and dispensaries were established should pass at once from being alms-receivers to alms-givers, without going through the intermediate stage of independent self-support.

Under this arrangement "subscribers' letters" would be a thing of the past. Every family would be a subscriber, and would demand of right what had previously been obtained by troublesome and humiliating solicitation. Those only who have seen what must be endured on out-patient days at general hospitals, notwithstanding every effort to reduce the suffering crowd to order, can appreciate the blessing of the prompt treatment obtainable, through the medium of provident dispensaries, on any day and at any hour, either at the dispensary itself or at the homes of the patients, according to the nature of the case.* On the other hand, the hospitals themselves, being relieved from the pressure of trivial dispensary cases, would more fully perform their true function of bringing the highest skill and the largest experience to bear upon serious and difficult surgical and medical cases. One of the incidental advantages of the provident dispensary system is that, being based upon payments made from month to month, without any balance accruing to the benefit societies, members changing their residence can enrol themselves wherever they happen to be without any special arrangement being made for the transfer.

During the last seven years there has been a satisfactory development of convalescent hospitals, which, although situated on the seaside and elsewhere in the neighbouring counties, are really an admirable supplement to the London hospital system. The buildings and original outfit are provided from charitable funds, but the current expenses are, in general, defrayed, as far as possible, by payments made by, or on behalf of, the patients. Without going the length of saying that the cases are numerous in which persons spend the winter in London hospitals, and the summer in seaside convalescent institutions, it is certain that more than usual care is requisite to sift the real from the pretended claims to this attractive description of charity, and recourse ought to be freely had to the experienced and considerate inquiries conducted by the district committees of the Charity Organisation Society. There ought also to be a closer bond of union between the curative and convalescent hospitals, so that cases requiring change of air to complete the restoration of health may be freely transferred to the hospital sanitorium, either upon payment or gratuitously, as the circumstances may be.

After so many years of searching investigation and discussion following upon Sir William Fergusson's strong professional committee, sufficient common ground may surely be found to serve as the basis of future action. The specific practical proposals I am going to submit will, I hope, be accepted, not as my private opinions, but as the conclusions which must be drawn from the ample experience which has been acquired.

1. Out-patient letters should be abolished, and admission to the out-patient departments of hospitals should be confined to those cases which, on account of their urgency, difficulty, or other peculiarity, require hospital treatment, while ordinary trivial cases should be referred to provident, or, if the applicants are paupers, Poor-law dispensaries. When patients suitable for hospital treatment appear to be unsuitable as objects of charity, they should pay at prescribed rates or have their circumstances inquired into.

2. The existing free dispensaries should be converted into provident dispensaries, and new provident dispensaries should be established in proportion to the wants of the population. For this purpose the upper and middle classes should come to the aid of the working-class until the dispensaries become entirely self-supporting; and some portion of the abundant resources derivable from obsolete metropolitan charitable endowments, might with advantage be applied to providing the requisite buildings; but, from the first, not less than half the managing committee of each dispensary should be elected by the members, the remainder being appointed by the honorary subscribers.

3. For the double purpose of securing the prompt admission of cases requiring the special resources of a hospital, and of increasing the supply of instructive cases for medical education, the medical officers of provident and Poor-law dispensaries should be authorised to recommend for treatment in the neighbouring hospitals, such cases as, from their peculiar or difficult character, or from their requiring prolonged clinical treatment, can best be dealt with in a hospital.

Beyond these, I am not aware of any indispensable conditions of the reform of the present system of metropolitan medical relief. The managing committees, and the subscribers who supply them with the necessary funds, best know how to adapt these general principles to the individual circumstances of each institution.

By drawing closer the connection between hospitals and dispensaries two desiderata of the present state of the medical profession would be supplied. Regular means of instruction would be provided in the domiciliary treatment of disease,* including the every-day class of domestic complaints which form so large a part of the business of the medical practitioner; and the difficulty of surmounting with safety and credit the critical interval between the completion of professional education and the establishment of a satisfactory practice would be diminished. When students have finished their course at the hospitals, they could not have a more suitable field for acquiring varied experience and laying the foundation of a professional reputation, earning meanwhile an income, which, although moderate, would suffice for their support, than by an appointment at a provident dispensary, and engaged actively in visiting patients at their own homes, as well as attending them at the dispensary.[*]

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* It is more important to the poor than to the rich to have their ailments promptly attended to. Their bread depends on their health; and to get a doctor at once, when wanted, saves many a day's work to a poor man.

* The following is from Sir William Fergusson's Sub-Committee on General Hospitals:—"One of the most glaring defects in the present system of medical education, a defect which has become more and more prominent since the discontinuance of the system of apprenticeship, is the entire absence of practical acquaintance with the domiciliary treatment of disease. In the hospital everything is at hand—the formula for the prescription, the nurse with every convenience, the dietary fixed and suitable, and the ward with perfect cleanliness and space—whereas even in the most perfect private dwelling the medical attendant is called upon to tax his ingenuity and resources to the utmost. He must give instruction as to ventilation, cleanliness, feeding, nursing, &c., and these and other directions have to be varied in almost every dwelling. He must also write out in full his prescription, so that it may clearly be understood. The sub-committee are therefore of opinion that the teaching power of the out-patient department would be very largely increased if students of three years' standing were required to attend for six months as assistants at a provident or Poor-law dispensary, and they think that some provision might be made by which serious and interesting cases admitted to these institutions shall, through the instrumentality of the dispensary, be transferred to the hospital for special treatment and clinical illustration. By such an arrangement the consulting staff of hospitals would at all times be able to secure the attendance at the hospital of a series of cases illustrating special diseases, and by this means also carry out and test special modes of treatment; whilst, as in Edinburgh, the affiliation of such dispensaries to hospitals would always secure the prompt admission of acute diseases, and of cases requiring the peculiar resources of the hospital. It is believed that an ample field of useful and interesting observation would always be secured to the out-patient staff, without the possibility of abuse, and they therefore think that the out-patient department ought to be recognised for purposes of special clinical teaching in the same way as the in-patient department is already."

The evils with which we are familiar here have also appeared at Manchester, Liverpool, Glasgow, and other centres of population, but, in dealing with them, these provincial cities have two advantages over us. Although their population is large, and their medical institutions are numerous, compared with any other place, except London, yet each is pervaded by a corporate spirit, and forms a real autonomy, so as to be perfectly manageable on a question of this sort affecting the general municipal interest; whereas London is not so much a city, as a province of houses, which can only with the utmost difficulty be influenced from a single centre; and, secondly, these northern communities are more strongly constituted than the corresponding stratum of London society, being chiefly composed of large bodies of well-paid workmen who have not been corrupted by a vast indiscriminate system of public and private charity. The provident dispensary system first took root in these northern parts, and to them we still look for an example in all that concerns thrift and independence.

Last year the members of the Northampton Provident Dispensary entitled to attendance were 17,849[†]—more than one-third of the population of the town. The payments made by them amounted to £2,218; the attendances on patients at the dispensary were 5,903; at the medical officers' houses 15,062; and the visits paid to patients at their own houses 29,804. The payments to the three medical officers for the year were £1,696 At the Derby Provident Dispensary there were 5,696 members, who paid £997, and voted £497 to the medical officers. But of late years Manchester has taken the lead. In July, 1873, Sir Rutherford Alcock and Dr. Ford Anderson were deputed by the Charity Organisation Society to attend a meeting of the subscribers to the hospitals and dispensaries at Manchester, at which it was resolved:—"That, as there is a large class of working men above the condition of pauperism who, while unable to pay the ordinary medical fees, are yet able to make small periodical payments for medicine and medical attendance, it is desirable to establish provident dispensaries, by which these cases may be provided for." Manchester and Salford were then divided into districts, with a view to a provident dispensary being placed in each, to be managed by its own committee, consisting of ordinary members, honorary members, and medical men. Up to the present time seven such dispensaries have been established with 13,759 members, who subscribed last year £2,881, and paid £1,492 to their medical men. Lists of applicants to the hospitals and free dispensaries are daily sent to the Provident Dispensary Society, by whose inspectors they are visited at their homes; and those who are able to pay the small subscriptions required under the provident system have their cards stamped in such a manner as to preclude them from receiving gratuitous relief a second time, and are referred to the provident dispensary of their district.

At Liverpool, also, serious attention has lately begun to be given to the subject. The number of persons receiving gratuitous medical aid is greater in proportion to the population, than at any other town in the United Kingdom—being no less than 159,063, without including homœopathic dispensaries, the Consumptive Hospital, &c.; and the following resolution has recently been passed by the Northern Medical Society of Liverpool:—"That the indiscriminate bestowal of gratuitous medical relief interferes to a large extent with the rights and maintenance of medical men; and, so far from being a real boon to the working classes, it encourages many of them to take advantage of institutions intended to be utilised only under special circumstances, thereby fostering in such persons acts of imposition and dishonesty, which too often lead the sacrifice of self-respect, and to improvidence and pauperism." The case is much the same at Glasgow, where the local Charity Organisation Society has the matter in hand. Provident dispensaries have recently been established at Chudleigh, Oxford, Watford, and Shewsbury, and the subject is under consideration at Southampton, Lancaster, and other places.

Some of the most remarkable instances of the advantages of the provident dispensary system are to be found in the rural districts. I know a county neighbourhood in which the beneficent practice of the medical profession was well-nigh suspended, owing to the mutual irritation caused by the difficulty the labourers had in paying, and the doctors in getting, the amount of their bills; but this dead-lock was brought to a close by the establishment of a provident dispensary, at which the labourers' pence were collected, month by month, in advance, and were handed over without risk or trouble to the medical men. More ambitious arrangements have been made to comprehend entire unions, and even an entire county, in a provident dispensary association; but the institution is essentially local, and, however much provident dispensaries may profit by an exchange of experience, each must stand upon its own basis of a duly constituted committee of management acting in communication with the members on one side and the medical officers on the other. There is now a general desire to take advantage of the improved condition of the working classes in order to encourage them in habits of providence and self-respect, and nothing would more conduce to this than the substitution of the provident dispensary, which is based upon forethought and independence, for outdoor medical relief, which, like the out-patient department in towns, is too often the first step towards pauperism.

This sketch would be incomplete without briefly noticing cottage hospitals, which have been founded of late years in full view of the faults of the existing system of medical relief, and with a corresponding desire to avoid them. Instead of concentration there is decentralisation. The type aimed is that of a well-ordered home, with its kindly, health-giving, individual influences; and, as the patients are treated as if they have duties to perform and a character to sustain, their moral nature receives no taint from the material aid given to them.

In all this we ought to remember that we are an imperial people, and that the prevailing arrangements here are reproduced, by the mere force of habit, in our colonies and dependencies. The transplantation of our hospital system to Victoria is described as follows in a recent letter from Melbourne:—

"The old colonist, always a tremendous boaster and immensely proud of anything colonial, will be sure to point with pride to the large hospitals, the benevolent asylums (in plain English, workhouses), refuges, and dispensaries; and with much self-glorying will point to them as evidences of the immense charity of his fellow-colonists. Were he less ignorant, he would be not proud but ashamed of them. In Melbourne, a young city of 230,000 people, surrounded by a large, fertile, and almost uninhabited district, where labour commands high wages, may be seen vice, poverty, misery, and squalor equal to that in any town of similar size at home. If the people would but leave the town for the country much misery would be obliterated. But the Victorians, ignorant of the true causes of poverty, and unmindful of what has occurred in other countries, foster and encourage the growth of all these evils by spending fabulous sums in ill-directed charity.

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[*] An arrangement on this principle is successfully acted upon at Paris:—"There were in 1867 about 1,000 persons on the medical poor-relief staff, students in the fourth and fifth years of study. These appointments are much sought after, and are only given by competitive examination."—"Poor Relief in Different parts of Europe, 1873."

[†] This number is more remarkable as there is another large medical institute in the town supported by the Odd Fellows and other working men's clubs.

"In London the doctor is often disgusted by seeing well-dressed and well-to-do patients seeking gratuitous medical aid, but in Melbourne he would be still more shocked by seeing patients driving to the hospitals in broughams, female patients and their friends rustling in silks and gaudy costly jewellery, and shopkeepers wealthier than the doctor occupying his time and exhausting his energies—without paying a farthing."

After some remarks by the Chairman,

Sir William Gull said—We are all agreed that the conditions under which gratuitous medical advice is afforded in this country are unsatisfactory. They have not always been unsatisfactory, but are becoming more and more so every succeeding year, owing to the advances of society to which Dr. Acland has alluded. Going back to forty or fifty years, we find that the Poor-law Department at that time took but little care of the sick poor, but now they are drafted into the Poor-law infirmaries, where they are not only well treated, but where they receive the same skilled medical attendance as they would if inmates of the larger hospitals. Then, above paupers, we come to a class who, although they cannot pay largely for medical relief, nevertheless feel they ought to pay something for the attendance afforded them; a feeling, the exercise of which begets independence in the breasts of those who foster it, and which recognises at the same time the value of our advice, and the right to remuneration of the members of our profession. The animus of the medical profession prompts to bestow relief at any moment, and upon any object requiring it. The value of professional skill under such circumstances should be properly estimated. There is an idea prevalent among some that, as advice costs nothing, it should therefore be given for nothing. That is a mistake—injurious to the profession and to society; because it puts the skill of a professional man in a false position, and his position at a disadvantage. Therefore it is that all present feel that the class in this country above the pauper class ought to place themselves in relation to the medical profession as liberally according to their means as we place ourselves towards them. Provident dispensaries ought on this ground to be much more numerously established than they are, not only for our profession's sake—though we shall, as hitherto, when needed, gladly bear the burden of gratuitous advice—but because, as matters now stand, they tend to pauperise and mislead the working man, and to make him think lightly of medical advice, and leave him generally under the impression that when he is ill there is nothing for it but to take drugs. If provident dispensaries were more generally established, and the medical men attached to them were constantly to visit at their own homes the patients who were too ill to personally attend, the best influences would be brought to bear upon this class of society. Most of you know—I see many of the most eminent members of the medical profession present—that the poor have an idea that disease comes from Providence, and that it must be cured by drugs. Now, if there is any idea that ought to be rooted out, it is this. Children are often brought to be drugged when in reality they require to be washed and fed. I believe that one of the beneficial effects of our meeting here to-day will be that it will have a tendency to spread abroad the fact that disease should be prevented by attending to hygienic laws by eating good food which has been properly cooked, by regulating the quantity and guaranteeing the quality of that which is taken. The existence of gin palaces at one corner of the street, and free dispensaries at the other, are evidences by contrast of the monstrous anomalies existing in our society. I am certain that many people are intemperate more from habit than design. They think that anything strong gives strength. They say—it is a common expression of such ignorance—"Won't you take something to fortify yourself?" I feel sure that the establishment of provident dispensaries will inculcate a feeling of independence among the people who receive medical advice from them. They will, under such circumstances, be better treated than they possibly can be when they come with a great rush to the hospitals, and the surgeon has no knowledge of who they are or whence they come. With regard to the uses and abuses of great charities, doubtless some persons go to them who ought to pay for advice. It is, in one sense, a kind of compliment to those institutions. There is a feeling in society that the great hospitals are so well managed, that it is worth while for people to put off their best clothes and don poor apparel in order thus to get the advice of skilled medical men. That is a practice to be discouraged; but people will be dishonest in some cases, and there is no doubt that they are under the impression that by this practice they get better advice than they could otherwise. Sir Charles Trevelyan has suggested that no out-patients' letters should be issued. I think in this he is mistaken. It may be necessary to issue out-patients' letters in many cases—such as diseases of the skin, the eyes, &c. But whilst we shall all agree, as I said before, that the present condition under which gratuitous medical advice is given is unsatisfactory, on the other hand we ought to encourage the lower classes to help themselves, because in so doing they will gain intelligence, and we shall be able to strike a blow at bad habits which, through ignorance, are prevalent among them. The resolution which I have to propose to you is worded in general terms, so as to carry you all with it. It commits you to very little indeed. I think we shall all agree, in general terms, that the present organisation, or want of organisation, of our charities requires alteration. The out-patient department of our large hospitals is rather a novel introduction—at Guy's not, I believe, over 50 years. It has grown largely of late, and interferes with the good order of these institutions. It might be curtailed, not only to the advantage of the hospitals generally, but to the benefit of the people who come there. All who are connected with hospitals know that poor persons are wonderfully fond of drugs. Many take them almost for pleasure. Poor people have indeed a superstitious fondness for drugs as a kind of fetish. Many persons are averse to any alteration in the terms under which gratuitous medical relief is afforded. They say, "We are told on the best authority, that in charity the left hand must not know what the right hand does." Though this feeling must be respected, still there are so many cases of imposition attempted, that inquiry is absolutely necessary in a great majority of instances. I know from experience that the inquiries of the Charity Organisation Society are conducted with great delicacy, and in such a way as not to hurt the feelings of anyone, and I acknowledge my indebtedness to that Society for the work which they have done for me, and for the beneficial effects which have arisen in a general way from their operation. Whilst it is necessary that the really poor who are not paupers should have liberal gratuitous medical aid, yet it is equally necessary that attempts at imposition should be thwarted. We meet here to-day with entirely unselfish aims. We come here for the purpose of advancing the good of the community, and not with the view of enhancing the interests of our profession in any way that we are not fairly entitled to. The lesson we teach is that every class of society should rely upon itself, as much as possible, for obtaining the means of life, and for procuring, when stricken down by sickness, the best medical attendance with a view to obtaining a restoration to health. Sir William Gull concluded by moving the following resolution:—"That the improvement of the people of London in health and habits of thrift and independence demands that, while, on the one hand, out-patient departments should be regulated so as to secure the prompt treatment of cases requiring the special resources of a hospital, on the other, free dispensaries should be converted into provident dispensaries, and new provident dispensaries should be established in proportion to the wants of the population."

Mr. Prescott Hewett said—I shall have no need to trespass upon you at any length to-day. The admirable paper with which we have heard read, and the able address with which we have been favoured from Sir William Gull, have exhausted anything which I could advance on the subject. I will only say that, perhaps unluckily for me, I was one of the longest resident house-surgeons at St. George's Hospital, and from the experience which I gained in that capacity, I most cordially concur in all that Sir William Gull has said.

Sir Rutherford Alcock said he fully agreed with everything in Sir Charles Trevelyan's paper, and desired to give it his hearty support.

Mr. T. Holmes said—I wish to make a few observations upon the general question of inquiry respecting the hospital patients, and the condition of life of those who seek medical relief. We hear a great deal of the position in life of those who apply for hospital aid, and the nature of the inquiry to be made into their pecuniary condition—but we hear little of inquiry as to the necessity of their application, or of the nature of their diseases. Now, if we had information which would show whether a person is really suffering from disease or injury requiring hospital advice, and the nature of the illness, a great deal of the necessity for inquiring into their domestic circumstances would not then exist; and I regard many of those inquiries as objectionable, one objection being that when you have made inquiry you do not always learn what you desire to ascertain. A man earning 60s. a week may require medical aid of an expensive character, and he may not be so well able to afford that as a man earning 30s. a week can afford the medical aid he needs. I think, however, that the out-patient departments might have the demands upon them cut down very greatly without injury to the deserving, and the way in which this could be done would be by having affiliated to the hospitals the provident dispensaries, the Poor-law dispensaries of each district, and the private practitioners, and from one or other of these sources it would be known whether or not the applicants were really in need of hospital advice. Then I think that the out-patients' department should be in a great measure, if not altogether, consultative. The practice of the hospital might in this way be assimilated to some extent to the private practice of the hospital (or "consulting") physicians and surgeons. These practitioners have two classes of private patients—those whom they treat entirely, and usually at the patient's own home, analogous to the hospital in-patients, and those whom the consultant sees at his own house, often only once, and who are usually sent to him by other medical men for his opinion. It is to these latter that I should like to see the hospital out-patients assimilated. The class whom a medical man sees at the hospital ought to be seen for the purpose of consultation only, and a kind of idea of this practice is given in the Parisian hospitals, for the out-patients in Paris are not treated, but are sent for consultation only, and only receive advice. I think it was Sir William Gull who said, and rightly, that the great rush of out-patients to our hospitals was quite of recent institution. At St. George's, at a comparatively recent time, the out-patients were seen by the visiting surgeon, and it is only of late years that this rush of persons has occurred to the out-patient department. It would be well if the general public would look at the professional aspect of the question, as well as the political, social, and moral aspects of it. Hospitals are not only places for giving curative aid to persons afflicted with disease or injury, but they are places for the teaching of medicine and surgery, as well as for the relief of pain. Under the system which was formerly in vogue, teaching of medicine and surgery could be carried on even more thoroughly in the out-patient departments than in the in-patient wards, but it is impossible to ask a man who has to see a hundred patients an hour to teach medicine or surgery at the same time. I say a man cannot teach under such circumstances; and he cannot, either, give the requisite attention to the patients who require it. As the poor cannot have due attention, and the rich cannot expect to obtain the cultivation of the skill which the teaching in the hospitals used to give, this is a question of the utmost importance to both rich and poor, and a change ought to be made in the present system in the interest of both classes. Everyone will see the desirability of remedying the evils I have mentioned, and I think means may be found for carrying out in principle the plan I have sketched.

CORRESPONDENCE.

THE NEW SODA PROCESS.

The discussion upon my paper read before the Chemical Section on the 10th of May being so lengthy, time did not admit of my going minutely into the many objections urged by the Chairman against my projected process, and from the report in the *Journal* of the Society for May 18th, it may appear that I have not with sufficient plainness shown wherein the principal of these objections are contrary to facts—but a glance at the printed discussion will show that the numerous criticisms to which I was subjected by Mr. Weldon would in themselves be sufficient to prevent my doing so—I will therefore reply now more fully to the Chairman's figures stated by analogy in contradistinction of mine, arrived at by deduction from actual prices and experiments; but first I would wish to point out that my first experiments with this process were commenced (as stated by me to the meeting on the 10th May) in the year 1872.

Price of Phosphate of Alumina.—I still maintain that it can be bought in quantity at £3 3s. per ton, or less. Within the last few weeks I have myself bought at £3 5s. a small quantity, delivered in Manchester. Mr. Weldon, in quoting from "a price current list," admits the inference that this article is at present being sold as a marketable product; but he is evidently unaware when the last sale of any importance was made, or of the many thousand tons now in this country which have remained practically unsaleable for some years.

Price of Salt-cake.—It has been for some weeks back, and it is still quoted at 50s. 6d. per ton for present or early delivery. Sales have been made up to the end of the year at 52s. 6d., and I know myself of sales at 51s. In my opinion it is not likely to advance for some time, unless there be a decided improvement in the value of carbonate and caustic soda.

Price of Phosphate of Lime.—I have taken particular pains to arrive at a proper basis for the valuation of this, and have before me samples and prices of several cargoes of bone-ash lately imported. The following are carefully ascertained average prices for bone-ash on the basis of 70 per cent. phosphate of lime delivered ex-ship, Liverpool:—

	Per cent.		Jan.		May.
Rio Plata....	70 to 73	..	£6 2 6	..	£5 17 6
Rio Grande..	70 to 78	..	6 8 9	..	6 11 3

The precipitated phosphate of lime would doubtless be used for the same purposes to which Rio Grande bone-ash is now applied, and on 76 per cent. would, *pro rata*, be worth £7 2s. 6d. per ton. I purposely stated it at £6 13s. in my paper. Mr. Weldon would confer an undoubted boon upon users of high class phosphates could he procure them a supply of good 76 per cent. phosphate of lime free from, or substantially free from, iron and alumina, at 1s. 3d. per unit. It cannot be done. A finely precipitated phosphate of lime is worth infinitely more than a raw unground mineral one, even for making superphosphate, irrespective of the value of a precipitated phosphate for direct application to the soil.

Mejillones guano, valuable only for its phosphate of lime, is at present worth £7 per ton, on 70 per cent. in Liverpool, and I have before me a copy of a certificate from a Glasgow chemist for the benefit of Scotch farmers, to the effect that a cargo, testing 74 per cent., just arrived, is value to them for £9 15s. per ton ex-ship. If any one will refer to the *Journal* for the 18th May, he will find there that the highest authority upon such matters in this country values insoluble phosphate of lime for manurial purposes at 1d. per lb.; this is equal to 1s. 10·4d. per unit; so that 1·5 tons of 76 per cent., containing 104 units of tribasic phosphate of lime, would be worth £10 10s., as against £10, or 1s. 9d. per unit, upon which price I extended my calculation of the value of this article in the tabulated statement published with my paper.

Extra Fuel required.—I consider I have more than allowed for this. Every one connected with the caustic soda manufacture knows that a ton of this article can be made by the combustion of 6·5 tons of fuel. In the statement above referred to there are 7·5 tons allowed per 15 cwt. of caustic soda made; therefore, any extra fuel which may be required is well covered by this excess.

Extra Labour required.—I cannot see that 0·63 extra labour will be required; but, supposing it were, it would only reach as far as the furnacing and filling into the vats, the liquors being treated in the same manner as now pursued, so that, once got into liquor, there would be no extra expense.

Loss of Soda.—Mr. Weldon stated to the meeting that, from my own published analyses, not less than 11·9 per cent. of the total caustic soda produced was left in the lime mud. Mr. Weldon seems to have a weakness for debiting me with excessivo charges, and I challenge him to find, and show from my figures, any such per-centage loss as he states. Two per cent. of soda in the mud is only 4 per cent. loss, therefore I fail to see where Mr. Weldon finds 11·9 per cent. loss in (at the highest) 1·906 per cent. of sodium hydrate in the mud. However, there is no reason why almost all the soda should not be washed out of the phosphate of lime; but suppose 5 per cent. were wastefully left in, I will point out one great discrepancy with Mr. Weldon's figures. By working 1 ton of Redonda I reckon to produce 15 cwts. of 60 per cent. caustic soda, this is equal to $22\frac{1}{2}$ cwts. upon Mr. Weldon's quantities. Now, 10 per cent. loss on this, is $2\frac{1}{4}$ cwts., and as the selling price of caustic soda is now 12s. per cwt. = 27s.; but I have never said there is 10 per cent. loss, and I know that 5 per cent. is excessive, and that when managing alkali works I have only been credited with alkali in liquor at £5 per ton on the basis of 48 per cent. of alkali. But I will take 5 per cent. as lost, and as it has undergone no charges of concentrating, fishing, nitreing, finishing, or packing, charge this loss at £6 5s. per ton — $1\frac{1}{8}$ cwt. then at 6s. 3d. = 7s., as against Mr. Weldon's 29s. 6d.

Value of the Residue.—My estimate of this I still consider reasonable, the more especially as I have not attached any money value to the fact that the residue produced is not a noxious waste; but an article capable of bearing its own working expenses and leave a profit. Again, I must state that Mr. Weldon does not appear to have been acquainted with the "surroundings" of this process when he so energetically deprecated the production of green copperas. Irrespective of nearly 50 tin-plate and other works where the waste pickle from all the vitriol used is made into copperas now in astonishing quantities, there are a considerable number of works in this country, and also on the Continent, where it is extensively and specially made. It is used very largely in Lancashire and Yorkshire, and in fact pretty considerably all over the world for a variety of purposes too numerous to mention. In one works alone near Manchester they have made on an average over 3,000 tons a year for many years. A ton of Redonda phosphate would give on an average one-third of a ton of copperas theoretically, and if this complete oxidation could be obtained, who would call the resulting iron-free residue a valueless waste? but for argument's sake let us consider it almost as such, and accept Mr. Weldon's estimate of its value, 27s. 6d.

Comparative Statement.—Following Mr. Weldon's plan, I have drawn up a statement to show how my process for making caustic soda compares with the present method, the mixture for the furnace being made up according to Mr. Mactear's proportions:—

	Old Process.	Excess.		New Process.	Excess.
95 per cent. salt-cake	1·65	—	....	2·75	1·10
35 per cent. phosphate of alumina..	—	—	....	1·50	1·50
Limestone..........	1·18	1·18	....	—	—
Lime..............	·12	·12	....	—	—
Slack..............	·68	—	....	·75	·07
Sand..............	—	—	....	·75	·75
	3·63	1·30	....	5·75	3·42

Mine being 2·12 parts more on the total furnace mixture than the old process, and abstracting what I have now written, the following table shows how my table compares with the old process at present worked by Mr. Mactear:—

Extra Money Expended by my Process.

Dr.	£	s.	d.
35 per cent. of phosphate of alumina 1·5 tons at £3 3s.	4	14	6
95 per cent. of salt-cake, 1·1 tons at £2 10s. 6d......................	2	15	6
Slack ·07 tons	1	0	0
Sand ·75 tons			
Labour and fuel 63 per cent..........			
Doubtful items but excessively estimated by Mr. Weldon			
Loss of soda 5 per cent., say	0	7	0
	8	17	0

Extra Money Realised by my Process.

Cr.	£	s.	d.
76 per cent. phosphate of lime 1·5 tons at 1s. 10d.	10	10	0
Limestone not used 1·2 at 7s. 3d. per ton	8	6	0
Lime not used 0·12 at 17s............	0	2	0
Residue as valued by Mr. Weldon	1	7	6
	12	8	0

So that for every 1·65 tons of salt-cake worked by the old process—the new process shows a direct money advantage of £3 11s.

If the Dr. and Cr. accounts had just balanced, the process would at least have been as good as the present one, and this process has the advantage that no noxious vapours are given off from the insoluble residue.

I desire to explain that the values in the tabulated statement published with my paper were stated at what I considered safe figures, but accepting Dr. Voelcker's value of soluble phosphate of lime, and as he is of opinion that an equal weight of phosphoric acid soluble in water has about the same manurial value, whether it exists as an alkaline phosphate or a phosphate of lime or other phosphate made soluble in water, he would probably value the soluble phosphate in the "phosphate balls" at equal to 3s. 8d. per unit of tribasic phosphate of lime made soluble, which on the 35 units of phosphoric acid would be worth £13 18s. 8d. as against £8, the present price of all the raw materials required to produce it. I stated it at £10 15s., which allowing for the sulphur recovered would leave a margin of £6 10s. to cover labour, working expenses, and profit, and at 1d. per lb. for the precipitated phosphate of lime (see *Journal* for May 18th, p. 625), the margin for making an article of 76 per cent., including ¾ ton of 60 per cent. caustic soda, would be £7. My former estimate as per tabulated statement published at the end of my paper was £6 11s. to cover labour, general expenses, and profit. Mr. Weldon stated I had not pointed out where he was wrong in his statements; I contend the discrepancy was pointed out. I allow Mr. Weldon's value for the residue, I allow for an excessive loss of soda, also £1 for what I call doubtful items; but it was a question of prices upon which we differed, and I really cannot allow him to debit me with salt-cake at £3 when it is quoted at 50s., and neither can I allow him to value a precipitated phosphate of lime at 1s. 3d. per unit when its value is 1s. 9d. If there should be any reader who doubts this valuation of mine I must refer him to page 625 of No. 1,278 of this *Journal*.

Before I close this letter I wish to point out that Mr. Weldon's statement that I could only, even theoretically, get three-fifths of the salt-cake used, as sodic phosphate, is completely erroneous. He ignores the fact that it is only the alumina which causes a loss of soda. Now the raw phosphate is described in my paper to be composed of 57 per cent. of phosphate of alumina, and 18 per cent. of phosphate of iron, the phosphate of iron causes no loss of soda save that small proportion which becomes converted into the double sulphide of iron and sodium, and this is so small when worked properly, that solutions of the phosphate of soda in some of my experiments have contained traces only of sulphide of sodium. I may as well point out another fact which I have discovered in working at this process, viz., that when strongly heated in a reverberatory furnace for a long time, the "phosphate balls" separate into two layers, the upper one consisting of the tribasic phosphate of soda in a fused state, the bottom layer consisting of a double silicate of alumina and soda, the mass dividing exactly in the same manner as a pot of fused caustic.

George E. Davis.

Barton Arcade, Manchester,
May 31st, 1877.

INSECTS HURTFUL TO AGRICULTURE. — "A SECRETARY OF STATE FOR THE FOOD DEPARTMENT."

It is with great regret that I find myself unable to attend the Society's special meeting upon the occasion of Mr. Murray's paper, the subject of this gentleman's discourse being one I have long regarded with particular interest, albeit such matters have been up to the present time almost completely neglected in this country. A few careful observers here and there have, I grant, contributed valuable facts, opinions, and experiences, relating to the "Insect Pests" of this and other lands, but (in England at least) there seems to have been nothing approaching a systematic attempt to classify what is known about insects and their influence —most frequently a malevolent one—upon our national food supplies, and by thus publishing the information at present obtainable, to point out the directions in which further knowledge should most urgently be sought.

In other countries, something has been done in the way just indicated, notably in France and the United States of America, but in the former the inquiries have been but sparse, and generally confined to some particular "pest," and have resulted (as for instance in the case of the *phylloxera*) from a sudden scare, demanding a hasty "investigation by order," and a still more hasty "report," while as regards America, although the subject has for the last eleven or twelve years received far more attention, and of a sound and practical as well as scientific kind, than as yet obtains elsewhere, the fact that America is where it is robs the annual report of the State entomologist to the Commissioner of Agriculture of much of its reference value as far as Great Britain is concerned. I have the authority of Mr. F. Moran, late United States Secretary of Legation to our Government,* for stating that every facility for the "exchange of facts and desiderata" would be gladly afforded by his Government (and I take this opportunity of gratefully acknowledging how courteously such information has at all times been furnished to myself) to our own, but for the awkwardness of there being no department here corresponding to that which accomplishes so much useful work accross the Atlantic.

I have no doubt that Mr. Murray's paper, and the resulting discussion, will prove of much scientific interest and practical utility, but fervently hope that the Society will not allow the matter to end with the reading and publication thereof, but will take steps to place the entire question upon a more permanent basis; so that, before long, this country may be, in relation to such matters at least, upon a par with the United States.

This is not the first time, by very many, that this subject has been mooted by myself. Many years ago, it was included in a comprehensive scheme submitted by me to Dr. Lankester, and highly approved by him, in connection with the Food Museum at South Kensington (of which the learned doctor was then superintendent). With some modifications of his own, this scheme, which was intended to form the nucleus of a future Government "Food Department"—somewhat resembling, but far more comprehensive in its scope, than the United States Agricultural Bureau—was, in various ways, earnestly urged upon the authorities at South Kensington by Dr. Lankester, and so thoroughly had he entered into the spirit of the suggested reforms, that he resigned his post at the Museum (so he told me afterwards) on finding that the plan would not be carried into effect.

Later on I had an opportunity of bringing the same subject under the notice of Mr. McLagan, who introduced the question in a broad and general way before Parliament, in an eloquent and interesting speech, which was very well received.

In my opinion, the Society of Arts, which has inaugurated so much good and useful work of a kindred nature, should not rest content now with (1) appointing a committee upon "Insect Pests;" (2) with publishing lists in tabular or cyclopædic form of (*a*) plants and vegetable products, and the insects inhabiting or feeding upon such, and (*b*) insects, their habits, modes of generation, the plants, &c., giving their *habitat*, or to which they prove destructive, and (*c*) remedial measures, and the results of (3) collecting similar information from foreign sources, and (4) offering premiums for special information and successful remedial treatment, but, as the time is fast approaching when the present expediency of the formation of Ministerial Food Department will be developed into a national necessity, should take into serious consideration the best means of attaining this end.

To say more at this moment, would be perhaps to tread ungraciously upon the subject-matter of Mr. Murray's paper. I hope, however, to be permitted ere long to return to the subject, one well worthy of, and fully within the objects of the Society.

Wentworth L. Scott.

County Analyst's Laboratories, Wolverhahampton,
June 4th, 1877.

The loss from damage to the vine, the hop, to all kinds of fruit and vegetables, grain, and roots, is immense—so great that a large sum of money, £800, has been offered by the French Government as a prize for preventing the ravages of the *philloxera* or vine pest. The damage to the hops from the bug, or "louse," and the fly amounts to a very large sum in money, and every fruit, vegetable, and root has its insect pest. The beautiful ermine or silver moth, whose larvæ, brown and green caterpillars, which are gregarious, about half an inch in length, are most destructive to the apple. They swarm in such myriads, and completely defoliate the apple trees and the thorn (*cratœgus*) and from 20 to 30 caterpillars in one web rot out the parenchyma of the leaf and then proceed to another, till the tree is quite denuded of leaves, through which it is oxygenised, and being deprived of oxygen, the fruit crop is partially or wholly destroyed, and the tree itself injured sometimes beyond recovery. I need not—indeed I could not—in a short paper enumerate the various insect pests to the corn, the turnip, the bean, &c., and they are a legion, as every vegetable, fruit, &c., has its insect pest.

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* Now Ambassador at Lisbon.

The point of interest is how to exterminate these insect pests.

Firstly. It is of the greatest importance to banish the vulgar notion about "blight," shared by persons of education to a great extent, from my own experience, and the received opinion of most gardeners, farmers, and agricultural labourers. There is no such thing in the sense commonly entertained, viz., "that these pests are the result of some particular state of atmosphere (electric) combined with easterly wind and fog when 'blight' comes;" the real state being that the warm and electric condition of the air hatches the eggs of the various pests, some into larva, worm, or caterpillar, which pass through the stages of chrysalis and moth, which deposits its eggs and dies; others, as the arachnoids, are hatched from the egg into their final state, as the red spider, which attacks the hops. They spin the moment that they are hatched and are fully organised. The important thing is to study the habits of each insect, to trace where and how it deposits its eggs, and at what stage of the insect life its destruction could be best effected. This requires a long and careful research by competent observers. I have myself written on two insect pests, the *Abraxas gropulasia* and the silver ermine moth, which attack the apple (*Tinea argentea*), and given the mode of treatment to diminish, if not to utterly destroy these pests. Close research for several years is necessary to determine the steps necessary to be taken, mechanical and chemical. In the States of America, professional entomologists are paid by the State to report on noxious insects, and there are many valuable reports published on these subjects. I venture humbly to suggest that a committee might be advantageously appointed to communicate with the learned societies and men on the subject, with a view to obtain and disseminate sound information on noxious insects.

John Frederick Stanford.

5, North-bank, Regent's-park, N.W.

MEETINGS FOR THE ENSUING WEEK.

Mon.... Victoria Institute (at the House of the Society of Arts), 8 p.m. Rev. Isaac Taylor, "The History of the Alphabets."

Asiatic, 22, Albemarle-street, W., 3 p.m.

Tues....... Woman's Protective and Provident League (at the House of the Society of Arts), 8 p.m. Annual Meeting.

Statistical, Somerset-house-terrace, Strand, W.C., 7¾ p.m. Mr. E. G. Ravenstein, "The Population of Russia and Turkey;" after which "Diagrams Illustrating the Accounts of the Banks of England, France, Germany, Belgium, Holland, &c., will be submitted, and Remarks made thereon," by Mr. Ernest Seyd.

Zoological, 11, Hanover-square, W., 8½ p.m. 1. Mr. P. L. Sclater, "Reports on the Collection of Birds made during the Voyage of H.M.S. *Challenger*." No I. General Remarks on the Collection. 2. The Marquis of Tweeddale, "Reports on the Collection of Birds made during the Voyage of H.M.S. *Challenger*." No. II "On the Birds of the Phillipine Islands." 3. Rev. O. P. Cambridge, "Some New Species of Araneidea, with Characters of Two New Genera, and some Remarks on the Families *Podophthalmides* and *Dinopides*." 4. Mr. J. H. Gurney, "Note on the Polish Swan." 5. Mr. F. Moore, "The Lepidopterous Fauna of the Andaman and Nicobar Islands."

Wed..... National Health Society (at the House of the Society of Arts), 4 30 p.m. Dr. Bridges, "The Influence of Civilisation upon Health."

Meteorological, 25, Great George-street, S.W., 7 p.m. 1. "Report of the Lightning Rod Committee" 2. Rev. Charles J. Taylor, "An Improvement in the Mechanism of Self-recording Meteorological Instruments." 3. Mr. William Ellis, "Results derived from the Sunshine Records obtained at the Royal Observatory, Greenwich, by means of Campbell's Self-registering Sun Dial, during the year ending April, 1877." 4. Mr. William Ellis, "The Diurnal Variation of the Barometer at the Royal Observatory, Greenwich." 5. Mr. Griffith N. Cox, "The Rainfall of Jamaica during the Seven years 1870-76."

Geological, Burlington House, W., 8 p.m. 1. Prof. John Milne, "The Action of Coast-ice on an Oscillating Area." 2. Mr. G. M. Dawson, "The Superficial Geology of British Columbia." 3. Mr. G. H. Kinahan, "The Chronological Classification of the Granitic Rocks of Ireland," and (4) "The Cambrian Rocks of S E Ireland" (communicated by Prof. Ramsay). 5. Mr. M. A. Daubrée, "Points of Similarity between Zeolitic and Siliceous Incrustations of Recent Formation by Thermal Springs, and those observed in Amygdaloid and other altered Volcanic Rocks." 6. Mr. R Mallett. "A hitherto unnoticed circumstance affecting the Piling up of Volcanic Cones." 7. Mr. T. Belt, "The Steppes of Southern Russia." 8. Mr. C. A. Zaohariæ, "Description of the Fossil Organic Remains of Bendigo" (communicated by the President). 9. Messrs. R. L. Jack and J Horne, "Glacial Drift in the North-eastern Carpathians." 10. Mr. E. Gilpin, "Notes on some Recent Discoveries of Copper Ore in Nova Scotia." 11. Mr. W. A. E. Ussher, "Terminal Curvature in the South-western Counties." 12 Messrs. W. Gunn and C. T. Clough, "Discovery of Silurian Beds in Teesdale." 13. Mr Rooke Pennington and Prof. W. Boyd Dawkins, "The Exploration of the Ossiferous Deposit at Windy Knoll, Castleton, Derbyshire." 14. Mr. D. Mackintosh, "A Number of New Sections around the Estuary of the Dee which exhibit Phenomena having an important bearing on the Origin of Boulder Clay and the Sequence of Glacial Events." 15. Mr. J. F. Campbell, "The Glacial Period." 16. Mr. W. A. E. Ussher, "The Chronological Value of the Pleistocene Deposits of Devon," and (17) "The Triassic Rocks of the South-western Counties" (Part II). 18. Mr. J. S. Gardner, "The Cretaceous Dentaliadæ."

Royal Horticultural, South Kensington, S.W., 1 p.m.

Royal United Service Institution, Whitehall-yard, S.W. 8.30 p.m. Captain Hamilton Geary, "The Combustion of Fuel in Steam Boilers."

Thur.... Royal, Burlington House, W., 8½ p.m.

Antiquaries, Burlington House, W., 8½ p.m.

Linnean. Burlington House, W., 8 p.m. 1. Mr G. Herbert Carpenter, "The Genus *Actinometra*, with a Morphological Account of a New Species from the Philippines." 2. Mr. W Philip Hiern, "Notes on the Peculiarities and Distribution of *Rubiaceœ* in Tropical Africa." 3. Mr. Joseph S Baly, "Description of Genera and Species of Australian Phytophagous Beetles." 4. Mr R. Bowdler Sharpe, 'Birds of New Guinea" (Part III.).

Chemical, Burlington House, W., 8 p.m. 1. Mr. H. Grimshaw, "Diamyl." 2. Mr. Watson Smith, "Dinaphthyls." 3. Mr. Watson Smith, "Certain Re-actions between the Oxalates and Carbonates of the Alkalies and Alkaline Earths." 4. Messrs. R. Y. Friswell and A. Y. Greenaway, "Thallious Platinocyanide" 5. Mr. E W. Prevost, "Crystallised Barium Silicate." 6. Mr. W. H. Perkin, "Note on Anethol and its Homologues"

Zoological, 11, Hanover-square, W., 5 p.m. (Davis Lectures.) Prof. Garrod, "Man-like Apes."

Numismatic, 4, St. Martin's-place, W.C., 7 p.m. Annual Meeting.

Royal Society Club, Willis's Rooms, St. James's, S.W., 6½ p.m. Annual Meeting.

Philosophical Club, Willis's-rooms, St. James's, S.W., 6½ p.m.

Psychological, 11, Chandos-street, W., 8½ p.m.

Fri....... Royal United Service Institution, Whitehall-yard, 3 p.m. Lieut.-General Sir Richard Wilbraham, "A Military Study of some of the Chief Theatres of War in Europe."

Quekett Microscopical Club, University College, W.C., 8 p.m.

Royal Botanic, Inner Circle, Regent's-park, N.W., 4 p.m. Professor Bentley, "Plants, with Reference to their Life and their Organs of Reproduction." (Part 2.)

The Andrœcium or Staminal Whorl. The Gynœcium Thalamus. The Fruit. (Lecture VII.)

Sat....... Physical Science Schools, South Kensington, S.W., 3 p.m.

Royal Botanic, Inner Circle, Regent's-park, N.W., 3¾ p.m.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,283. Vol. XXV.

FRIDAY, JUNE 22, 1877.

PROCEEDINGS OF THE SOCIETY.

FINANCIAL STATEMENT.

The following statement is published in this week's *Journal*, in accordance with Sec. 42 of the Society's Bye-laws:—

TREASURERS' STATEMENT OF RECEIPTS, PAYMENTS, AND EXPENDITURE, FOR THE YEAR ENDING MAY 31st, 1877.

Dr.	£ s. d.	£ s. d.
To Cash in hands of Messrs. Coutts and Co., 31st May, 1876	269 13 10	
Do. do. Secretary	23 5 11	
		292 19 9
„ Subscriptions received during the year from Members and Institutions in Union	6,207 14 0	
Life Contributions	466 0 0	
		6,673 14 0
„ Dividends and Interest		603 18 0
„ Examinations (Commercial, &c.):—		
Donation (Clothworkers' Company)	10 10 0	
Prince Consort's Prizo (H.M. the Queen)	26 5 0	
Fees, &c.	7 5 8	
„ Examinations (Technological):—		
Donation (Clothworkers' Company)	10 10 0	
Ditto (G. N. Hooper, Esq.)	10 10 0	
		65 0 8
„ Industrial Hygiène Prize:—		
*Donation (late Benjamin Shaw, Esq.)		16 0 0
„ Blow-pipe Prizes:—		
Donation (Col. A. Croll)		10 10 0
„ House and Office (receipts for gas)		50 7 0
„ Advertisements		1,458 0 11
„ Sales:—		
Journal	182 17 3	
Cantor Lectures	12 8 6	
Sewage Conference Reports	48 10 0	
Traction Committee Ditto	1 0 0	
		244 15 9
„ Owen Jones' Memorial Fund		400 0 0
		£9,815 6 1

Cr.	£ s. d.	£ s. d.
By House and Premises:—		
Rent, Rates, and Taxes	342 13 8	
Insurance, Gas, Coal, and House Charges	221 14 4	
Repairs and Alterations	95 15 4	
		660 3 4
„ Office:—		
Salaries, Wages, and Commissions	1,682 1 11	
Stationery and Printing	268 5 9	
Advertising	106 10 9	
Postage Stamps and Parcels	222 13 9	
		2,279 12 2
„ Library, Bookbinding, &c.		94 9 10
„ Conversazione		248 7 2
„ *Journal*, including Printing, Stamps, and Distribution		2,387 4 10
„ Advertisements		716 19 7
„ Union of Institutions, including Commercial Examinations, Prizes, Fees, Postage, Printing, &c.	572 8 9	
Prioce Consort's Prize	26 5 0	
Technological Examinations, including Prizes, Fees, Printing, &c.	197 14 9	
		796 8 6
„ Sewage Conference		260 14 7
„ Domestic Economy Congress		13 19 6
„ Medals:—		
Albert	24 10 0	
Society's	31 9 0	
		55 19 0
„ Memorial Tablets		10 17 6
„ Memorial Window		10 0 0
„ Cantor Lectures		172 12 6
„ Special Lectures on "Unhealthy Trades"		2 4 6
„ Juvenile Lectures		24 3 0
„ Science Lectures		31 16 0
„ Sections:—		
African	69 14 0	
Chemical	69 17 6	
Indian	93 19 0	
		233 10 6
„ National Training School for Music, including Society's Scholarships		245 7 10
„ National Training School for Cookery, including Society's Scholarships		60 14 6
„ Committees:—		
General	25 7 10	
Drill (Challenge Banner, &c.)	101 18 0	
Museums	15 0	
Patent Law	26 15 4	
Railway Lamps	3 0	
Revolution Indicator	6 4 5	
		161 3 7
Mulready Trust		1 11
„ Industrial Hygiène Prize		4 13 5
„ Blow-pipe Prizes		1 0 0
„ Subscription returned (paid in error)		2 2 0
„ Annuity to Mrs. Cantor		25 0 0
„ Purchase of £317 17s. 8d. Reduced 3 per Cent. Stock (Life contributions)	300 0 0	
Ditto £423 Canada 4 per Cent. Stock (Owen Jones Memorial Trust)	399 16 6	
		699 16 6
„ Cash in hands of Messrs. Coutts and Co., 31st May, 1877	604 16 8	
Ditto in the Secretary's hands	11 7 2	
		616 3 10
		£9,815 6 1

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* To form with first year's interest on £133 6s 8d. Consols (presented by Mr. Shaw to the Society) the amount of the prize to be awarded in 1877.

Liabilities.

	£	s.	d.	£	s.	d.
To Sundry Creditors	1,345	0	6			
,, Rates	45	0	0			
,, Prince Consort's Prize	26	5	0			
,, Examiners' Fees (Commercial, &c.)	164	17	0			
Ditto ditto (Technological)	85	1	0			
,, Examination Prizes (Commercial, &c.)	143	10	0			
Ditto ditto (Technological), estimated at	72	10	0			
,, Clothworkers' Company's Prize	105	0	0			
,, Sir Walter Trevelyan's ditto	100	0	0			
,, Sections: — African, Chemical, and Indian	180	0	0			
				2,267	3	6
By Balance of Assets over Liabilities				5,921	6	6
				£8,188	10	0

Assets.

	£	s.	d.	£	s.	d.
By Society's Funds invested in—						
Reduced 3 per Cent. Stock, £3,441 19s. 7d., viz., £3,176 7s. 6d., less £571 12s. 6d. reserved to meet Trusts stated below	2,604	15	0			
Great Indian Peninsula Railway 4 per Cent. Debenture Stock	200	0	0			
				2,804	15	0
,, Subscriptions of the year uncollected	843	3	0			
,, Arrears, estimated as recoverable	400	0	0			
				1,243	3	0
,, Barry's Pictures and other property				2,000	0	0
,, Prince Consort's Prize				26	5	0
,, Mrs. Harry Chester's ditto				9	0	0
,, *Journal*, by Advertisements*				1,289	3	2
,, Cash in hands of Messrs. Coutts and Co., 31st May	604	16	8			
,, Ditto on Deposit	200	0	0			
,, Ditto in hands of Secretary (Petty Cash)	11	7	2			
				816	3	10
				£8,188	10	0

*A portion of this sum is still subject to charges for printing, &c.

P. Le Neve Foster, *Secretary.*

Stocks and Cash standing in the Name of the Society.

	£	s.	d.
Consols	£4,891	6	4
New 3 per Cents.	388	1	4
Reduced 3 per Cents.	3,441	19	7
Great Indian Peninsula Railway 4 per Cent. Guaranteed Debenture Stock	2,170	0	0
Oude and Rohilcund ,, 5 ,, ,,	2,150	0	0
Bombay and Baroda ,, 5 ,, ,,	2,450	0	0
Cash in hands of Messrs. Coutts and Co., on deposit	200	0	0
United States 2,500 dols. 5 per Cent. Funded Bonds, 1871	509	1	3
India 4 per Cents.	105	18	7
Metropolitan 3½ per Cent. Stock	343	14	3
Canada 4 per Cent. Stock	423	0	0

Trust Funds included in the above.

		£	s.	d.	
1.	Dr. Swiney's Bequest	£4,500	0	0	Consols, chargeable with a sum of £200 once in five years.
2.	John Stock's Trust	100	0	0	,, ,, ,, the Award of a Medal.
3.	Benjamin Shaw's Trust for Industrial Hygiène Prize	133	6	8	,, ,, ,, ,, Interest as a Money Prize.
4.	North London Exhibition Trust	157	19	8	,, ,, ,, ,, ,, ,, ,,
5.	Fothergill's Trust	388	1	4	New 3 per Cents., chargeable with the Award of a Medal.
6.	J. Murray, Esq., in aid of a Building Fund	50	0	0	Invested in Reduced 3 per Cent. Stock.
7.	Subscriptions to an Endowment Fund	431	12	6	
8.	Dr. Aldred's Bequest	90	0	0	
9.	Thomas Howard's Bequest	500	0	0	,, ,, United States 5 per Cent. Funded Bonds, 1871.
10.	Dr. Cantor's Bequest	5,052	19	8	,, ,, Bombay and Baroda and Oude and Rohilcund Guaranteed Railway Debenture Stock.
11.	Owen Jones' Memorial Trust	400	0	0	Invested in Canada 4 per Cent Stock.
12.	Mulready Trust	109	12	9	,, ,, India 4 per Cent. Stock.
13.	Alfred Davis's Bequest	1,800	0	0	,, ,, Great Indian Peninsula Guaranteed Railway Debenture Stock.
14.	Memorial Window Fund	345	0	0	,, ,, Metropolitan 3½ per Cent Stock.
15.	Sir W. C. Trevelyan's Prize	100	0	0	In Deposit with Messrs. Coutts and Co.
16.	Technical Examinations, Clothworkers' Company Prize	100	0	0	

The Receipts of the Society set forth above have been credited by Messrs. Coutts and Co.

The Payments set forth above have been made by authority of the Council.

The Assets, represented by Stock at the Bank of England, and securities, cash on deposit, and cash balance at Messrs. Coutts, as above set forth, have been duly verified.

J. Oldfield Chadwick, *Auditor.*
Edward Brooke, } *Treasurers.*
H. Reader Lack, }

Society's House, Adelphi, 20th June, 1877.

EXAMINATIONS, 1877.

The list of successful candidates in the Examinations for the present year (the Technological Examinations excepted) has been printed, and is forwarded to the Institutions in Union with the present number of the *Journal*. A copy will also be sent each candidate.

The results of the Technological Examinations and of the Examination in Blowpipe Analysis will be published as soon as it is known whether the candidates have obtained the necessary certificates from the Science and Art Department.

CONVERSAZIONE.

The Society's Conversazione will be held on Wednesday evening next, June 27th, at the South Kensington Museum, by permission of the Lords of the Committee of Council on Education. Cards have been issued to the members.

ANNUAL GENERAL MEETING.

The One Hundred and Twenty-Third Annual General Meeting, for the purpose of receiving the Council's report and the Treasurers' statement of receipts, payments, and expenditure during the past year, and also for the election of officers and new members, will be held, in accordance with the Bye-laws, on Wednesday next, the 27th of June, at 4 o'clock p.m.

By order,
P. Le Neve Foster, *Secretary.*

June 20th, 1877.

SOCIETY OF ARTS EXAMINATIONS.

Report of the Educational Officer.

To the Council of the Society for the Encouragement of Arts, Manufactures, and Commerce.

Gentlemen,—I have now the honour, for the eighth time, to submit to the Council a report upon the Society's Examinations held during the present year.

The Council, having decided to hold a Conference on Domestic Economy, as a branch of General Education, at Birmingham, on the 18th and 19th July, have determined not to hold the usual Educational Conference at the Society's House this year. They have, however, invited the representatives of the Institutions in Union and Local Boards to attend the Conference at Birmingham, and it is hoped that many of them will be able to be present on that occasion.

It will be remembered that last year was the first occasion on which the new system of examinations in commercial knowledge was put into practice. Upon the old system certificates were given in each of the subjects specified in the programme, but in order to obtain a "Certificate in Commercial Knowledge," it was decided that a candidate must pass in three subjects at least, two of which must be Arithmetic and English; the class, first or second, obtained in each subject being recorded on the certificate. The third class was abolished.

A glance at the tables accompanying this report will show a large increase in the number of candidates and of papers worked this year. The number of candidates examined in 1876 was 974, while in the present year there were no less than 1,185. The number of papers worked in 1876 was 1,508, but in the present year the number has risen to 1,776. This is, no doubt, partly accounted for by the fact that Music, a subject omitted in 1876, was restored to the programme for 1877, the number of papers sent up in it being 155; but, besides these, it will be seen that there is an increase in most of the other subjects. In Arithmetic, English, and Book-keeping (the first two being subjects necessary for a commercial certificate), the increase has been moderate, but in the Domestic Economy subjects there has been a marked advance, though the number of candidates in them is still too small, considering their importance. In Cookery there has been an increase, from 10 to 26, and in Health from 8 to 35; but, in the last-named subject, the quality of work done was so very poor that the Examiner has only been able to grant certificates to nine candidates.

I must repeat the expressions of regret that I made use of last year with regard to the falling off in the number of candidates for modern languages. In French especially this has been most remarkable, for while in 1875 there were no less than 250 candidates in that subject, the number fell to 157 in 1876, and has fallen to 123 in the present year. In German there has been a similar falling off from 77 candidates in 1875 to 30 in 1876 and the same number in the present year, and while Spanish brought 30 candidates in 1875, only 9 and 7 respectively appeared in the last two years.

This is certainly a matter for surprise as well as for regret. The object of the Society in instituting these Commercial Examinations is, I need not say, to encourage those intending to devote themselves to commercial pursuits in the cultivation of such branches of knowledge as are sure to be of use to them in their chosen career. Surely, with the exception of the first three subjects in our list; Arithmetic, English, and Book-keeping, there are none a knowledge of which is so valuable to a commercial man as modern languages. The clerk who desires promotion in his employer's office could hardly promote his interest better than by showing his knowledge of the languages of the countries with which he is compelled to hold constant communication. Strange indeed is it that while the commerce of Italy is constantly increasing, its language should be so neglected in England; and the same may be said of Spanish, a language largely spoken in the South American Continent. I can only express a hope that these important subjects will receive more attention in future years.

It is a matter for congratulation that the subject of Music has been restored to the programme, and has brought 155 candidates, about the same number as in 1875. An addition was made to the programme for this year, with the view of holding examinations in the practice of music as well as in the theory. This system was not carried out, as a sufficient number of candidates did not apply for examination, but it is hoped that in future years it may be found possible to make arrangements for holding these practical musical examinations. In making this proposal, the Council were not only actuated by a desire to complete their scheme of musical examinations, by giving to vocal and instrumental performers the same incitements to improvement, and the same opportunities of testing their powers which they have so far given to theoretical students, but by the hope that, incidentally, latent musical talent worthy of the cultivation offered by the National Training School for Music might present itself, and possibly be brought under its influence.

The number of prizes awarded is larger than usual. Thirty-four have been given in the Commercial subjects, and eight for those in Domestic Economy.

The Prince Consort's Prize of twenty-five guineas, graciously placed by Her Majesty at the Council's disposal each year, has been awarded to Alfred Carter, of the Birkbeck Institution, who has gained nine first-class certificates with three prizes during the specified period. The Council has also awarded the prize for female candidates, which has been gained by Mary Susan Mungeam, also of the Birkbeck Institution, who has obtained four first-classes, with two prizes during the specified period.

In my report last year, I anticipated that the alteration in the system, and especially the abolition of the third-class, might fairly be expected for a time to diminish the number of candidates, as under the former system many persons whose occupation had little of a commercial character, came up for examination. I am glad to be able to report that this anticipation has not been realised. So large an increase in numbers has taken place that the new system may fairly be regarded as quite successful, and as supplying a want to the class for whose benefit it was intended.

I have already referred to the increase in the numbers of those coming forward in the Domestic Economy subjects, and as this question will be fully discussed in the forthcoming Conference at Birmingham, I will not touch upon it further.

In the subject of Fine Arts applied to Industries, first introduced into the Programme for last year, no candidates have as yet appeared.

An addition to the system made in the present year was an examination in the Knowledge of the Contents of Public Museums and Collections of Works of Science and Art, the special object being to encourage the study and acquirement of a knowledge of the technical value of objects in any public museums. The prizes offered were one Society's silver medal with three pounds; two Society's bronze medals, with two pounds with each medal; three certificates with one pound each, and four certificates with ten shillings each, besides certificates without money prizes. No candidates came forward in this subject.

I now pass to the Technological Examinations, first held in 1873. In the first year's programme there were five subjects—Cotton Manufacture, Silk Manufacture, Paper Manufacture, Steel Manufacture, and Carriage-building, but only in three of them did candidates appear. In 1874, the five subjects above-mentioned were retained, with the addition of four more—Cloth Manufacture, Glass-making, Pottery and Porcelain, and the Manufacture of Gas; and in 1875 five more were added, as follows:—Agriculture, Silk Dyeing, Wool Dyeing, Calico Bleaching, Dyeing, and Printing, and Alkali Manufacture. All these were retained in 1876 and in the present year.

The table in the next column shows the number of candidates that have appeared in each of the five years in the various subjects.

	1873.	1874.	1875.	1876.	1877.
Cotton manufacture	1	10	13	19	17
Paper "	..	..	..	..	..
Silk "	..	..	..	1	1
Steel "	2	14	16	26	28
Carriage-building	3	3	4	3	2
Manufacture of Pottery and Porcelain	..	..	1	..	..
Gas manufacture	..	7	6	10	11
Glass "	..	..	..	..	..
Cloth "	..	2	3	2	1
Agriculture	..	..	2	..	..
Silk-dyeing	..	..	..	..	..
Wool-dyeing	..	..	1	1	2
Calico-bleaching, dyeing, and printing	..	..	..	..	..
Alkali manufacture	..	..	..	..	6
	6	36	46	62	68

It will be noticed that in the first year, with five subjects, three of them were taken up, the number of candidates being only six. In the second year, with nine subjects, only five of them were taken up, but the total number of candidates increased to thirty-six; in the third year, with fourteen subjects, eight of them were taken up, and the number of candidates advanced to forty-six; in the fourth year, with the same number of subjects, seven of them were taken up, and the number of candidates advanced to sixty-two; while in the present year eight subjects have been taken up, and the number of candidates has increased to sixty-eight. I had certainly hoped to have been able to report a larger increase in the number of candidates. Every means has been taken to make these examinations known amongst workmen; prizes of considerable amount are offered, and the Clothworkers' Company have munificently offered a scholarship of one hundred guineas in the subject of Cloth Manufacture, the award of which will shortly be under the consideration of the Council. Even so large a prize as this has tempted but few candidates to come forward in this subject, and this year there is only one.

One great reason for the small number of candidates doubtless is, that there are scarcely any classes where a student may learn any branch of technology; and there are no classes because there is no inducement to teachers to open them. The fees paid by working men, who must form the bulk of the students, are not sufficient to remunerate a teacher. If there were the same inducement held out to teachers to open classes in Applied Science as is held out to teachers in General Science, by paying them on the results of instruction, we may be quite certain that they would be opened; and when opened, that large numbers of artisans would flock to them.

It is, however, improbable, from the condition of the case, that there would be either so many classse or so many students in Applied as in General Science. The same student may, and often will, learn a little of several branches of General Science, but it is not likely that he will learn any Applied Science but that which bears on the industry in which he is engaged. This, however, would be of great value to him, and thus it is likely that the number of students would be considerable.

The Clothworkers' Company are to be congratulated on having made a commencement in this direction, by voting "a sum not exceeding two hundred guineas, for the purpose of paying the Teachers of the Students who may be successful in the Technological Examinations of the present year, on the same scale as Science Teachers are paid under the regulations of the Science and Art Department." This liberal offer came too late to act as a stimulus in the present year, but it will, no doubt, have an important influence in future years.

While on this subject, I ought to mention a munificent offer made by the Court of the Drapers' Company. They passed a resolution to the following effect:—"That with the view of making some immediate provision for improving the technical knowledge of London artisans, and of ascertaining the extent to which the members of this class would be likely to avail themselves of a system of technical instruction, this court will guarantee to the Society of Arts a sum not exceeding £1,000, to be expended during the next two years, in providing courses of lectures, with demonstrations, in metal and wood, and their application to commercial industries." They also offer a sum of £50 to be given in prizes. The interest taken by these two

TABLE I.

RESULTS OF THE EXAMINATIONS OF 1877.

NAME OF LOCAL BOARD.	No. of Candidates Examined.	No. of Candidates who Passed.	No. of Unsuccessful Candidates.	No. of Papers Worked.	No. of First-classes obtained.	No. of Second-classes obtained.	No. of Papers not Passed.	No. of Commercial Certificates awarded.	No. of Prizes awarded.
Aberdeen	62	50	12	80	8	55	17	...	...
Aldershot	13	7	6	26	...	7	19	...	...
Ashford	6	6	...	10	4	4	2	...	...
Aston	2	...	2	3	...	...	3	...	...
Bacup	20	8	12	38	1	15	22	1	...
Belfast	10	6	4	18	1	6	11	...	...
Birmingham	62	40	22	72	9	35	28	1	1
Bolton, Church Institute	22	7	15	28	...	7	21	...	...
,, Mechanics' Institution	8	6	2	9	...	6	3	...	...
Burnley	19	15	4	37	7	17	13	4	...
Cardiff	17	8	9	21	2	7	12	...	...
Carlisle	14	12	2	29	6	11	12	...	...
Carmarthen	1	1	...	2	...	2	...	...	...
Crewe	5	5	...	14	2	9	3	...	...
Derby	2	2	...	4	...	2	2	...	...
Dublin	1	1	...	1	1	...	...	...	...
Dudley	12	5	7	16	2	6	8	...	...
Dundee	3	2	1	3	1	1	1	...	...
Edinburgh	4	3	1	5	1	2	2	...	...
Gartsherrie	43	34	9	43	5	29	9	...	...
Glasgow, Anderson's University	67	44	23	81	10	39	32	1	...
,, Athenæum	33	24	9	46	9	26	11	7	2
,, Young Men's Society	27	13	14	43	...	20	23	...	...
Halifax	30	13	17	37	3	10	24	1	...
Huddersfield	7	3	4	14	1	6	7	2	...
Hull, Church Institute	10	10	...	10	9	1	...	...	...
,, Young People's Institute	75	55	20	96	14	49	33	2	...
Hyde	1	1	...	3	...	1	2	...	...
Ipswich	3	2	1	4	...	3	1	1	...
King's Lynn	10	4	6	10	...	4	6	...	...
Leeds	6	2	4	9	1	2	6	...	...
Leicester	21	8	13	21	1	7	13	...	...
Liverpool	28	19	9	42	14	16	12	1	2
Lockwood	4	...	4	4	...	...	4	...	...
London, Birkbeck Literary and Scientific Institution ...	119	100	19	197	74	80	43	10	18
,, Bow and Bromley Inst.	2	1	1	3	...	1	2	...	...
,, City of London College	68	54	14	103	31	47	25	7	7
,, Dunn's Tailors' Labour Agency Inst. ...	1	1	...	4	2	2	...	1	2
,, Islington Youths' Inst.	20	15	5	28	2	18	8	2	...
,, Kentish-town Literary Inst	7	6	1	14	4	7	3	2	1
,, Primrose-hill Educational Board	6	6	...	13	...	11	2	...	...
,, Quebec Inst.	24	12	12	40	8	14	18	3	2
,, Royal Polytechnic College	21	12	9	34	6	10	18	1	1
,, St. Stephen's Evening Classes	5	3	2	10	3	4	3	1	2
,, Stockwell Inst.	15	12	3	41	7	17	17	3	1
,, Walworth Literary and Scientific Inst. ...	4	3	1	12	...	5	7	...	...
,, Working Women's College	4	3	1	10	...	4	6	...	...
Manchester	67	56	11	126	27	58	41	6	2
Mossley	16	10	6	20	1	10	9	...	...
Oldham	39	24	15	56	4	23	29	...	...
Penzance	22	12	10	33	1	15	17	...	...
Rugby	4	4	...	14	4	4	6	...	...
Salford	41	22	19	54	8	23	23	2	...
Saltaire	1	1	...	3	...	2	1	...	...
Sheffield	2	...	2	2	...	...	2	...	...
Stevenage	12	8	4	27	...	9	18	...	...
Stonrbridge	13	6	7	22	...	11	11	3	...
Swindon	10	5	5	14	...	7	7	1	...
York	14	9	5	17	2	8	7	...	1
Totals	1,185	801	384	1,776	296	795	685	63	42

Number of Local Boards, 59.

N.B.—The Prizes in Writing from Dictation, in Writing and Manuscript Printing, and for Handwriting generally, are included in the Prize column.

great companies in the improvement of technical education will, no doubt, lead to most valuable results in the future, especially in inducing other of the principal City companies to follow the example thus set.

An examination was held this year, for the first time, in a new subject, namely, Blowpipe Analysis. Prizes of £5, £3, and £2 respectively, and certificates, were offered in this subject, the competition being open to any person, but intended principally for those interested in the mining industries of Devon and Cornwall. The arrangements were in the hands of the committee of the Miners' Association, and the examination was held at Redruth, and was conducted by Dr. Clement Le Neve Foster, H.M. Inspector of Metalliferous Mines. The President of the Miners' Association and several members of the local committee for the Science and Art Department were present at the examination. The examination was entirely practical, and candidates were required to have taken certificates in the Science and Art Examinations in Inorganic Chemistry and Mineralogy. There were nine candidates, one from Truro, one from St. Day, one from Camborne, and six from Redruth. Three of them satisfied the Examiner. The particulars will be given with the results of the Technological Examinations in a future number of the *Journal*.

In his report on the examination, Dr. C. Le Neve Foster says:—

"Though only three passed, and no one was qualified to take the first prize, the examination must not be looked upon as a failure. It is probably the first examination of the kind that ever took place in England, and many persons were afraid to try, as they had no idea of what the examination would be like. Others, again, did not care to pay the expense of a journey to and from Redruth on the chance of getting a prize. The mere fact of the successes bearing so small a proportion to the number of candidates shows how much systematic instruction in blowpipe analysis is required; and should the offer of prizes be continued for a few years, no doubt more time would be devoted to a study which is of great value to miners, mineralogists, metallurgists, geologists, and chemists."

On the whole, I venture to think that the Society may be congratulated on the results of the present year's examinations.

I have the honour to be, Gentlemen,
Your obedient servant,
CHARLES CRITCHETT,
Educational Officer.

TABLE II.

NUMBER OF PAPERS WORKED IN EACH SUBJECT IN THE PRESENT AND THREE PAST YEARS, WITH THE RESULTS FOR THE YEAR 1877.

SUBJECTS.	1874.	1875.	1876.	1877.			
				No. of Papers Worked.	No. of First-classes obtained.	No. of Second-classes obtained.	No. of Papers not passed.
Arithmetic	404	459	518	524	56	229	239
English	..	..	333	366	28	250	88
Book-keeping	290	311	325	339	82	120	137
Commercial Geography and History	..	23	11	31	8	15	8
French	227	250	157	123	8	23	92
German	61	77	30	30	11	13	6
Italian	4	7	5	6	..	3	3
Spanish	26	30	9	7	4	1	2
Political Economy	34	33	17	24	8	8	8
Shorthand	..	..	66	77	18	37	22
Domestic Economy:—							
Clothing	..	..	10	16	9	6	1
Cookery	..	..	10	26	15	11	..
Health	..	..	8	35	3	6	26
Housekeeping, &c.	..	..	9	17	6	3	8
* English History	111	..	..	..	..	..	..
* English Language	162	212	..	..	..	..	..
* Logic	8	..	..	..	..	..	..
* Floriculture	6	..	..	..	..	..	..
* Fruit and Vegetable Culture	7	..	..	..	..	..	..
* Gardening	..	2	..	..	..	..	..
† Theory of Music	112	154	..	155	40	70	45
Fine Arts	..	..	..	..	..	..	..
Museums	..	..	..	..	..	..	..
Totals	1,452	1,558	1,508	1,776	296	795	685

* Examinations in these subjects have been discontinued. † This subject was omitted in 1876.

EXAMINERS' REMARKS.

The Examiner in *Arithmetic* says:—"On the whole the papers have not been so intelligently worked as in former years. This may be partly accounted for by the fact that the questions have been framed on a more commercial basis than has previously been the case."

The Examiner in *English* says:—"Twenty-eight are in the first-class. These have all done well, and the prizemen thoroughly deserve their honours. The candidate who stands first is clearly first amongst worthy competitors."

The Examiner in *Commercial Geography and History* says:—"The papers of 1877 are very much better than those of 1876. The average number of marks obtained for the first-class is considerably higher; fully half of the candidates in the upper division have done good work, but the difference between the best and the worst set of answers is too great. Though the average number of marks obtained for the second-class is low, the work of some candidates in this division deserves praise. Three hours were allowed for each examination paper, and instructions given that only six questions out of ten need be attempted, yet several candidates seem to have taken up a fresh question every ten minutes or quarter of an hour."

The Examiner in *Shorthand* says:—"A little facility would be given to the Examiner if the members of the Local Board could be induced to put the time occupied in all cases at the foot of the paper. All that is needed is perfect uniformity in this respect. It would also be be advantageous to get the Local Boards to insist on the employment of such paper as was mentioned in the instructions."

The Examiner in *Political Economy* says:—"I have to report a considerable improvement in the answering this year. Where there has been a deficiency it has, in most cases in the present year, been in quantity, not in quality, the answers given being generally correct, or nearly so."

The Examiner in *French* says:—"I regret I cannot speak with even moderate praise of the majority of this year's papers. The best are indeed excellent, and display much aptitude and industry, but the great mass betray a very defective method of study. I have already had occasion to remark on this peculiar feature, viz., that the good and the bad papers come almost uniformly in groups. Now, allow me again to call your attention to some striking instances this year of the same affinity between papers apparently from the same centres. Numbers of consecutive papers are in several instances complete failures; and the same may be said of the successful papers. I cannot help thinking that this points very distinctly to a marked inequality in the resources, or, to speak plainly, the teaching power, within the reach of students, between the different localities where these Examinations are held."

The Examiner in *German* says:—"The result of this year's examination is, in some respects, an improvement on that of last year. The number of candidates was exactly the same; but, of the nineteen candidates who tried for a first-class, eleven were successful, whilst last year only eight obtained that distinction. Of the other eight candidates who aspired to the same class, seven obtained a second-class, and only one entirely failed in his attempt. Eleven candidates presented themselves for a second-class, and five of them were successful. Those candidates who aspired to a first-class and only obtained a second-class, were able to translate a German letter into English, but did not display a sufficient knowledge of German, in general, to convince me that they could properly translate an English letter into German, or write an original German commercial letter with that accuracy of expression which is indispensable in commercial communications. The chief defect, however, of those candidates who failed, entirely or partially, did not lie so much in the want of a sufficient commercial vocabulary as in their insufficient knowledge of the German language in general, and of German grammar in particular. Candidates should remember that, in order to be able to write a correct and intelligible German letter, it is by no means sufficient to be acquainted with a number of commercial expressions and phrases, acquired from 'Commercial Letter-writers,' or at German offices and counting-houses, but it is absolutely necessary to have a good general knowledge of the language, and, above all, to be well-grounded in German grammar. A constant application to the latter is, therefore, not only essential for the success of those who intend to present themselves as candidates on future occasions, but also for the permanent efficiency of those who have already obtained the highest certificate awarded by the Society of Arts, as, without such application, they are sure to lose, in the course of time, the standard of excellence implied by a first-class."

The Examiner in *Clothing* says:—"I am happy to inform you that the average is higher this year, as the answers to the questions are on the whole most intelligent and thorough. But I regret to find that the patterns are still extremely bad, not one of the candidates getting the right number of marks for the two simple patterns required."

The Examiner in *Health* says:—I regret that there should be so small a proportion of the candidates whom I am able to recommend for a certificate. By far the greater number of the candidates are perfectly ignorant of anything that would be of the least practical use in domestic life."

The Examiner in *Handwriting* says:—"The specimens of handwriting this year continue to show that the advantage of perfectly legible writing is becoming more generally recognised by the candidates. Although the first and second prizemen scarcely reached the standard of previous years, the twelve best specimens of writing were singularly close together in point of excellence. The Examiner would again point out the importance of writing with absolute clearness and legibility, with good and even spacing between letters and words, with short loops and absence of flourish, with small well-formed capital letters, with upstrokes and downstrokes of an even thickness, and with a general appearance of manliness and decision, or at least, as 'George Eliot' says, 'a hand in which each letter is distinguishable without any large range of conjecture.' The specimens of printing were few in number, and not so good as on former occasions."

HEALTH AND SEWAGE OF TOWNS.

Friday, May 4th; the Right. Hon. JAMES STANSFELD in the chair.

Sir Henry Cole, in resuming the discussion, said the meeting represented chiefly local governing bodies in and out of the metropolis, and they might be congratulated on having an Act which, if properly worked, would help them to do all they wanted in the way of removing the sewer-gas. In London they had spent between £4,000,000 and £5,000,000 in making the sewers, and happily, according to some of the opinions which had been expressed there, not much above one-third of the houses were connected with them. This question of sewer-gas was a troublesome one, and if all they heard was gospel, they were to be congratulated that they had not made full use of their £5,000,000 of expenditure. The people of London were not under a Board of Health, but under the Home-office and under the Vestries. Between one and the other, the result was that at the present time the chairman's successor sat in one of the worst public buildings ever erected, and next door to him was Mr. Cross, who had the care of the health of the metropolitan area! In addition to that, there was another government authority, the Office of Works, superintending the building of the Home Office, which was erected by one of the most eminent architects in the country, who had ignored the whole question of drains, and it was only when the clerks began to get typhoid fever, and Mr. Cross's own nose was offended, they asked how it was sewered. He did not wish to make any personal questions of this state of things, but the architect seemed to have turned the drains over to his clerk of the works, who had forgotten all about it, and though no doubt the architect got his five per cent. on the contract, he produced a building utterly unusable. When that was the practical outcome of what Government did in London, he thought people in the country might congratulate themselves that they were under a different kind of rules. In London they were in the most benighted condition. There was a Metropolitan Board of Works, but when any people went to it to make complaints, as the Society had done, they were shown to the door, termed busybodies, and told that everything was perfect. In his own parish of Kensington everything was declared to be perfect, although they had almost chronic typhoid fever, and could not get any redress.

Mr. Weaver, C.E., F.C.S., explained, by the aid of a diagram, his system of ventilating sewers, which he had described in his printed paper. He also added with reference to what had been stated about Dr. Parkes having made a report with regard to the sanitary condition of Liverpool in connection with Dr. Burden Sanderson, that, as the result of their observations, they found there was a down draught, and not an up draught in the ventilating pipe, he had been in correspondence with Dr. Parkes on the subject, and informed him that this statement was contrary to his own experience. Dr. Parkes wrote to him in reply, saying that he knew nothing whatever about that statement, and was not aware how it got into the report.

Mr. Bryan (Blackburn and Burnley) said there were one or two precautions necessary in using the system of ventilation recommended by Mr. Field. The house in which he lived had been arranged in this way for eleven years; but when he went there eleven months ago, he found a most awful stink in the bedrooms; and, after some investigation, it appeared that the weight of the ventilating pipe and soil pipe, being of lead, caused a subsidence just at the bend where they entered the drain, so that the sewage had percolated through into the soil, and found its way into the cavity wall, and from there up into the house, and caused a most polluted state of the atmosphere all over the house; even in the rooms farthest from the water-closet this offensive smell was very perceptible. He found the same thing had occurred in several other houses in the neighbourhood, which were built in the same way with a cavity wall, and it showed the importance of seeing that the connection was sound at the bend.

Mr. Honeyman (Glasgow) said he had come rather to learn than to speak; but, inasmuch as Glasgow was, next to London, the city where the water-carriage system was most generally in use, it might be as well to state what was being done there. It was particularly well situated for a water-carriage system, because they had no difficulty in getting gradients for the common sewers. The great difficulty had been with the outfall, and steps had been taken to overcome that; but, as a strong confirmation of the evils resulting from the admission of sewer gas into houses, it was worthy of remark that the bad outfall was not the cause of any serious injury to the community. The statistics showed that the districts furthest from the Clyde were the most unhealthy, and those nearest to it the most healthy, showing the deadly effects of sewer gas in the higher districts, and the possibility of getting rid of these effects by sufficient ventilation. The whole of the sewage was thrown into the Clyde; but it immediately found access to the air, became diluted, and was perfectly innocuous. The authorities in Glasgow had no power to interfere with the junction of the common sewers with the house drains; they compelled the inhabitants to join the drains, but exercised no supervision over them. They did, however, insist on the water-closets being ventilated, and, in most cases, on the soil-pipe being carried up through the roof. The water company insisted on the waste pipes from the cistern being taken either through the walls of the houses or into the baths, or if there were no baths, being left open exactly over the water-closet seat. Their object, of course, was to prevent waste of water, but it had an important influence in preventing sewage-gas getting out and contaminating the water. Besides this, very little had been done to prevent the evils of sewer gas in the dwellings of the lower classes, but in the better class of houses, erected under the superintendence of architects, some additional means were taken as a rule. There was, however, a great deal of misapprehension with regard to the duties of an architect in the matter, and also as to his power, and some people seemed to think that architects were principally to blame in this matter. He found, however, that within the last 10 years, in Glasgow, 40,000 new houses had been built, and he was quite certain that with not more than 10,000 of those had an architect anything to do. It was clear, therefore, that you must look to bye-laws or some public authority to ameliorate this evil. He did not think there had been any suggestion made for the last 20 years which might be expected to produce more practical results than that made by the Chairman in opening the proceedings yesterday, namely, that the implied contract between the local authorities and those bound to use the drains should be kept in view, and he hoped that remark would be borne upon the consciences of local authorities throughout the country. He was inclined to go farther than the chairman, who thought that the authorities were bound to provide sewers into which house drains might debouch, every precaution being used by the owners against emanations arising; but he thought they were bound to provide common sewers into which the inhabitants could send their drains, irrespective of any safeguards whatever. There were difficulties no doubt, but the authorities made no attempt to meet them. It was not impossible to overcome them, and if on the one hand they told people to join their drains to the common sewer, on the other hand they ought to be compelled to make that sewer in such a way that compliance with their edict should not endanger the health of the people. If was now about 20 years since he brought forward all the essential points which were brought forward now, and advised similar plans for overcoming the evil. His plan was essentially the same as Mr. Field's, except that the ventilating shaft was over the U dip, which was a much better plan. The trap on the table, which Mr. Weaver had referred to, was almost the same as he advised, and he might add for the benefit of those who were disposed to think that architects had not done their duty, that a trap essentially similar to Mr. Weaver's was designed by a architect 20 years ago, and its use clearly stated. He would also remark that it was of no consequence whether the current of air went up or down; it was almost certain to be up, but if it came down the drains were equally kept free from the nuisance of sewer gas, which was the real object aimed at.

Mr. Baldwin Latham said he was bound to dissent from some of the facts stated by Mr. Field, although he did not dissent from the principles laid down. But he would show what had taken place in practice with regard to some of these arrangements. It also seemed somewhat doubtful whether or not sewer gas did produce the deleterious effects laid to its charge. He had long thought that sewer gas was the cause of the outbreak of enteric fever which had occurred in Croydon, but he had since changed his opinion. In 1875, when the last epidemic occurred, being a member of the sanitary authority, it greatly concerned him that a town which had spent so much money upon drainage should still be subject to these continuous outbreaks; but the same cry was raised, that it was due to the sewer gas. In 1853, a commission was appointed, and there were several reports by officers of the General Board of Health, and then a special commission was sent down by Lord Palmerston, consisting of Dr. Arnot and Mr. Page. They came to the conclusion that the outbreak was due to the effect of the Bourne water elevating the subsoil water under the sewers, and, in the absence of ventilation, driving back the sewer air into the houses. Now, at that period, there were three outfall sewers in Croydon, only one of which was on a sufficient level to be affected by this Bourne water; yet in the whole of the district sewered and supplied with water was enteric fever rife. In 1865, there was another severe outbreak, and it struck him as it had struck those gentlemen, that it was due to the want of ventilation of the sewers. But in 1865 and 1866, he carried out a system of public ventilation, and introduced into the houses such arrangements as were shown on Mr. Field's diagrams, all direct communication with the sewers being cut off, so that, in 1875, when another great outbreak occurred, there were very few houses but what had their drains ventilated, and the whole of the public sewers were ventilated also. Being directly concerned with the sewer arrangements of upwards of 50 towns in England, he thought it time to make some inquiry on his own account, in reference to the frequent outbreaks at Croydon, to only three of which he had alluded, and he, therefore, got a return of all the cases of enteric fever from 1843 to 1876. The result was most remarkable. It showed that one part of Croydon was remarkably healthy, whilst another was subject to these epidemics, and the area so affected was supplied by water from the Croydon Water Works. Further inquiry showed that the wells which supplied Croydon, which were located in the centre of the old town, went through only 15 feet of gravel over the chalk from which the supply was taken, and at particular periods these were liable to pollution, so much so that, when the Bourne water had been out, the water in the wells and subsoil had been elevated, and, if they stopped pumping at the water works, the water rose in the cellars of the old town, and starting to pump withdrew the water, showing the intimate connection between these wells and the subsoil water. The subsoil water, moreover, is known to be at times highly charged with sewage. In 1854, after the first outbreak, the General Board of Health made a report, and said if fever were due to defective works, no alteration having been made in those works, how was it the fever was all gone? Shortly after this, Mr. Henry Austin, the chief inspector, made a similar observation, showing that they were not at all satisfied with the result arrived at in 1853. But it so happened that Croydon became the battlefield of a new system of sewerage, and, in consequence, the whole of the evils of this outbreak of enteric fever were at once laid to the new-fangled system of dealing with the sewage, as it was termed, and every other consideration was lost sight of. As a member of the Board of Health, he moved for a return from the medical officer, Dr. Philpot, of the number of houses and the number of cases occurring in the whole district of Croydon, and the results showed that in the whole of the water district of Croydon, in the year 1875, one person out of every 42·49 persons living was affected with fever, and the enteric fever death-rate was 1·63 per thousand of the persons living in that district. Outside the Croydon water district one person out of every 808·82 persons had fever, whilst the enteric fever death-rate was ·36 per thousand. But there were only 17 cases in a population of 13,750 in the area outside Croydon water district, though the proportion of deaths to the number of cases was much greater than within the water area. In the water area one case in every 17·2 cases proved fatal, while out of the water area 1 case in every 3·4 cases proved fatal. In that part of Croydon in which defective sewers were to be found one person out of every 45·03 persons living in 1875 had fever, and one death occurred in every 25·76 cases. All these defective sewers are located within the Croydon water district, and the figures show how little effect the sewers could have upon the matter. The result came out that there had been fewer cases of fever in roads with defective sewers than in other parts, and also fewer deaths. He was quite satisfied that sewer air would transmit disease, for he had known scarlet fever transmitted from house to house in the way shown by Dr. Thorne. He did not believe for one moment that sewer gas was the cause of enteric fever; It was now shewn to arise from a high order of fungoid growth, and it was impossible to get a development of a high order of fungus in air, for it must be brought into contact with soil; so that, where there were cases of enteric fever transmitted by sewers, that sewage must have been in contact with soil through a blocked sewer, or something of that kind. He did not say that enteric fever could not be caused by sewer air, but that an epidemic of it was not so caused. A further evidence of that was given by Dr. Maclagan, who, in his work on the "Germ Theory of Disease," showed on pathological grounds that it was almost impossible to get enteric fever by breathing impurities—that the germs must be taken into the body, either in food or drink. If sewer air was of this deleterious nature, and if sewers under houses had such a malarious influence on the population, the death-rate from enteric fever ought to be very high in London; but, instead of that, in the last nine years, it averaged the lowest rate known thoughout the whole kingdom, yet in London all the sewers ran under the houses, and very few of the house-drains were ventilated. In a large house not far from that room, a large banking establishment, he was called in not many months since to investigate what was said to be an outbreak of enteric fever. He found the establishment could not be in a worse possible condition, there being a number of openings in direct communication with the sewers; and there were two of these openings near the fireplace at which all the meat was cooked, from which the draught was so great that two candles placed near them were immediately blown out. If he had not had so much experience at Croydon, he should have immediately put that down as a case where sewer air caused the outbreak. There was, however, only one gentleman in the establishment, one of the partners, who had fever, and, happening to call upon him two months ago to examine his house in Park-lane, he informed him that he had been down with his servants and his brother-in-law to visit his father-in-law in the country, and it appeared after this visit that he was not the only one of the party that had fever, although he was the only person in the London establishment that suffered. The cause of the fever was discovered in a spring of water which the party had used in the country, and with which a direct communication with sewage was established. There, again, the question of ground water-supply came in, and he believed that in all instances where there was an epidemic outbreak of enteric fever it was invariably due to some defect in the water-supply. Dr. Thorne had said that the current of air was always in one direction; but he could hardly think he had had much practical experience in the matter, because it was very well known that if you poured a bucket of water down the sewer you did not at first see the water, but it drove a volume of air before it; if you flushed a long length of sewers, you had a violent current of air long before the water appeared, showing that the air always went in the direction of the water. If pipes of the kind shown were sealed at one end, to suppose the air would go back up against the water, was contrary to common sense. Many of these theories arose from gentlemen not knowing the practical working of sewers. The fact was there were currents both ways. At one period of the day the sewers were running half full, and at another period three-quarters full, and during the time when the sewage was rising, it was expelling the air at every opening, but when it was declining, it was drawing in the air at every opening. If you only had openings sufficient, the sewers would take care of themselves; but in the majority of cases, these openings were not provided. With regard to traps, as Mr. Humphris had already said, they required to be very carefully made, or they were worse than useless. If any one wished to make a little inquiry as to these traps, they might go to Beckenham, where the house drains formerly had a trap inserted between the sewer and the drain. But they had been taken out, because, in the course of a few years it was found that instead of being any benefit, they had caused stoppages in the drains. He was, however, quite ready to admit that putting a trap between the sewer and the house was a good thing, but the difficulty was the form of the trap. He had been making some experiments on the matter, and he argued in this way—that the reason that these flat traps failed, was, that when the water was running for some time, it came in with no practical velocity, and had no power to drive the floating matters under the dip. In order to get over that difficulty, he made a trap in which the water fell like an overfall into the trap, a depth of something like six inches, and of course any floating matters coming under the influence of that fall were taken underneath the trap. In his trap the mid-feather was only one inch wide, so that the materials had only to dip down a short distance to get free. Mr. Buchan, who seemed a very practical man, had lately published a book on "Plumbing," in Weale's series, which he should recommend every one interested in this question to study. He had hit upon the same thing, and also described other modes, as well as a cowl to be put on the top of the pipe to ensure an upward current. He understood that some people had been threatened with legal proceedings for using such a cowl; but he might inform them that a book was lately published in France which showed that this system of admitting air into drains, and using appliances for the extraction of the foul air had been in use 12 years, so that it was nothing new. The effect of the cowl was to produce an induced current, and to suck up the air from the lower point. Without such an arrangement, all these things were liable to have the current reversed; the air rose by specific gravity, and in cold weather the metallic pipe might get so cold that the current would descend. This fact should be borne in mind in making sewer openings. The whole question of ventilation required to be carefully considered, especially in reference to epidemics of enteric fever, for he considered it was clearly established, in the first epidemic at Croydon, that the houses which had ventilation pipes did not escape, and the same experience had been abundantly established in more recent times. At Ashford, in Kent, he had found a plain case in which scarlet fever was spread through the instrumentality of untrapped and unventilated sewers and a cesspool. There were 30 houses in a row, and there was no direct intercourse between the tenants. A stranger came to one of these houses, having a child ill with scarlet fever, and before a week the children in the whole of the houses were laid down with the same disease. The houses all drained into one cesspool, and the sink of each house communicated directly with it, without even the intervention of a trap.

Mr. Hewson wished to ask, with regard to Stott's system of ventilation at Halifax, whether the street gullies were trapped and the sewers ventilated; also what was the size of the pipe which led from the sewers to the furnace. His opinion was that the distance at which these extractors could be effective must be very limited, because the supply of air induced by the furnace would come through the openings nearest to that furnace. At Rochdale they had ventilators 50 yards apart, the ventilating pipe opening directly into the road, and at every 200 yards there was a man-hole, that distance being regulated, of course, by the side streets. But there was always one other junction at the side streets with the main sewers. As they had steep gradients in Rochdale, they found the gas all accumulated in the upper levels, and there was an up-draught in the higher sewers. But to overcome this, they had now fixed in the various man-holes, a wooden valve, hung from each of the arrival sewers, so that instead of the whole of the sewage gas rising to the highest levels, each particular district got its proper share. With regard to private drains, he did not see any objection to the plan proposed, except that it would be rather expensive. He might add that at Rochdale, whenever they served a notice on an owner of property, they also served him with a plan showing how the ventilation could be carried out. As to the quality of workmanship, they had a list of qualified drainers, who were admitted to it on the same terms as the various plumbers by the gas companies, the conditions imposed being that no connection was to be closed in until it had been inspected, and the dimensions and particulars of the sewer into which the drain was discharged, taken. Whenever any contractor departed from this very essential condition he was at once struck off the list.

Mr. Ainley said all the gulleys in Halifax were trapped. Before the introduction of Stott's system, there were up currents at all the street openings; but since then this had been introduced they always found a down current. They had only applied it where there were complaints of bad smells, using 18-inch pipes, which were brought from the main sewer by the boiler furnace, the air being brought under the fire-grate and so through the fire.

Mr. Weaver asked if the manufacturers were willing to grant permission for these to be put down?

The Chairman said it was a matter of voluntary arrangement.

Mr. Weaver said, to his certain knowledge, the same idea had been carried out in a large midland town some 15 years ago; but they found great difficulty in getting permission to make the connections with the furnace.

The Chairman said that might be a difficulty in some places; but it had not been found so in Halifax.

Mr. Latham said some years ago a series of experiments were made when the clock tower at Westminster was in course of construction, and a furnace was put up to try its effect in ventilating the sewers. It was then shown that the currents ordinarily produced in the sewers from the ebb and flow of the sewage and other causes, far exceeded the current produced by the special ventilating apparatus at the clock tower.

Mr. Woodward asked how this system could be applied to towns like Leamington or Cheltenham?

The Chairman said it could not be applied under such circumstances.

Mr. Woodward said it appeared to him the best plan was to adopt such a trap that the sewer-gas could not pass up from the ventilating sewer; and he had seen that morning a simple contrivance in the room below through which it seemed almost impossible that sewage gas could escape. It might be called a self-acting double-ball construction; it was very inexpensive, and simple in construction, and easily adopted to every kind of drain; so that he might strongly recommend it. Mr. Field's diagram explained his own system of ventilation very well, except that he had a catch-pit which intercepted the sewage; and yet, with all that precaution, he found that if any neighbours used lime in their water-closets, he found it quite perceptible in his own house.

Mr. Bolton (Aberdeen) agreed with very much of what had been said, and had adopted a similar plan to Mr. Field's, except that he placed the air-opening in the side of the wall perpendicularly, so as to prevent the entering of any dust, and the pipe descended the wall into the sewer. He had no doubt that many people had invented the same thing independently. In their bye-laws they had full power to compel the ventilating of sinks, soil-pipes, and water-closets; and in all new houses, this system was being carried out in the most thorough manner. He had an inspector appointed to do nothing else but look after these drains, and see that they were properly constructed and ventilated. Whether the air went in at the air-opening and up the shaft, or came down the shaft and up the other channel, did not appear to him of importance, because if the current of air was kept up in the soil-pipe, there could be no perceptible smell from it. He agreed very much with the previous speaker, that trapping could be overdone. His doctrine was that the more smell was confined, the more it smelled.

Mr. Ernest Turner said he supposed he stood before the meeting at a disadvantage, as he belonged to that much abused profession, the members of which were supposed to care little about the subject under discussion and to know less. With reference to the "pan-closet" that had been so justly condemned by Mr. Rogers Field, he had for many years been convinced that the offensive effluvium often noticed in water-closets does not, in a great number of cases, arise from the gas from the sewer, but from these disgusting appliances for the accumulation and stowage of filth, and he felt sure that people generally did not know the difference between the "pan" and the "valve" closet. He had seen many dozens of these pan apparatus taken down, and could assure the meeting that the workmen would give the pan a kick, and that a complete cake of decomposing matter, a quarter of an inch thick or more, would fall from them. Mr. Turner pointed out on the diagram the various parts upon which matter accumulated, and said that in the container there was often a small air hole at the top through which foul air could escape into the house. He thought that if, as Mr. Field had said, it was impossible to have a healthy house where these contrivances are used, it was surely a question that affected not only the individual who used them, but the community at large, and should therefore be recognised by the Legislature, so that steps might be taken to prevent the further introduction of such dangerous appliances. He always recommended their removal, but where cost was an obstacle, they were only cleaned and burnt out, when the closets would for a time be free from smell (other arrangements being perfect), but would gradually become more and more offensive. With regard to the pneumatics of the soil pipe, his experience was, and he had made a large number of experiments, that the air current was sometimes upwards and sometimes downwards, and having found this downward current, he recommended a cowl at the top to produce an upward current as often as possible.

The Chairman asked how the cowl acted?

Mr. Turner explained that what was called a "cowl" really acted as a pump or exhauster; there were several good "cowls." Braby's archimedean screw, Banner's and Boyle's, were all equally useless when the air was perfectly calm, but when there was a great pressure of wind, which was the time when the traps are most sorely tried, they best perform their functions. He was pleased to hear Mr. Baldwin Latham's views as to certain so-called "patent systems," as he had been threatened with legal proceedings, for daring to introduce air into the soil pipe.

The Chairman asked if the cowls were simply fixed to break the force of the wind, or whether they revolved with the wind?

Mr. Turner said there were several kinds of revolving cowl, one was called the archimedean, and another Boyle's, and they produced an upward current in the shaft. His object was to prevent the presence of foul gases, not to take up a patent, but he happened to be the unfortunate individual who was threatened with legal proceedings for daring to admit air into the soil pipes.

Mr. Adam Scott said he must make a few remarks on Mr. Latham's statements with regard to sewer-gas. In the small manufacturing town of Selkirk the water-closet system was partially adopted, and the upper part was well sewered, but in the lowest parts of the town there was nothing of the sort, and the people simply put the refuse out of their houses and it was carried away every day or two. But the water-supply to the whole town was exactly the same. Therefore, if Mr. Latham's views were correct, the typhoid epidemic which occurred last year should have been as prevalent where there were no sewers whatever, as it was in the upper part of the town where the sewers prevailed. But the medical report was that where the stuff was got rid of daily and there was no connection with the sewers, though the same water was used, typhoid fever was entirely absent. This proved, therefore, distinctly that typhoid fever was in some way or other connected with the water-closets, and the connection of the sewer with the house. He had a cousin living there, who had thirteen members of his family all down with fever. They had a water-supply of their own, but they were connected with the town sewers, and the whole family were struck down, and one died. Dr. Littlejohn stated that in the parts of the town where there was no connection with the drains, they did not know what it was to have typhoid fever or diphtheria, but they were always prevalent in the fashionable parts of the town; in fact, almost endemic, and he believed the same thing occurred in Glasgow.

Dr. Bartlett wished to put forward a new point of view in connecting disease not only with sewer-gas but with water supply, the one and the other being frequently coterminous. Everyone seemed to agree, perhaps with the exception of Mr. Latham, that it would be desirable, as far as possible, to exclude sewer-gas from the house. Mr. Latham rather upheld a notion that sewer-gas would convey diseases, but would not cause an epidemic of typhoid. He desired most distinctly to point out that if any disease could be brought, or engendered, or disseminated by sewer-gas, it mattered very little whether it were typhoid, or scarlet fever, or any other. Sewer-gas was certainly not that which any one would wish to have in a house. The opinion put forward was this, that when sewer-gas was brought into houses in any way whatever, it might be absorbed not only through the water in the traps as Mr. Field had shown, and as he absolutely knew to be the case, but being taken up through the waste pipes and into the closet, and by a variety of other means, it became absorbed in the drinking water. So that while Mr. Latham might say the disease was caused through the water and not through the gas, it might be primarily through the gas and merely vicariously through the water. Within the last six months he had verified the fact that in water in cisterns where there was a connection with the sewer-gas, in neighbourhoods where there was a typhoid epidemic, there were myriads of the *crinothrix polispora*, which Dr. Klein had identified with organisms which were found within the bowels of patients suffering from typhoid fever, and which he himself had found in the urinous slops of typhoid patients. If we adopted the opinion that these might not be the germs of any particular disease, but that they no doubt accompanied this disease, we had a very distinct indication by which we could indicate where disease was, and where it was most probably to be found, and thus we had a distinct connection between typhoid epidemics carried directly by sewer-gas, or indirectly through water which might have dissolved them. Hence he wished to ask Mr. Field whether, when the gas bubbled through the water which sealed the trap, it would not find its way into the house. He believed the gases would be greatly diluted, but he had no faith in the dilution theory with regard to poisons of this nature. Whether you had one shot or a dozen, it mattered little if you were shot in a vital part. If these epidemic germs were disseminated in the diluted form so long as they were capable of extention, it merely meant that the chances of evading a germ were multiplied; but the germ itself, and the poison therein contained, might possibly be magnified by dilution. The germ might have found the manure and soil which suited it, as was the case with some ferments. If you took an ounce of yeast and kept it without any dilution, it would not weigh an ounce in course of a few days, but if you put it in a proper soil, with proper manure, that is in a saccharine solution, you would have in a few days instead of an ounce many pounds weight. This might be the case with diluted typhoid germs, which were not perhaps a higher order of fungoid growth, but rather a kind of monads, and therefore not to be taken as being absolute growths, but as single germs or cells. It appeared to him, therefore, that if there were a constant draught passing up the upright pipe, a certain portion of the sewer-gas must be diffused into the house, but this might be avoided by an additional opening between the trap and the upper pipe to let the fresh air in.

General Cotton asked if Dr. Bartlett did not believe that the germs were absolutely destroyed by a certain amount of dilution; whether they were not absolutely destroyed by the amount of oxygen they came in contact with in the air?

Dr. Bartlett said he had now at his laboratory a large number of vessels, in which the *crinothrix* was to be seen germinating as far as it would germinate. He did not find any amount of oxidation in a living body destroyed it until its growth was exhausted.

Mr. Coghlan (Sheffield) thought few sanitary engineers would find any novelty in the suggestions made by Mr. Field. When they could succeed in educating the British bricklayer in the laying of drains properly in a straight line, in having the main sewers well ventilated, they would have overcome the greatest difficulty. He had had this system in use for many years in his own house; but instead of traps, which would be generally found a nuisance, especially in winter, when they would be frozen, he had another opening nearer the sewer. In Sheffield the system of cutting off all the sinks was adopted, and that was the great point to prevent direct communication. In his own bedroom he had the water laid on, and the waste pipe was simply carried through the outside wall down an ordinary rain pipe to an open grating in the centre of the yard. Not long ago he visited a gentleman in a very fine house, who showed him the water laid on in his bedroom. He did not like to make inquiries about it; but shortly after he heard that his child was ill with fever and died, and then he himself was ill. It then occurred to him that the waste pipe must be connected directly with the sewer; and on inquiry he found this was the case, though, of course, there was a trap at the bottom, which, as usual, was of no use.

The Chairman inquired what was the object of a double inlet to the drain?

Mr. Coghlan said, to have as much fresh air as possible. You did not want Mr. Latham's ventilator, or Mr. Rawlinson's charcoal basket, but simply plenty of inlets and outlets for the air.

The Chairman asked if there was any advantage in having two inlets instead of one double the size?

Mr. Coghlan said the second inlet was much farther from the house; he wanted it as near the main sewer as possible.

Mr. Turner said if they were to have so many openings, why not resort to the primitive form of an open ditch at once?

Mr. Coghlan said the open ditch would be the best thing if it was not for the appearance.

Mr. Watson said they were originally of opinion at Leeds that the more thoroughly they trapped the main drains, the more thoroughly they would secure the public health, but they found that when they had accomplished the work, the higher parts of the town were flooded with sewer-gas, and since then they had untrapped every drain at every gully, and were now under the impression that if the sewage gas was liberated directly it was generated no harm would ensue, but the longer you confined it the more injurious it became; and, therefore, at every gully-gate there were means of ventilation introduced, and since then they had never had any complaint of sewage gas. In all recent buildings, also, they had carried out ventilating shafts up to the roof of every house, and that was found to be a decided advantage.

Dr. Wilson said Mr. Latham was quite at variance with Dr. Carpenter and Dr. Buchanan, with regard to the outbreaks of the enteric fever at Croydon. Dr. Carpenter ought to speak with great authority, because he had had typhoid fever in his own house, which he could demonstrate to have arisen from sewer-gas coming through the water-closet. They had had almost a dissertation on the origin of typhoid fever from Mr. Latham, and, no doubt, the majority of medical officers present would think it was the old story of *ne sutor*. With regard to scarlet fever, the opinion of the majority of the profession was that it did not arise *de novo* from drains, although if washing water were thrown down it might be the means of conveying infection. At the same time, a bad sanitary condition arising from drains and water-closets was most prejudicial, causing the disease to have a more fatal tendency. The conclusion he drew was that water-closets and conveniences ought to be outside the house, away from any chance of polluting the air.

Mr. Latham wished to say, in explanation, with regard to the opinions of Dr. Carpenter and Dr. Buchanan, that if Dr. Wilson would carefully read the report, he would come to the conclusion that Dr. Buchanan did not form any conclusion whatever as to the cause of fever in Croydon, for he distinctly mentioned a number of houses where he could find no sanitary defect whatever, and the question was, how was the fever brought into those houses. That which caused the fever there might equally have been the cause in other houses where he had found defects. With regard to Dr. Carpenter, the only difference of opinion between them was this, Dr. Carpenter was of opinion that it was caused by the water in 1875, but thought it was by impurities getting into the water-mains owing to the intermittent supply, whilst he (Mr. Latham) was of opinion that it was fouled at its source rather than after it left the works. Another gentleman seemed to imply that he did not advocate ventilation, but those who had studied his work on "Sanitary Engineering," would hardly come to such a conclusion. He was the first who pointed out the necessity of ventilation 12 years ago, and then had to fight the question most energetically whether or not ventilation should be insisted upon, for the large majority then said it was totally unnecessary, and only a few others besides himself were in favour of it. But in the course of 12 years he had seen the principle brought into operation. He did not say that scarlet fever arose *de novo* in the sewers, but he did say that sewers might be the means of transmitting disease from one house to another, and that was clearly established in the particular case he referred to. It was quite clear also to those who read Dr. Murchison's work that there was some strange relationship between scarlet fever and enteric fever, but what it was, it was for medical men to find out. With regard to the cases mentioned by Mr. Scott, he must say this. It appeared to him sewers were often most imperfectly constructed, especially with regard to the joints of the pipes, and in that way pollution might have spread. Hitherto they had been selecting the best material for sewers, namely, glazed pipes, but they then joined them together with a plastic material like clay. In 80 out of 100 drains the sewer pipes were jointed in that way, but in his own practice he had long since discontinued it. If you put two pipes together with a spigot and socket joint, and filled the joint with a soft, yielding material, the mere weight of the earth put upon it in filling in the trench would press out the whole of the material underneath the pipe, leaving an aperture at the top, so that the inside was in direct communication with tho ground. In many towns, where the subsoil water escaped at a considerable distance from the sewer, the tendency was for the water to leak out of the sewer into the subsoil, and thus the whole subsoil got more or less permeated with sewage and fæcal matter, and the consequence was that the ground atmosphere, which to a great extent aërated the houses, was contaminated. His experience in London showed that most of the people who went into the fever hospital with enteric fever were domestic servants, those who worked in the basements and kitchens, and at Croydon they had also been shown that the greater number of sufferers were women and children, the water drinkers who had been brought in contact with the telluric influences through the instrumentality of the ground water supply. It was not at all necessary, however, that a system of sewers should have this effect in causing enteric fever. It appeared from the last report of the State Board of Health at Massachusets, that they had sent a commissioner to different towns, and amongst them to Dantzic, which he had had the honour of draining, and it appeared in their report that enteric fever was now unknown in Dantzic within the drained area, and had become only a disease of the suburbs. The whole of the sewers there were constructed below the ordinary water line; they were pumping sewers, and the effect was for the water to flow in the direction of the sewer rather than out of it, and, therefore, although there might be a little imperfection, the current being in the direction of the sewer, there was a pure soil and pure aëration for the houses.

Dr. Bartlett said he had been a resident at Croydon for a good many years, where Mr. Latham's ideas had been carried out; but the sewer ventilation there was now condemned as almost useless.

Dr. Wilson said that when the disconnected system of sewers had been introduced, a diminution of fever had invariably followed.

Mr. Barr said he could demonstrate from his own observation that enteric fever did arise from sewer-gas poisoning.

Mr. Rogers Field, in reply to the various observations which had been made, said there was a practical objection to having the opening directly over the centre of the trap. He tried it first that way himself, but if it were in the middle of the opening the fæcal matter would rise into it and prevent its action. Moreover the foul matter retained in this opening created a nuisance. He quite agreed with what Mr. Latham said that you ought to let all matters pass as freely as possible, and if a trap were properly arranged it would do so. With regard to tho drainage of cellars, that was explained in the diagram attached to the Uppingham bye-laws, but it would take too long to explain them now. What Mr. Turner said about cowls was quite right. He generally adopted a cowl, of which there were several kinds all more or less efficient. At the present moment he was having a series of experiments made with these cowls. He had four or five side by side with an anemometer to give the velocity of the wind, and a current meter at the bottom to measure the upward current produced.

Mr. Weaver asked if he found they never produced a less current than 4 feet per second?

Mr. Field said the upward current varied with the velocity of the wind.

Dr. Bartlett said a mile and a half an hour was the smallest current perceptible.

Mr. Field said the current meter showed a less current than that. Dr. Bartlett had asked what took place if the sewer-air bubbled through the trap; but it must never be allowed to bubble. Bubbling through was an indication of under pressure, and this would never occur if there was proper ventilation. If it diffused through, it would pass off through the man-hole, which must be properly ventilated. Whether being so diluted it was perfectly innocuous, was a medical question, but it was generally so considered. He did not think there was any danger of the traps freezing, at any rate, in the South of England. He feared it himself at first, especially with reference to the sink disconnection, but he had never found this difficulty arise, probably because the outlet of the trap was in communication with the sewer where the air was presumably warmer.

Mr. Austin asked if the syphon traps did not sometimes suck dry, and allow the gas to escape through them?

Mr. Field said he never found such a thing occur in a properly ventilated drain. If there were one trap near to another without intermediate ventilation the one might suck the other, and that would happen in the pan closets, if there were not a hole of some kind to allow the air to escape, as he had already pointed out when speaking of the defects of this apparatus.

Gen. Cotton said that, let a ventilating pipe act in what way it would, you had sewer-gas passing up past the water-closet, whether much or little diluted, and in opening the closet it must enter the house. The connection wanted was an opposite direction of current down from the top, past the closet, and up somewhere else, and he suggested, therefore, that there should be one cowl at the top of the ventilating shaft compressing the air, and another to extract it at another point some distance from it. He understood that this system was in operation at Guy's Hospital. There was one point which he had not time to go into fully, but which he wished to mention, namely, the condition of sanitary law. At this moment there was nothing in London but bye-laws. The Acts of Parliament were before the Vestries, and each of them had a different reading of them, and had its own bye-laws. Those bye-laws were in some cases extremely arbitrary, and in others very lax. In some parishes they read the law as enabling them to make any bye-laws they pleased, which put the public under any amount of tyranny; and, although it might look as if it were necessary for the health of the public that such laws should be in existence, yet when the laws were put in practice they were found to be too arbitrary to be possible. According to the bye-laws in some parishes, the inspector might come and say a house was unsatisfactory because there was typhoid fever, and require the owner to go to an expense which very possible he was not able to meet, and they might then say they could enforce this by fining the owner so much every day until it was done. This was simply fining a man because he had not got a balance at his bank. It was quite clear that in case of any epidemic, such a law could not be carried out. What he wanted to see was that the national laws should be such as to dispose of the questions without leaving them to be brought before the Vestry. There were two perfectly distinct cases, however, to be brought under the law—one that of houses already in existence, and the other those being erected. In the case of new houses, the law could hardly be too arbitrary and determined, because, you might say, you are converting arable land into building land, and you must do it under certain restrictions, which shall ensure a good sanitary state of things. There were some laws of that kind in existence, but they were not sufficient. Vestries had the power to prohibit a man laying down drains unless they were approved of by them; but that was only the theory—in practice it was not carried out, because in some parishes, as, for instance, in Kensington, there were so many houses being built that they could not see to the laying down of the drains pipe by pipe, which was absolutely necessary. There was another important point which they could not insist upon, namely, where they drains should be. If houses were built according to the most approved sanitary principles, the main sewers would be between the backs of the houses. But that was impossible, because there was nothing to enforce the distance of the houses apart; consequently they were laid down in the streets, and the houses had to be drained underneath, and whenever the drains were opened, it interfered with the traffic, and the whole thing was wrong. Laws might very well be enforced, if it were insisted that when houses were built plans should be submitted to some local body, which should determine whether they were in such a position that sanitary arrangements were possible. At this meeting they were complaining that they could not set old London to rights; but they were going on constantly building a new London with much the same faults as the old one. In old houses it was impossible to set matters right in anything like a reasonable time, because to insist on every house being put into a sanitary state was utterly impossible. Perhaps it might be done if there were a fund at the disposal of the Vestries by which houses could be put in order, the owner paying off the amount by instalments. Such questions, however, were not for him to dispose of; but he wished to suggest the advisability of having a Conference in which these laws on sanitary subjects could be thoroughly discussed. One gentleman from Glasgow had said that nothing new had been suggested, and that might be true. It was said that railways and telegraphs were all prophesied by an old lady many years ago, but she did not bring them into operation. He, as an old engineer, had often been called upon to look into houses that his friends were buying, and he might say that last year thero was not one word ever said by a builder to him about the houses being in a sanitary state, but this year he had never gone into one where they had not first of all assured him that Mr. So and So, a sanitary engineer, had been looking after the drains. This was a very satisfactory result, which he attributed to the information diffused at such meetings as the present.

Mr. Field said there was one important point he forgot to mention, namely, that it had been said that when the valve of the closet was opened, there would be an upward rush of foul air from the disconnecting man-hole. But that was not the case at all. If they had a proper flush of water, as Mr. Latham had shown, the rush of water drove the air before it, and so the motion of the air was down the pipe. This point had been tested most carefully by Dr. Buchanan, who had the disconnecting man-hole outside the house filled with sulphur, and he put his nose down into the closet to try if he could smell the sulphur. It so happened that, after holding the valve open for a minute or so, the water-supply ceased, but it was quite a minute after the water stopped running before any smell of sulphur ascended.

Mr. Banner said Mr. Field and another gentleman had inveighed against the pan-closet on account of the incrustation which took place. It was quite true that that was so; but it was almost invariably owing to the spluttering out of the water from the D-trap at the bottom. If that trap were done away with, the incrustation would not take place.

Mr. Field said that he was able to give some practical experience with reference to this. He himself had the same opinion formerly, and removed the D-trap from a pan-closet to test the question, but found the result still unsatisfactory.

Mr. Banner said, with regard to the pan-closet and trap, it was said there was a current downwards, and no effluvium arose when the handle of the closet was raised; but, when the water which was held in the pan was let fall, the space which it occupied displaced a certain quantity of air in the container, which had no alternative but to rise, since it could not get out below, and, therefore, there must be some smell arising from the foul air at the bottom. The same thing would occur with the hopper closet, which he considered worse than the pan.

Mr. Field said that many ordinary hopper closets were undoubtedly bad, as they would not pass all the foul matter through the trap. This, however, could be obviated by proper attention to the details.

Mr. Banner said he had never seen any arrangement good enough to effect the desired object.

Mr. Field said he found no difficulty with proper apparatus. All the closets he fixed were tested before they were used. A quantity of paper was put in the basin, and, when the handle was drawn up, if the paper did not appear directly afterwards in the man-hole outside the house, the apparatus was considered defective, and steps taken to alter it.

Mr. Thorburn (Birkenhead) said there was no doubt that a considerable portion of excreta lodged in the container, and the sewer-gas coming up from the sewer, which did not escape up the ventilating pipe, would accumulate in the bottom of the closet, and when the valve was opened, the air so accumulated would go into the house. The remedy he adopted was to put a small pipe from the container slanting upwards into the ventilating pipe. It had been pointed out that a trap with the ventilator was an improvement upon a trap alone. He considered an ordinary square catch-pit, with a cover which could be taken off, so that you could see both sides, with a feather six inches from the bottom, better than any trap, such as shown on the diagram. His plan had been to form two shafts between the sewer and the house; sometimes the one nearest to the sewer would act as a downcast, in which case the other would act as an upcast, and sometimes it was reversed. It had been pointed out that what was wanted in sewers was not so much traps as a free circulation of air, because if you got that the air inside the sewer was oxidised, and prevented partially, if not wholly, the formation of gas. As far as he could understand, sewer gas was not gas at all, but formed of a variety of minute insoluble particles floating on the surface, and by the current of air these were carried upwards in all directions. As had been explained by Mr. Field, the water in the traps became charged with gas. But he could not understand how this so-called sewer-gas could so pass, not only from the nature of the particles of the so-called gas, but from the regular and constant change of the water when the closet was used. He thought some of the engineers present, and some of the medical officers, had rather overstepped their particular department, for they had had engineers explaining the medical part of the question, and medical officers explaining the engineering part.

Mr. Thomson (Glasgow) said he was neither a chemist nor an engineer, but he had had some experience in these matters. Some years ago he had an iron pipe run up the outside wall of his house, with a trap to the main sewer, but the trap by some accident got dry, and then an extremely disagreeable smell was perceived in the house. It was found first at the top; but they soon found it was stronger the further they got down. In fact, it passed right down through the house into the basement, but as soon as he found the cause, he removed the trap and replaced it with one similar to that shown in Mr. Field's diagram, and had never had any further trouble with it.

Mr Honeyman (Glasgow) said nothing could be worse than a pipe in the centre of the trap, not only because of the disadvantage which Mr. Field had pointed out, but because it cut away the very best part of the trap. What he recommended was that the pipe should be directly over the inlet to the trap.

Mr. Galloway said he had just completed a specification for an arrangement which drew off the gases proportionately as they came from the drains, and from the main sewers, passed them over a fire, and completely got rid of them.

The Chairman said he must now call on Mr. Cresswell to state his views on the "Legal and Moral Difficulties in the way of Sanitary Progress."

Mr. Cresswell said he intended to stick to his last, and, as a lawyer, to deal with the legal aspects of the question. During the proceedings of this Conference he had heard a great deal that was instructive, and a great deal that was alarming to a nervous mind; and the conclusion at which he had arrived was that a water-closet, although it was the most finished implement of civilisation, was a very complex piece of machinery, and that if they held another Conference, or series of Conferences, it was very possible the end of it would be that the Council would recommend their abolition by Act of Parliament. They wanted good bye-laws, but, besides that, they must have the good-will of the people to obey them. The great difficulty in the district he represented was not only the difficulty of making bye-laws, but, inasmuch as they were compelled to submit them for the sanction of the Government, when they sent up a set of bye-laws they had a great difficulty in getting them back again. The pigeon-holes of the Government-office were filled with bye-laws, which, like the sewage itself, would very soon decompose altogether. His district had taken a great deal of trouble to prepare a set of bye-laws, which they sent up nearly 18 months ago for approval, but they could not get them back again, and meantime they had adopted that which they knew was the ready resource of Englishmen in an emergency, to govern without any laws whatever. The result was they had excited in the minds of a great many people an infinite feeling of disgust against sanitary administration altogether, and a determination, so far as lay in their power, to oust every man who felt any desire to do his duty. He had no doubt that any one who held a similar position to his own would corroborate what he said, when he asserted that until they altered the laws of the country, particularly the Public Health Act, and Mr. Gladstone's Act for Poor-rate collection, which put the power in the hands of the cottage proprietors, who were the real delinquents, they would never be able to effect any real progress towards that sanitary millenium to which they hoped they were tending. The fact was the power of rating was really in the hands of the body of men who, in small urban districts and in country towns, possessed those long lines of cottages which were a disgrace to the civilisation of the age, and the fruitful source of all the disease with which they endeavoured to cope. The moment you endeavour to deal with that class of men, by sending a sanitary inspector to report on the condition of the houses and the water-supply, you tread on the toes of a very sensitive body, who regarded the question of the rates as much more important than the health of the people. They probably argued somewhat in this way:—The chances that I shall be carried off by typhoid fever or any other epidemic are very remote indeed; but the certainty of 6d. in the pound appeals to me immediately. In that spirit, they returned men who endeavoured, if possible, to do nothing. It was that particular moral obstacle to which he had endeavoured to call attention in the paper he had contributed, which was the result of practical experience, and if this Conference could in any way assist him, or produce any suggestion to carry into effect the reform which he described, he should feel grateful for the opportunity of having made known his grievance. He had suggested, as a remedy, to give the small cottage tenant the protection of the ballot, and let him vote for the men he really wished to see in power, and then he would arm the local Parliament with power which they did not now possess. His experience taught him that no cleanly housewife, and no respectable cottager, dared go and summon the inspecting officer, and put him on the scent, simply because he would call down thereby the influence of that which had been called "the shadow on the hearth," namely, an exacting and relentless landlord. The practical effect was, that not until an outbreak of cholera or typhoid fever arose, pointing with its too fatal fingers to an outbreak of disease, had the medical officer or inspector an opportunity of investigating. The next point was the fact that medical officers, many of whom were most able and energetic, found very great difficulty in dealing with the evils around them, from the simple fact that they were in the most delicate social relations with the very men whose greed and selfishness they were called upon to correct. He would suggest, not that they should be removed from the sphere of duty in which they might be of very great use, but that they should be enabled to refer to, and shelter themselves under the protection of, a superior officer, namely, the county medical officer of health—one in every county, and in some four or five, all well paid, and of great experience; that they should have emoluments, derived from the county rates, which would enable them to exercise their most difficult duties with a degree of independence which a local officer could not possess, and that they should be nominated by the Government, who had the best possible means of ascertaining the most efficient men for the purpose.

Mr. Baldwin Latham next gave an explanation of the system of sewerage at Longton. He said the great difficulty with regard to the treatment of sewage at the outfall was the question of the storm water. In many cases it overflowed, and communicated directly with the sewers, and in times of heavy rainfall contributed in that way a large amount of polluted matter to the watercourses. The difficulty was this—if you took an ordinary manufacturing town, the waterflow off the street received in many small streets the slop water from cottages, and in the case of the town to which he was going to refer, many of the houses being built back to back, the tenants had no back-yards whatever, and disposed of the whole of their slops by throwing them out of the front door. In towns of that description the effect of the water flowing off the roads was to cause a degree of pollution in the water courses quite as great as that of sewage; in fact, Professor Way, some years ago, made an analysis of the water flowing off the streets of London, and showed that it was far more impure than ordinary sewage. The difficulty was to know how to get rid of this, and not have too large an amount of water at the outfall. In Longton he had got over that difficulty in a way which met every objection. The sewage was taken by the Duke of Sutherland, to whom the authorities paid £500 a-year to take it; but he made it the condition that he should not be compelled to take the storm water. In order to meet that, the following system was devised:—In every street there were two systems of drainage. The old system of sewers, which were in operation previously, had been used for the purpose of conveying the impure surface water and storm-water to its natural outlet; and a new system had been constructed for conveying the sewage proper. At particular points, there was a connection made between the two systems, in such a way that when a very small amount of water was flowing down the surface water sewers, it flowed naturally into the sewers; but in time of rainfall, when the quantity increased, the rush of water by its own gravity leaped over the special opening provided between the two systems of sewers, and flowed on to the surface water streams of the district.

General Cotton asked if that was not the same system which was in use in Norwich several years ago?

Mr. Latham said he was not aware of it, and he knew the system in Norwich pretty well. This system had given the greatest satisfaction to the Corporation at Longton, and to everyone connected with the works. It could be seen by anybody, and there was no patent in connection with it. The whole cost of the drainage works was £31,719, the population being 25,000. The old drains were used for the surface water, and new sewers were constructed for the sewage.

Mr. Coghlan said he did not wish to at all detract from the advantages derived from the Conference, but he thought, with all due respect, there had been a great deal of "beating about the bush." He was engineer to a population of some 300,000, and knew thoroughly the feeling of all the borough engineers of the country on this question; and he could assure the chairman that if he could do something to get an amended Public Health Act, no man in this country would more deserve the gratitude of the community. His own experience in Sheffield was this, that they had 500 streets undedicated, but nearly built upon, and really unfit to traverse. As every borough engineer knew, the amount of red-tapeism was so great that engineers and town councils were perfectly helpless unless they went to Parliament to get a special improvement Act.

Dr. Kenyon (Chester) wished to add one word on the ventilation of sewers. It was said that the old form of ventilating pipe was worse than useless, because the offensive vapours went up it into the closet, and so passed into the house. But if they so contrived the pan that the gas did not go into the house, the action would be all right. The expense of a simple ventilating pipe was very moderate compared with some of the other plans which had been suggested, and especially if the sewers were well ventilated, he thought such an arrangement would go far to remedy the evil.

Mr. Russell suggested, with a view to help the Local Board, &c., to enable the public to ascertain how far they were doing their duty, that the Society should turn its attention to forming standards of expenditure for various sanitary objects. Improvements were often delayed because communities were afraid of the immense expense which they might entail, and therefore, if any standard could be prepared showing what was a reasonable amount of cost to be devoted to sewer ventilation, to water supply, and so on, it would be very useful.

Dr. Bartlett thought in any legislation which it might be considered advisable to apply for, the most important point of all would be to make compulsory, under very heavy penalties, the disinfecting of the slops immediately connected with disease, which would disseminate contagion with epidemics of any kind. They had had a long discussion as to the modes of keeping sewer-gas out of houses, but one thing had escaped notice, and that was the importance of disinfecting slops before they went into the sewers.

Dr. Vacher said if it had not been expressly stated, it had been implied, that if you kept sewer-gas out of the house, you avoided any chance of typhoid fever or similar disease being conveyed from the drain to the house. Now, sewer gases, the presence of which became apparent, such as sulphuretted hydrogen, were comparatively innoccuous. No one ever caught typhoid fever from breathing sulphuretted hydrogen, or any gas of a similar kind. What caused typhoid fever was not a gas at all; it was something insoluble in water or in watery liquid—a small albuminoid particle, and to the life of that particle it was essential there should be a certain amount of moisture, but he did not know that anything else was essential to it. It floated about in the sewers and pipes, and propagated itself in them. If you could keep that out of the house, you kept out disease, but it did not follow that anything which cut off sewer-gas, would cut off particles of this kind. A trap might be quite efficient to prevent the ascent from the sewers into the house of any gas like sulphuretted hydrogen, and yet not prevent the ascent of such a particle as that referred to. All that was necessary to its life was a little moisture. It lived as well in the water or the trap as in the moist air. It came along with the moist air of the sewer, was taken by the water into the trap, was picked up again by the air, and might be carried into the house; therefore any principle similar to those which had been described and shown on the diagrams was objectionable, inasmuch as you created between the house and the trap a strong current or draught of air. This particle came from the sewer, lodged in the water, and any strong current or draught took up part of the water in the trap, and might take up some of these small particles along with it. If it did so, it conveyed them up the ventilating pipe, the draught came over the top of the water, and when the closet valve was lifted, the particles might then lodge on some wet surface, or in the trap beneath the closet itself, and subsequently be given off from the surface of the water, and come into contact with the person using the closet; therefore any system by which you created a draught between the water and the trap which severed the house drain from the sewers, was mischievous. One very grievous source of error was the habit they had got into of speaking of sewer gases as dangerous. They were not dangerous in themselves; anything you could smell was almost innocuous. What was dangerous, was a thing which was not a gas, and under no circumstances could be a gas, or volatilised.

Mr. Adam Scott said he should have liked to have made some remaks in connection with the fifth subject on the agenda, and no doubt many other gentleman would have done the same. But there was not now time to do so; and he suggested, therefore, that any statement gentlemen might have wished to make on this question should be sent in to the Secretary in writing, and included in the proceedings.

Dr. Wilson thought Dr. Vacher had drawn a distinction without any difference. It was of little relative value to know that sewer-gases, *per se*, were not injurious, if they were the carriers from the drains of that which was injurious; and therefore it was equally advisable they should be kept out of the house. This was essentially one of the reasons for adopting the pail system, and for making it compulsory.

The Chairman said the Society would be perfectly prepared to receive papers in lieu of speeches which might have been delivered, with this reserve only, that it must rest with the Secretary and the Executive Committee to consider how far they could be put into print. His impression of the Conference was, that it had been at least as instructive as that of the year before, though it was not easy to compare events at such a distance of time. The discussions had concentrated themselves round two or three points of debate, and this was an indication of the reality of the information conveyed, and of the practical turn given to the discussion. Yesterday they were mainly occupied in discussing dry systems dealing with excreta of towns. Halifax played a prominent part therein; and as he was a native of that town, and one of its members of Parliament, he was glad to think it had contributed its fair share to the discussion. They had heard from Mr. Pollard the details of the management of the Goux system there; and also other details on collecting excreta on the dry system, and the result of the discussion which arose was very satisfactory. They all seemed to realise the character and the merits of the methods by which excreta were dealt with on these systems; but the general opinion must be, that the immense safety of such methods lay in their unscientific character, so to speak. You did not trust to mechanical means, which might be hidden from human sight, but had to depend on human agencies, and were almost compelled to find out deficiencies earlier than was always the case in the water-carriage system. Then there had been some useful information on the cost of drying sewage matter, whether collected by the dry or water-carried system. That was somewhat incidental, but it was useful; and representatives of various localities would go back feeling that they had gained information which might be of use to the towns they represented. But, after all, one of the most useful results of the dissemination of information as to the dry systems, and of such discussions as that which occupied the greater part of the preceding day, was, that it had put, so to say, not only the advocates but the practical administrators of the water carriage system upon their mettle. That was shown in the great space given to the discussion of how to keep sewer gas out of houses. He did not attribute that entirely to the discussion of yesterday, for the question had been raised last year, and he had since received several communications on the subject. But, taking the two discussions together, they both led to this question being felt in its real importance, and to the minds of sanitary engineers and others connected with the construction of house drains being applied to the solution of that very difficult problem. They had been lately told that, after all, it was not a question of sewer gas, but of certain albuminoid particles, or germs, which came into the house from the drains or pipes which might produce specific disease. But, in the first place, he must say, his impression, taking the common sense view of the matter, was this, that foul air and sewer-gas in themselves were deleterious; they were undoubtedly offensive, and he believed them to be deleterious, and he held it to be the duty of a community which told you to drain into a sewer to keep them out of the house. He did not know whether or not they were the cause of specific disease. Typhoid fever might be produced entirely by fungoid growths, which were in themselves not soluble either in gas or air; but the practical effect remained the same, that they were conveyed by sewer gas into the house; and Dr. Buchanan's words remained entirely unchallenged, that the practical result was, if you did not have proper appliances, that sewer air was laid on like gas to the house. He would ask his hearers to allow that striking fact to sink into their minds, that practically, at this moment, sewer air, in itself offensive, and he believed deleterious, possibly conveying with it germs capable of producing specific disease, was in many cases laid on to the house, and that they had a right to say to local communities that it should be cut off. The question was, how was it to be done? The problem was a difficult one, no doubt; and he was not sure that they could hope for a perfect solution of it. But, that being so, they ought to aim at the best solution, and even at a multiplication of appliances, provided they were simple in character, having this object. In the first instance, evidently the sewers ought to be flushed. They had been told that this was not a perfect remedy; but whatever comparative value might be attached to other methods, there was no one who would not agree that when you had a system of sewers, and house drains communicating with them, it was the duty of the sanitary authorities so to construct the sewers as that they might be flushed efficiently. But that was not enough. They must also be ventilated. They might be ventilated simply by openings, and he saw no objection to that. The impression he derived was that the simpler the openings were, the better. But in certain special cases they might do even more. For instance, at Halifax, more was done. The special method called Stott's method, could only be applied where you had furnaces to hand, and where the owners of factories were sufficiently enlightened to allow you to supply the furnaces with sewer air instead of ordinary atmosphere. Then you got a great draining power, and ventilated the sewers to a very considerable extent. But although sewers might be flushed and ventilated, when you came near the house there was still some danger left, against which both the community and the householder ought to provide. He had followed Mr. Field's description as attentively as possible, and the subsequent discussion, and to his mind the plan shown on his diagram had considerable merits. But having in view particularly the particle theory, he was under the impression that it was not a plan that was absolutely or sufficiently safe. After all, the best idea was to cut off the connection as far as the closet pipe was concerned. If it were not for the question of decency, no doubt an open drain was the best thing; and, in the last arrangement, that of the manhole, you had practically an open drain. You cut off anything in the shape of draught occasioned by a close pipe in the open part under the manhole, and that appeared to him to be an arrangement which had perhaps more to recommend it than any other. Still, you could not say even then that there might not be some current up the pipe into the house, and he did not know that any method could be devised by which one could absolutely guarantee an influx of air which could not by possibility carry some germ or particle of fungus which might create specific disease. He was not satisfied that a perfect solution of the problem of absolutely preventing the possibility of the conveyance of germs of specific disease into the house from the sewer had been accomplished by any method suggested. It was a great thing, of course, to minimise the danger; and one thing had occurred to him during the discussion, which perhaps scientific men might deem it worth while to consider. A method of ventilation which was largely in use in Halifax for factories and mills, called Watson's ventilator, had occurred to him as being possibly applicable to this subject. It depended on this principle, that, if the air shaft in the diagram, being of sufficient dimensions, were bisected, in all probability the outer air going down would prefer one of the two openings, and the moment it preferred one, the sewer air which might escape would ascend the other. The principle of Watson's ventilator consisted in not having two openings for ventilation separated from one another, but in having them close together, so that you left the current of air to select its own passage, and if the downward current selected one, the upward current would select the other. It might be worth while to ascertain whether by that expedient you might not check a certain supply of sewer gas which might otherwise enter the house. All that remained to be remarked upon were the suggestions made by General Cotton and by Mr. Cresswell. With regard to the subjects which ought most advisably to occupy their attention another year, in all probability by that time there would be quite enough material for a long discussion, were it only on the same basis as the present. But he did so far agree with them as to think that they might at the next annual Conference, begin the question as to what legislative alterations were necessary. He would somewhat limit that branch of the subject when it was taken up, because as soon as they began to talk of legislation they might easily spend two days without doing much; and he should, therefore, propose to precede the talking of legislation by such practical discussions as they had now had, and then to give a limited time to the discussion of legislative reforms. But on that subject he would ask the Council and the audience to direct their minds for a moment to the methods by which to prepare themselves for that discussion. The subject was so vast and the law so complex, although it was reduced into some simplicity now by the codification of the Sanitary Acts, that if gentlemen did not carefully possess themselves of it, and be quite sure, before they suggested an enactment, that it was not already provided for, there would be a great deal of time wasted. No man carried the law entirely in his head, and there had been one or two suggestions of alterations in the law, which he had not felt quite sure that the existing law, if it were sufficiently known, might not be found to meet. He would, therefore, ask gentlemen to make themselves as fully acquainted as possible with the existing law before beginning the discussion. There was a great deal of sanitary law not availed of. As Mr. Field had said, at Uppingham they had made bye-laws of an extremely stringent character. It was much more difficult to deal with old houses than with new. But, as to new houses, it was quite possible, under existing Acts of Parliament, to have very stringent bye-laws; and he might point out that rural sanitary authorities could obtain, from the Local Government Board, any urban powers, for any part of their district, for any length of time, under whatever limitation seemed right to the Local Government Board.

Dr. Syson said they would not do it.

The Chairman said that was precisely an illustration of what he was saying. The law existed, but either they would not or did not avail themselves of it. The question might arise, what was the good of the law if the local board would not use it for the public good? That was a question which required an answer; but the answer was not entirely to be given from the point of view of immediate efficiency of the law alone. After all, the sanitary question was an educational question. If you took a large view of it, you could not hope, dealing as you had to do with the households of all England, to introduce by compulsion conditions which should be favourable to health, unless you enlisted in favour of the law of health the intelligence and good-will of the local communities and of the individuals who composed them. The principle he laid down for himself, when he first took part in legislation on this subject, was this:—He would never yield to the temptation which was often placed before him by scientific men, and medical men especially, to make every law compulsory, saying that things should be done, and bringing down the central authority to do it if the local authority would not. That was a natural view for scientific men to take; but he felt, as a person who had a responsibility with regard to legislation, that he must not think only of what was the most direct route, but of the road which the people would be prepared to follow. He, therefore, laid down this principle, that, after all, the problem was educational—that if you had a population who were not educated to believe in sanitary laws—educated by the conditions by which they were surrounded, by the existence of local institutions intended for the administration of such laws—that no laws could make that population healthy. You could not control the habits of the people unless you enlisted them in the work, and, therefore, people should not believe too much in arbitrary law imposed by a sanitary authority. His view was to give all possible power to the local community; let the Local Government Board exercise its powers by seeing that the local community did its duty, or by calling it to account whenever a failure of duty on its part produced injury to the population in the shape of disease. By working on these principles, he did trust to see a great progress in the future sanitary condition of this country. In conclusion, he begged, on behalf of the Council, to express their thanks to the gentlemen who had attended, who, he trusted, would not regret the time they had spent there.

Dr. Syson moved a vote of thanks to the Chairman for the very able manner he had presided over their meetings, saying he had never yet attended a Conference where the discussion was so well conducted.

The resolution was seconded, and carried unanimously.

FELTHAM INDUSTRIAL SCHOOL.

A visit was paid to the Middlesex Industrial School, at Feltham, on Monday last (the 18th inst.), by some of the members of the Council. There were present—Lord Alfred Churchill (Chairman of the Council), Edward Brooke, Edwin Chadwick, C.B., the Hon. Dudley Fortescue, C. J. Freake, W. Hawes, H. Danby Seymour, and E. C. Tufnell, with H. T. Wood, Assistant-Secretary. Of the Committee and Staff of the School there were present, F. H. N. Glossop (Chairman of the Committee), Lieut.-Gen. Brownrigg, C.B., Capt. Brookes (Superintendent of the School), and the Rev. Mr. Newton (Chaplain). The visitors were allowed to inspect all the arrangements of the school, and, after being shown over the dormitories, class-rooms, &c., they saw all the boys drilled. After this the section of the school, which includes the boys who are being trained for the sea, went through their naval drill on a full sized model brig, erected in the grounds. Sails were set and furled, a line was carried on shore and several lads brought off as if from a wreck, and various other evolutions gone through. In both this and the military drill the visitors expressed themselves much gratified with the smartness and good discipline of the boys, Mr. Chadwick especially noticing the low death-rate (three per thousand), and the large proportion (eighty per cent.) of successful careers among the boys sent out from the school. The model farm, workshops, and swimming bath, were also visited. On leaving, the visitors expressed themselves as greatly pleased and impressed by what they had seen, and by the evidence it gave of the useful work effected by the school. Thanks were also expressed to Captain Brookes and Mr. Newton for the courteous way in which they had placed their time at the disposal of the visitors, and for the readiness with which they had allowed the whole establishment to be inspected.

MEETINGS FOR THE ENSUING WEEK.

Mon.... Royal Geographical, University of London, Burlington-gardens, W., 8½ p.m. Mr. Alfred R. Wallace, "The Comparative Antiquity of Continents, as Indicated by the Distribution of Living and Extinct Animals."

Tues. .. Statistical, Somerset-house-terrace, Strand, W.C., 3 p m. Annual Meeting.

Anthropological Institute, 4, St. Martin's-place, W.C., 8 p.m. 1. Mr. J. R. Mortimer, "An Underground Structure in Driffield, Yorkshire." 2. Mr. John E. Pive, "Note on the same." 3. Col. A. Lane Fox and Mr. E. W. Brabrook, "Anthropometric Report."

Wed.... **SOCIETY OF ARTS**, John-street, Adelphi, W.C., 4 p m. Annual Meeting. 8.30 p m., Conversazione at the South Kensington Museum.

Royal Society of Literature, 4, St. Martin's-place, W.C., 8 p.m. Mr. W. A. Barrett, "The *Etymons* of Musical Terms."

Thur....Antiquaries, Burlington House, W., 8½ p.m.

Zoological, 11, Hanover-square, W., 5 p.m. (Davis Lectures) Mr. W. B. Tegetmeier, "Variation in Domestic Animals."

Society for the Encouragement of the Fine Arts, 9, Conduit-street, Regent-street, W., 8 p.m. Fourth Conversazione, with Music.

Fri.......Royal Botanic, Inner Circle, Regent's-park, N.W., 4 p.m. Professor Bentley, "Plants, with Reference to their Life and their Organs of Reproduction." (Part II.) The Ovule. Process of Fertilisation. The Seed. Process of Germination. Conclusion. (Lecture VIII.)

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,284. Vol. XXV.

FRIDAY, JUNE 29, 1877.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

DOMESTIC ECONOMY CONGRESS.

The first annual Congress will be held in Birmingham, on the 18th and 19th July. The Congress will be opened by a *conversazione* on the evening of the 17th, and the Sections will meet on the 18th. The following papers have already been promised:—

"Results of Needlework in some Elementary Schools," Miss Kenrick; "Needlework," Miss Mary Willis; "Clothing and its Materials," Mr. Joseph Pope, Staff Surgeon (retired), late Royal Artillery; "Head to Foot Washing," Mr. Edwin Chadwick, C.B.; "Methods of Training Young Servants in habits of Cleanliness," Mrs. Watson; "Cookery in Public Elementary Schools; the difficulties stated and discussed," Rev. Newton Price; "Several Years' Experience of Cookery taught in various Schools," Mr. R. Browne Clayton; "The Practical Use of the Food Collection of the Science and Art Department," Mr. W. Stephen Mitchell, M.A.; "The National Training School for Cookery," Mrs. Charles Clarke; "The Art of Preparing Food; its Place in General Education," Miss Guthrie Wright, Hon. Sec. of the Edinburgh School of Cookery; "Errors in Diet," Dr. Wilson, Medical Officer of Health; "School Savings Banks," Mr. G. C. T. Bartley, Manager of the National Penny Bank; "A Birmingham Board School Bank," J. A. Langford, LL.D.; "Elementary Instruction to Children in Physiology," Professor Huxley, F.R.S.; "Nursing," Mrs. W. E. Gladstone; "Nursing in connection with Education," Miss Helen Taylor; "Sickness, and how to provide for it," Mr. Lawson Tait, F.R.C.S.; "Buildings for Working Men," Mr. R. Rawlinson, C.B.; "House Drains in their relation to Health," Dr. Alfred Hill, Medical Officer of Health and Borough Analyst, Birmingham; "The Appointments and Appearance of the Workman's Home," Mr. Frank Curzon, Organising Secretary of the Yorkshire Union of Mechanics' Institutions; "Warming and Ventilation," Captain Galton, C.B., F.R.S.; "The Practical Development of Elementary Education through Domestic Economy," Sir Henry Cole, K.C.B.; "The Teaching of Domestic Economy in conjunction with Cookery, in Elementary and Secondary Schools," Mrs. Fenwick, Hon. Sec. of the Leeds School of Cookery; "Text-books," Rev. J. P. Faunthorpe, Principal of Whitelands Training College; "Mode of Inspection and Administration of Government Grant," Rev. E. F. M. MacCarthy, M.A.; "Importance of Female Inspectors," Miss Synnot, assistant to the late Mrs. Nassau Senior; "Working of the Examinations of the Society of Arts in Domestic Economy," Mr. Charles Critchett, B.A., Educational Officer of the Society of Arts.

Persons desirous of preparing Papers on the above subjects should inform the Secretary of the Society of Arts, John-street, Adelphi, London, W.C., as soon as possible.

Papers should be sent not later than Wednesday, the 4th July, 1877, to the Secretary of the Society of Arts, or to the Honorary Secretaries of Sections, to be forwarded to him by them.

The Papers will, as far as practicable, be printed and distributed in the room, but will not (except under special circumstances, at the discretion of the Chairman) be read.

Members of the Society of Arts, and Delegates from the Institutions in Union with the Society, are admitted free to all Meetings of the Congress. It is requested that those proposing to attend will forward their names to the Secretary, when tickets of admission will be sent to them. Other persons can become Members of the Congress, and attend all the Meetings, on purchase of a Ticket, price Five Shillings; or Family Tickets, admitting four persons, can be purchased for Ten Shillings.

Exhibition.

It has been determined that during the sitting of the Congress there shall be held an Exhibition of Books, Diagrams, Models, Apparatus, Appliances, and other objects illustrative of the subjects that will come under discussion. It is in contemplation to keep the Exhibition open after the close of the Congress, it being anticipated that school teachers and the general public will take interest in the movement.

With the view of making the Exhibition as complete and as attractive as possible, the Committee invite the co-operation of all—authors, publishers, school teachers, inventors, patentees, manufacturers, producers, and others—who can in any way assist them in their project.

The articles exhibited will be shown in the various classes which they illustrate. Therefore, if one exhibitor should exhibit articles suitable for two separate sections, his exhibits will be divided and his goods shown in their proper localities.

Suitable premises will be secured for the Exhibition, and no charge will be made for space. It is hoped that exhibitors will arrange to unpack and repack their exhibits, but where this is not possible the work can be done under the supervision of the officers of the Exhibition. No risk of any kind will be undertaken by the Committee, but all possible care will be exercised in the protection of the goods while they remain on view.

It must be borne in mind that the Exhibition is intended as illustrative of economy as it might be in artisans' rooms, cottages, &c.; and that, consequently, costly articles in any class are undesirable. What is sought to be exhibited is a collection of the most improved forms of ordinary cottage cooking utensils, and the best modern appliances and inventions in cooking, personal and general cleanliness, health, &c.

The exhibited goods will be classified as follows:—

SECTION A.

Books, drawings, diagrams, models, appliances, apparatus and other objects illustrative of the following classes:—

Class 1.—Needlework and Working Materials.

Specimens of work of children of different ages at elementary and secondary schools, showing examples of hemming, stitching, knitting, netting, patching, darning, cutting out, making of wearing apparel, &c.

Implements, &c.—Scissors, needles for sewing, knitting, and netting, thimbles, patterns, work-boxes, pins, thread, cotton, tapes, buttons, &c. Also spinning-wheels and low-priced materials.

Class 2.—Cleanliness.

Personal.—Baths, towels, tooth-brushes, combs, soaps, tooth-powders, &c.

Household.—Towels, house-flannels, brushes, brooms, slop-pails, dusters, disinfectors, vermin destroyers, bees-wax, soft soap, &c.

Laundry.—Soaps, soda, borax, starch, blue. Irons: box, flat, Italian. Specimens of good and bad washing,* ironing, goffering, &c.

Class 3.—Food and Cookery.

Utensils for artisans' and labourers' dwellings: digesters, Dutch ovens, filters, frying-pans, gridirons, kettles, boiling pots and saucepans, pipkins, grates, knives and forks, metal and wooden spoons, earthenware, choppers, coffee-pots, &c.

Cottage grates, portable and other cooking-stoves, ovens, gas-stoves, fuel, cinder sifters, &c.

Analyses of food.

Class 4.—Household Expenditure.

Account books, money boxes, washing books, measures, weights and scales.

Class 5.—Thrift.

Printed information as to savings banks, penny banks, deferred annuities, waste, insurance, depositors' books, &c.

SECTION B.

Books, drawings, diagrams, models, appliances, apparatus, and other objects illustrative of the following classes:—

Class 6.—Health.

Drilling, games, toys, gymnastics, ventilation, pure water, physiology (the skeleton), music, singing, pets, silkworms, birds, flowers, window and other gardening, natural history, objects generally having relation to household recreation.

Class 7.—Sickness.

Sick rooms: Lighting, ventilation, nursing, watching, sick cookery, beds, &c.

Class 8.—The Dwelling.

Drainage, cisterns, windows, sewer traps, filters, fire grates, &c.

Class 9.—Warming, Ventilation, and Light.

Fresh air, foul air, gas, radiated and diffused heat, waste heat, down-cast, up-cast, and horizontal ventilators, fuel, lamps, candlesticks, window blinds.

SECTION C.

Class 10.—Teaching.

As illustrated by books, maps, drawings, models, objects, specimens, pictures, &c.

Class 11.—Preparation of Text-books, &c.

Competition, uniformity, specimens of text-books, &c. School fittings: desks, seats, hat pegs, inkstands, pens, pencils, slates, &c. Designs for cookery schools, fittings, &c.

Exhibitors will be allowed to state upon their exhibits full descriptions, retail prices, names of makers and of sellers, and other information. All goods exhibited must remain until the close of the Exhibition.

Authors, publishers, school teachers, inventors, patentees, manufacturers, producers, and others desirous of lending objects for exhibition may obtain the necessary forms from Mr. Allen Edwards, Assistant Secretary, 38, Edmund-street, (next Easy-row), Birmingham.

ANNUAL GENERAL MEETING.

The Annual General Meeting, for receiving the report from the Council and the Treasurers' Statement of Receipts, Payment, and Expenditure during the past year, and also for the Election of Officers, was held, in accordance with the Bye-laws, on Wednesday last, the 27th June, at four p.m., Lord Alfred S. Churchill, Chairman of the Council, in the Chair.

The notice convening the meeting having been read, the minutes of the last Annual General Meeting, and of the subsequent Special General Meeting, were read and signed.

The Chairman then nominated Dr. Mann and Mr. Christopher Cooke as scrutineers, and declared the ballot open.

The Secretary then read the following—

COUNCIL'S REPORT.

In compliance with the Bye-laws, the Council now lay before the members a report of their proceedings during the past year.

National Training School for Music.

This Institution has now been at work for upwards of a twelvemonth; it numbers under its charge upwards of 80 scholars, and these at the first examination of the school held a few months since, under the direction of the Principal and leading professors, showed a high degree of aptitude and skill in the various branches of the art to which they had applied themselves. While, however, the Council cannot but congratulate the members in having accomplished thus much for the promotion of so important a branch of the Fine Arts, it must still be remembered, and the Council would desire strongly to impress upon their members, that there yet remains much to be done, before the work accomplished can be considered as in any way adequate to the needs of an institution which lays claim to the title of national. The members may be reminded that the school is based on the principle of giving a free musical education to such as can give evidence of talent worthy of such help. None are admitted except on the result of competitive examination, and it is obvious that, to carry out such a system, funds must be provided for the purpose. It is calculated that £40 a year provides for the musical education of one scholar; and the aim of the Society has been, and still is, to promote the establishment of these scholarships. The Corporation of London, several of the leading City Companies, Corporations and Localities in other parts of the United Kingdom, such as Birmingham and Liverpool, as well as numerous private individuals, have responded to the Society's invitation, and have generously come forward and founded upwards of 80 such scholarships. Her Majesty the Queen, the Prince of Wales, the Duke and Duchess of Edinburgh, and the Royal family, have liberally contributed four scholarships of £50 each, and these have been competed for from amongst the other scholars. That such an institution is absolutely needed, is evidenced by the almost daily applications that are made to the Council by parties desirous of participating in the advantages it affords; but, unless the number of scholarships is increased, no answer but refusal can be given to those applying for admission. It is hoped, seeing now that the school is actually at work, that members and their friends will come forward and assist the Council in enlarging the means of this institution, so as to place it on a foundation strictly national, both in name and in reality.

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*Prizes will be given for the best specimens of washing.

PATENT-LAWS.

The Patent-laws have ever been a theme of special interest among the members of this Society. The Society took a prominent part in promoting the change and reform which took place in 1852, and the Act of Parliament then passed, forming, in fact, the existing code of Patent-law, is admitted on all hands to be of a most valuable character. Doubtless, in the administration of that Act, abuses have crept in, and it has not come up to the wants of the present time. The Council, believing that the greater part of the defects arise from the powers and principles of the Act of 1852 not having been duly carried out, and that they are due rather to failure in administration than to anything else, memorialised the Lord Chancellor to put in force the powers of the existing Act, by appointing Commissioners, as was intended, in addition to the *ex-officio* Commissioners, already overburdened with other duties, so that on such Commissioners the responsibility of working the Act should be thrown, and asked that no further legislation should take place until after a trial of the real working of the 1852 Act had been made. This memorial was signed by upwards of 1,200 individuals, all more or less deeply interested in the good working of the Patent-laws. A Bill has, however, been brought in by the Government to amend the Patent-laws, and it is now before the Legislature. Whether there will be found time to carry it through both Houses of Parliament this Session seems at present very doubtful.

The Bill is founded mainly on the conclusions arrived at by the Parliamentary Committee which sat a few years since under the chairmanship of Mr. Samuelson ,and though in many respects containing valuable provisions, it is defective in not providing for the one great necessity, viz., properly qualified and responsible paid Commissioners, able to devote their time and abilities to its due administration. As the Bill stands, its influence for good or for evil will depend entirely on how it is administered, and to leave this administration in the hands of those who have already other duties which engross all their time, and who have no special knowledge to guide them, would seem at once to condemn it. The Council, however, thought it right to call the members together for the discussion of the Bill, and invited others to attend who were known to take an interest in the subject. The discussion was opened by an able paper by Mr. H. T. Wood, the Assistant Secretary, was continued for three evenings, and resulted in the passing of resolutions which the Council were requested to lay before the Attorney-General for his consideration. The paper, discussion, and resolutions have all been reported in the *Journal.* Whilst, however, there were some of the resolutions to which the Council could not give their assent, they felt it to be their duty to bring them all before the notice of the Attorney-General, and accordingly this was done by a deputation headed by Major Beaumont, M.P., who had ably presided over the Conference. The resolutions were fully discussed by the Attorney-General, who promised to give them his best consideration, and thus the matter for the present rests.

HEALTH AND SEWAGE OF TOWNS.

The marked success which attended the Conference last year determined the Council to again undertake the convening a second in the present Session, and accordingly, in May last, a Conference was held, running over two days. The Right Hon. James Stansfeld, M.P., who had so ably presided over it last year, again undertook the duty. The Society have every reason to be congratulated on the attendance, which was gathered from all parts of the kingdom, and on the valuable interchange of experience which the discussion elicited. The Executive Committee was much gratified at receiving this year an increased amount of support, both in the way of attendance of representatives from various localities, as well as returns of information from a much larger number of towns, in reply to queries issued, than in the previous year. The information thus collected, together with special papers and reports, was published for the use of the Conference. This, with the discussions, has already appeared in the Society's *Journal*, and it will form the contents of a volume now in the course of preparation, which it is believed will contain a mass of very useful as well as highly interesting matter. The increasing importance of this subject, whether as regards the health or comfort of the populations, is admitted on all hands. That our sewage must be got rid of by some means or other is an inexorable necessity, and how to do this with the greatest benefit to health, and at the least possible cost, is the problem to be solved. While the early extravagant notions of the great value of the sewage are fast passing away, and a more sober judgment is being arrived at, science tells us not to overlook the fact that it has some value, and that by judicious treatment it may, under certain conditions, be utilised, and made to minister to the wants of the community, and thus afford some return for the expense of collecting and dealing with it. On this point very valuable information has been elicited during the course of the discussion at the Conference, which will, it is hoped, to some extent assist in guiding localities in their action. The escape of sewer gas into houses formed a topic of great interest at our former Conference, not only as regards sewered towns generally, but notably the metropolis itself. The facts which had come to the knowledge of the Executive Committee induced them to bring the matter before the Metropolitan Board of Works, with a view to some action being taken to remedy the evil. The Board of Works were, however, scarcely inclined to believe in the magnitude and extent of an evil which came rather within the jurisdiction of the separate Vestries of the metropolis. In consequence of this, the Council invited the Medical Officers of Health to meet them in conference, the result of which showed that, so far from the evil having been in any way exaggerated, it was unquestionable that imperfect connection—and, in many instances, an absence of connection at all—with the sewers was proved to exist to a very great extent in reference to the house drains of the metropolis, and that but little, if any, effectual supervision was exercised to ensure, as can readily be ensured, the complete exclusion of such noxious vapours. The subject was also brought by Deputation from the Committee before the President of the Local Government Board, when it appeared that the metropolis was all but exempt from that jurisdiction. Evidence showed that the Vestries or Sanitary Boards, to whom the supervision of these matters is by law entrusted, dealt more or less imperfectly with them, had no uniform system, and that, even when they did act, their action had reference to little else than new buildings or re-buildings, and this only in most cases in a very imperfect manner. In the older parishes, where new buildings are comparatively rare, little or nothing was known of the house connections with the sewers. Doubtless, it may be said that the proprietors or occupiers are the proper persons to look after such matters, but if they do not—and experience shows that neglect in such matters is the rule—then it is urged that it is the duty of public authorities to step in as guardians of the public health, which is in fact public property, and, for the sake of the community at large, compel that to be done which individuals either cannot or will not do for themselves. The subject underwent further discussion at the second Conference, and much interesting and useful information was elicited. A Bill has just been brought into the House of Commons to consolidate and amend the Metropolis Management Act, but this all-important point is not touched, and the leading journal, writing on the subject, says:—"The office of the Metropolitan Board is to construct and keep in order the main sewers of London. To form the local connections with these is not any part of the Board's business. This duty belongs to the local sanitary authorities, and it is a frequent matter of complaint by the Metropolitan Board how very imperfectly it is performed. There seems every reason why a consolidating and amending Bill should go fully into this most important matter—why it should point out the rights and duties of individuals and Vestries and District Boards, and the further power, if any, vested in some higher body of looking after them, and why it could cure, as it professes to do, the proved defects which hinder the working of the existing law."

Cantor Lectures.

Bearing in mind the importance, at the present time, of technical instruction, two courses of these lectures for the past session were devoted to subjects which it was considered would be of interest in those engaged in two branches of trade which have a specially large development in the metropolis, viz., coach building and gas making. Accordingly, a course on the "History of the Coach-building Trade" was given by Mr. G. A. Thrupp, well known for great knowledge and experience in connection with the subject. Tickets were issued freely to workers in this branch of industry, and the room was well filled. "The Chemistry of Gas-making" formed the subject of the second course, by Mr. Vernon Harcourt, and here again the room was well filled by earnest listeners from the gas-works of the metropolis, as well as by members of the Society. The third course, on an independent subject, was delivered under the title of "The Connection of Greek and Roman Art with the Teaching of the Classics," by Professor Colvin, Slade Professor of Fine Art in the University of Cambridge, and attracted a select audience at four o'clock in the day. It was thought, looking at the character of this course, that the afternoon would be found a more convenient time to gather together an audience than at 8 o'clock in the evening. The change was fully justified in the result, and it is expected that, on a future and similar occasion, when lectures of that character are repeated, and members are become more alive to the change, a still larger audience will be assembled. It may be, and probably will be found to be the case, that a somewhat later hour in the day, say five o'clock, will be found better adapted for the convenience of the members than four.

The first course of lectures has already appeared in the *Journal*, and the two following courses are prepared for printing in the *Journal* in the course of the summer.

Evening Meetings.

Into the Wednesday evening meetings this year a slight change has been introduced, which, the Council have reason to believe, has given satisfaction to the members; four of them have been devoted to scientific lectures proper, as distinguished from papers and discussions. The services of Sir John Lubbock, Bart., M.P., F.R.S., Professor Kennedy, Dr. B. W. Richardson, F.R.S., and Mr. E. J. Reed, M.P., C.B., F.R.S., were secured for these lectures, and on each occasion a full room testified to the great interest which they excited. On the other evenings the papers read embraced a variety of interesting subjects, and were followed by discussions which have already appeared in the *Journal*. The Session commenced with a paper by the Rev. E. L. Berthon on "Collapsible Boats." Then followed a paper by General Cotton, on "House Drainage," which attracted considerable attention, and produced a discussion extending over two evenings. Mr. Meyerstein's paper on a "New Method of Simultaneous Colour Printing," described an invention for accomplishing what printers have long sought, and have, indeed, almost despaired of. The process is fully described in the paper, and it may only be added that the latest reports from the inventor state that it is being successfully carried out on a commercial scale. These were all the papers read before Christmas. After the Christmas holidays the work of the Session was resumed with two short papers, on the "Cultivation of Common Fruits" by Mr. G. C. T. Bartley, and on "Railway Wastes" by Mr. Hyde Clarke, both papers having a somewhat similar object, the utilisation of waste spaces. Captain Douglas Galton's paper on "Street Tramways" was a most able *résumé* of the present condition of this subject, and would certainly have received a medal had not its author been a member of the Council. In the following week Prof. Barff introduced to the public, through this Society, his most remarkable invention for protecting the surface of iron by means of a coating of the peroxide, an invention which seems only to require further development to make it one of the most successful of the day. Mr. Ackers in his "Deaf not Dumb," gave a graphic account of the method of teaching deaf-mutes to speak. Capt. Tyler's paper on "Continuous Breaks" was followed by a long and animated discussion, in which the representatives of nearly all the best known continuous breaks took part; and the Session was successfully concluded by the exhaustive and elaborate paper on "Musical Pitch," by the well known authority on this subject, Mr. A. J. Ellis. The above may, perhaps, be considered the most important of the sixteen papers read, though several others deserve mention did space permit.

Indian Section.

Six meetings in this Section have been held, well attended. The papers and discussions have been of the highest interest, and exercised a useful influence, embracing "Indian Tea Culture," a large and growing industry, by Mr. Burrell; "Indian Railways," by Mr. Juland Danvers, the importance of which, for the welfare and progress of the empire, cannot be over-estimated; "The Progress of Trade in Central India," a masterly *resumé* and record of personal experience, by Sir Douglas Forsyth, and giving valuable information on the various trade routes, their present condition and prospects; "The Native Indian Press," a mass of interesting and original information, by Dr. Birdwood; "The Commercial Communications between Persia and India," a highly important and ably handled paper, by Gen. Sir F. Goldsmid; and the "Marvels of Trees in India," by Mr. William Tayler, illustrated by a large number of exquisite and coloured sketches from nature by the author himself.

The discussions on these papers, carried on by gentlemen connected with India, contributed to give more prominence to several topics therein referred to, such as the wheat trade of Upper India, the completion of the important railway from Calcutta to Darjeeling, and the opening up to navigation of the Karoon river in Persia. The paper of Mr. Juland Danvers gave rise to a correspondence on the extension of Indian railways, and excited so much attention that it has been separately published.

The discussions in the Section have been, in several instances, the means of promoting more active exertions in several matters of public interest.

African Section.

In the meetings of the African Section this year great interest has been manifested in the notable advance recently made in opening out the interior districts of Africa to trade. At the commencement of the Session, Commander Cameron gave an account of his explorations of the central region of the great continent, where the Zanzibar traders from the east meet the Benguela traders from the west, and argued for renewed effort to extend civilised intercourse throughout the regions about the great Central Lakes. Dr. Mann followed up this argument by drawing attention to the marvellous progress that has actually been accomplished in this seemingly impenetrable region within twenty years, and dwelt especially upon the fact that in the interior line of 6,000 miles which connects the mouths of the Nile, the Zambesi and the Congo, it is now known that not more 600 miles, or one-tenth part, is devoid of a water track, either in the form of a river channel, or of a lake basin. Mr. Edward Hutchinson urged the importance of the land communication between Zanzibar, the Victoria Nyanza, and Lake Tanganyika, and of the establishment of a central trading station at Mpwapwa, as the most certain means of opening the country around those vast inland seas, as well as of getting at the district of Nyangwe and the Lower Lualaba, which is now the outpost of inland exploration. Sir Samuel Baker and Colonel Grant energetically and cordially supported Mr. Hutchinson's view of the desirability of establishing Mtesa upon the northern shores of the Victoria Lake as an independent chief, and in a position of friendly intercourse with England, and testified to the enlightened and kindly regard that chief had hitherto shown towards English travellers, since the now somewhat remote time when he offered the services of a fully equipped army to Sir Samuel. A very excellent account of the trading proceedings and interests of the West Coast Settlements was given by Mr. James Irvine, a Liverpool merchant practically engaged in the commerce of that part, who dwelt on the promise found in the improved class of goods now sought by the natives of Africa, and especially advocated the extension of trading establishments from the coast into the interior. Mr. Richards described, in a graphic communication recounting his own personal experiences of travel in the district, the condition of the community that is rapidly growing in numbers and wealth, under the stimulus which has been furnished by the discovery of diamonds, in Griqua Land West, and raised the argument of the social and political capabilities of the Kafir race. In the last communication of the season, Dr. Leared, just starting upon a new excursion to Tangier and Fez, furnished an excellent account of the trading and manufacturing operations of Morocco, and argued for a more intimate alliance with the enlightened Sharif of Wazan, and for the organisation of an experimental caravan for the conveyance of a good class of English manufactures along the ordinary routes of caravan traffic, from Morocco to Timbuctoo.

Chemical Section.

The work of the Chemical Section has been maintained during the Session, by the reading and discussion of papers upon subjects connected with industrial chemistry.

Mr. Kingzett, having been engaged for two or three years in investigating the products obtained by the oxidation of the turpentines, and having shown that these products, in the case of most of such bodies, consist of peroxide of hydrogen and camphoric acid, proposes to apply the fact technically, by artificially oxidising turpentine, and utilising the product obtained for various sanitary purposes. A paper upon the subject was read before the Section by Mr. Kingzett.

"The Sources, Production, and Use of the Cinchona Alkaloids," was the title of a communication brought forward by Dr. B. H. Paul. The supply of quinine having become of such vital importance, any information which might lead to its increased or more successful production is of no small value. The alkaloids occurring together with quinine in the cinchona bark have been carefully studied, with the result, as it appears, that most of them are found to be equally valuable, as medicinal agents, with the quinine itself. It is somewhat disappointing to find that the Government cinchona plantations have not proved such a success as was anticipated. The artificial production of quinine in the laboratory, although a discovery much to be desired, has not yet been achieved, and the nature of the alkaloid does not hold out any speedy hope of such a result.

Mr. W. Thomson, of Manchester, coming from the centre of the cotton industry, gave the Section an exhaustive paper upon the "Sizing of Cotton Goods," each particular process being described in detail, from which it would appear that the work of sizing is one of the most important operations which manufactured cotton goods have to undergo. The process of sizing has, by some, been deemed a dishonest practice, for which purchasers of cotton goods have, in the end, to suffer; but Mr. Thomson defends it on the ground that the sizing is called for by the natives of those countries to which most of the heavily-sized materials go. The natives of these countries make various pieces of clothing out of them, and they prefer to buy a cloth, at a given price, which has a full and good appearance (effects produced by judicious sizing), to paying the same amount for a cloth which is entirely composed of pure cotton, but through which the daylight would penetrate and show every thread of the fabric; in fact, they have no objection to clothe themselves with a composition of flour, tallow, and china clay, to which a little cotton has been added to make it stick together. We are told that such perfection in sizing has been attained, that 1 lb. of yarn, after passing through the sizing-machine and drying, will weigh 2 lbs.

A description of "Phosphor-Bronze, and the various purposes to which it may be applied," was contributed to the Section by Mr. Alexander Dick.

Mr. C. W. Vincent brought forward the subject of "Spontaneous Combustion in Factories and Ships," upon which communication an interesting discussion arose concerning the spontaneous combustion of coal in ships at sea. The figures representing the loss of life and property, almost conclusively traceable to this cause, show a deplorable state of things. Thus, during the last four years there have been 37,712 tons of shipping and 47,873 tons of coal burnt from spontaneous combustion, and if the "missing" coal laden ships be included, the loss of property may be taken at £1,250,000, and the number of lives lost as 1,155. It may be hoped that the labours of the late Royal Commission upon this subject will bear fruit, and that the knowledge now acquired will be utilised by those interested, in taking such precautionary measures as will materially reduce the risk of combustion.

The "Alkali Trade" has been represented during the past Session in a paper by Mr. G. E. Davis, upon a new process which proposes to supersede the established method of obtaining soda crystals, and at the same time to prevent nuisance or the accumulation of "waste;" the main feature of this process consists in the action of silica or sand upon native phosphate of alumina and salt-cake, whereby silicate of alumina and phosphate of soda are obtained, the phosphate of soda being afterwards converted into either carbonate or caustic soda. This process is as yet in its experimental state, but Mr. Davis is sanguine of its success on a manufacturing scale.

School Drill.

The members will recollect that this subject for several years formed a prominent part of the proceedings of the Society, and they showed to the public, by the gatherings of school children which they got together under distinguished inspection, what might be accomplished. The Council even had in view the making such gatherings the business of the constituted authorities rather than that of a voluntary society like the Society of Arts, and they are happy to inform the members that the system of school drill forms a very important part of the School Board system in the metropolis, and that the London School Board last year, for the first time, held a review of their several schools in the Regent's-park, when upwards of 10,000 boys were marched on to the ground, and after going through a variety of manœuvres marched past with their bands. The Society has given a handsome banner as a challenge prize, to be contended for by the schools of the metropolis at these gatherings. Last year the banner was taken and is held by the Kender-street School of the Greenwich division. The importance of drill as a branch of education, and especially for the children of our elementary schools have been so often insisted upon, that repetition would be wearisome and out of place. The School Board are making arrangements for another gathering of their schools in the Regent's-park, probably for some day in July, when the banner will be handed over to that school which exhibits the greatest proficiency in drill.

Domestic Economy.

The importance of teaching domestic economy in our elementary schools will, doubtless, be admitted by all. Under the term domestic economy is comprised food and its preparation, cooking, dress, including needlework, &c. That such instruction should be imparted to all as part of the system of our elementary schools, will not be denied, and that greater encouragement for its teaching should be given to it than the Government Code provides. With this view, and the hope of giving a wide extended publicity to the subject, the Council have determined to organise an annual congress in some great provincial centre, and this year Birmingham has been chosen as the locality well suited for a commencement of the work. Great local support has been given to the movement. The three counties of Stafford, Warwick, and Worcester have furnished a large number of supporters, to act as a general committee for organising the meeting, and the Mayor of Birmingham has consented to preside over the committee. The Congress is fixed to take place on the 18th and 19th of July, when it is hoped that members of the Society will, by their attendance, give countenance and support to the undertaking. Already papers for the meetings and discussions in the several sections have been promised, and there is every reason to expect that the meeting will be of a highly interesting, useful, and successful character. A programme of the proceedings is in the course of preparation, and will shortly appear in the *Journal*.

The Council renewed this year their offer of five scholarships at the School of Cookery, of the value of ten guineas each, and these were duly awarded after a competition among candidates nominated by the members.

TECHNOLOGICAL INSTRUCTION.

This subject, which the Society has for some time past endeavoured to promote, by establishing examinations which should test the qualifications of those engaged in industrial occupations, and thus give them the opportunity of displaying their efficiency, is year by year coming more prominently forward. The public are becoming alive to its importance, and the working-classes are ready to avail themselves of every opportunity which is afforded them of gaining an insight into the mysteries of science. The popularity of the Workmen's Lectures at the Royal School of Mines in Jermyn-street is notable evidence in this direction. Lectures alone are, however, but a small instalment of what is needed. The City Companies are, with commendable zeal, ready with their ample means to furnish what is needed for the supply of that tuition in technology now so much needed, and are contemplating the establishment of an institution on a large and extended basis, where provision can be made for the due supply of technical instruction, and brought within the means of classes who cannot afford the payment of high fees. It is not in pure science alone that instruction is needed, for that there is ample provision already in existence. It is rather to be found in technical teaching, in classes where the elements of science may be learnt, combined with its applications to the special trades or occupations in which the masses of our people are engaged. The Council have to acknowledge with gratitude the liberal action on the part of two of the City Companies, the Drapers and the Clothworkers, the former of whom have passed the following resolutions:—

At the Court of Assistants of the Drapers' Company, held at Drapers'-hall, on Wednesday, the 2nd May, 1877,

Resolved—"That with the view of making some immediate provision for improving the technical knowledge of London artisans, and of ascertaining the extent to which the members of this class would be likely to avail themselves of a system of technical instruction, this court will guarantee to the Society of Arts a sum not exceeding £1,000, to be expended during the next two years, in providing courses of lectures, with demonstrations, in Metal and Wood, and their application to commercial industries. The lectures to be of a thoroughly practical character, and to be open to artisans and apprentices, under conditions of admission to be hereafter determined. The lectures to be given at the House of the Society of Arts, John-street, Adelphi, and the general arrangements for them to be previously agreed upon by the Council of the Society and the Committee of the Company on Technical Education. The Court, should they consider that the objects in view are not being attained by the lectures, or that it would be expedient to provide by other means the instruction intended to be afforded, are to be at liberty to discontinue them at any time, subject to any arrangements which may have been then made."

Resolved—"That in the event of the lectures suggested in the foregoing resolution being given, the Society of Arts be requested to include in their Technological Examinations for next year the subjects treated at the lectures, and that, with the view of encouraging regular attendance at them, a sum not exceeding £50 be offered in prizes in those sections of the examinations for which the lectures are intended to be preparatory."

The Clothworkers' Company, in view of promoting the establishment of classes among those preparing for the Society's Technological Examinations, have informed the Council that they are prepared to devote a sum of money, not exceeding £200, to reward teachers who bring forward successful candidates at the Society's Technological Examinations. The Council feel assured that the members cannot fail to be gratified at this mark of the confidence on the part of the Companies in the Society's operations.

The two proposals are now under the consideration of a committee with a view to carry out most efficiently the objects which the Companies and the Society have at heart.

IMPROVED RAILWAY LAMP.

The Society's gold medal, or twenty guineas, it will be recollected, was some time since offered for an improved lamp, or means of illumination suitable for railway passenger carriages, which should produce a good, clear, steady, durable, and safe light. It was required to be simple in construction and capable of being readily cleansed. Cost, too was an important consideration, in judging the merits of any competing system.

Lamps were sent in of various constructions, and using various materials, for burning oil, mineral oil, and gas. The committee to whom was entrusted the examination and testing the qualifications of the several articles sent in, made a lengthened and careful examination of them, and, by a process of exhaustion, at last arrived at one which they deemed worthy of a lengthened practical trial, the opportunity for which was afforded to them by the courtesy of the Metropolitan District Railway, who had permitted the erection of the necessary apparatus for trial of the lamp on a portion of their line. The result of that trial fully confirmed the anticipations of the committee, and they unanimously recommended the award of the gold medal to Mr. Pintsch for his system of lighting railway carriages with gas. The gas employed is derived from the distillation of shale oil, and is compressed in cylinders to the extent of six atmospheres, and sufficient gas for a consumption of 35 hours is readily carried, the amount per hour for each light being ·6 of a foot. The cost is less than that of the present oil lamps, and the facility for cleansing is great. The light afforded is soft and diffused, admitting the reading of small print readily in any part of the carriage.

Food Committee.

This Committee has watched with much interest the continued and increasing supplies of fresh meat now coming from America. The means adopted, viz., the application of an artificially cooled atmosphere, is one which the Committee have, on more than one occasion, put forward as that of all others best adapted for the purpose. The prize so long offered through the Society by Sir Walter Trevelyan, of £100, together with the Society's Gold Medal, for the importation of fresh raw meat from abroad, would seem now to have a fair prospect of being earned. Already a claimant has appeared, and it now remains to satisfy the Committee that his claim can be sustained. During the year the Committee have had before them the results of some very successful experiments, carried out on the Society's premises, by means of which several joints of meat, as well as fish and game, have been kept over very considerable periods, in one instance eight weeks, in a sweet and sound condition. The method adopted is extremely simple and inexpensive, and there would seem no reason why it should not be adopted on board ship for the importation of cargoes of meat. The Committee trust that the parties who have brought this matter before them will proceed to test their plan on a commercial scale.

The Council have to express their regret at the sudden death of Mr. Benjamin Shaw, which deprived this committee of their chairman, who had acted in that capacity since the commencement, and had always taken great interest in the work of the Committee.

Medals.

The following medals have been awarded:—

The *Albert Gold Medal* "for distinguished merit in promoting Arts, Manufactures, or Commerce, to Jean Baptiste Dumas, member of the Institute of France, the distinguished chemist, whose researches have exercised a very material influence on the advancement of the Industrial Arts."

The *Society's Gold Medal*, for an improved system of lighting railway carriages, to Mr. Pintsch.

The *Society's Medal* for papers read during the Session, viz:—

To Professor Barff, M.A., for his paper on "The Treatment of Iron for the Prevention of Corrosion."

To J. Meyerstein, for his paper on "Stenochromy," a novel method of printing in colours.

To A. J. Ellis, F.R.S., for his paper on "The Measurement and Settlement of Musical Pitch."

To B. St. John Ackers, for his paper entitled "Deaf not Dumb."

To Commander Cameron, R.N., C.B., for his paper on "The Trade of Central Africa, present and future."

To James Irvine, for his paper on "Our Commercial Relations with West Africa, and their Effects on Civilisation."

To Sir Douglas Forsyth, C.B., K.C.S.I., for his paper on "The Progress of Trade in Central Asia."

To W. Thomson, for his paper on "The Sizing of Cotton Goods."

Examinations.

These have been carried on during the present year with a marked increase in the numbers presenting themselves for examination. The particulars will be found in the Report of the Educational Officer, printed in the last number of the *Journal*. One new subject of a special character has this year been added to the list, viz., a practical examination in Blowpipe Analysis, a matter of great importance, more especially to those engaged in our mining industries. This subject, though specially attended to on the Continent, attracts but too little notice here, and it is not included in the curriculum of any examining body in this country. The Council have, therefore, thought it right to set such an examination on foot, in the hope that it may lead to a more extended practical use. For the particulars connected with the examination, the members are referred to the Educational Officer's report, printed in the *Journal* of last week.

Finance.

Appended is the balance-sheet of the Society, duly audited by the professional Auditor. It will be observed that, during the year, a sum of £133 6s. 8d. Consols has been invested in the name of the Society, the gift of the late Mr. Benjamin Shaw, the accumulating interest of which is to be applied every fifth year to the author of the most successful invention for preventing or mitigating loss of life, or promoting health in connection with any industrial occupation. The Owen Jones' Memorial Committee have handed over to the Society the sum of £400, being the balance unexpended of subscriptions raised for a memorial to the late Mr. Owen Jones, this amount to be held in trust by the Society, to apply the interest in prizes to students of our Schools of Art who produce the best designs for household furniture, carpets, wall papers and hangings, damask, chintzes, &c., regulated by the principles laid down by Owen Jones. This amount has been invested, in the name of the Society, in the purchase of £423 Canada Four per cent. Stock.

It will be remembered that the Council brought before the members the services of the late Mr. S. T. Davenport, and sought their subscriptions to a fund which should mark the estimation in which their long tried officer was held, and at the same time be of substantial service to his widow and numerous family. The amount subscribed was £1,632; of this £1,500 has been invested in the names of three trustees in the purchase of Liverpool and Mersey Dock debentures, and the remainder in cash has been appropriated for the immediate benefit of the family, while the interest on the debentures is, under the direction of the Council, from time to time to be paid to Mrs. Davenport.

DISCUSSION.

The Chairman moved, and **Mr. A. Cassels** seconded, the adoption of the Report.

Mr. Hale wished to make a few remarks on the Report, which he thought should have been printed and distributed before the meeting. He objected to the paper read by the Assistant-Secretary on Patent-laws. As he believed that a large sum, the surplus from the 1851 Exhibition, was now lying idle in the Bank of England, he would suggest that the Society should apply for a portion of it. He considered that Mr. Gladstone was the most suitable person to have received the Albert Medal. Though he did not wish to vote against any individual name on the balloting list, and though he had the greatest regard for the Council as a body, he objected strongly to the list as a whole, and would certainly not vote for it. He thought the Prince of Wales should be asked to present the prizes. He was glad to see Lord Northbrook's name in the list of the new Council, and hoped his lordship would continue to take interest in the Indian Section. He thought the Council did not pay sufficient attention to the expenditure of the funds, and he thought they might very well spend some money on painting the outside of the house. With regard to subscriptions, he did not believe there was any advance in the number of members, and it was owing to a stricter collection of arrears that the balance-sheet showed the Society to be in much the same position as last year. He would recommend that an advertisement of the Society should be printed on the *Journal* cover, and that the price should be reduced to 4d. More accommodation was required in the reading-room, and he would like to have another lavatory on the ground floor. He maintained that the total amounts of the salaries were not correctly given in the balance-sheet. Finally, he complained of the reports in the *Journal*, and stated that, in the case of a certain speaker whom he would not name, the report was always unduly shortened.

Mr. S. Ford endorsed the remarks of the preceding speaker as to the reading-room, and advocated the extension of the library. He considered a mistake had been made in giving one of the courses of Cantor Lectures in the afternoon, and recommended that the hour for the evening meetings should be altered from 8 to 7. He regretted to learn from what Mr. Hale had said that the Society seemed to be going back, and commented on the omission of the usual glee concert from the programme of the conversazione.

Mr. Campin, after some complimentary remarks on the paper on Patent-law to which a preceding speaker had referred, expressed a doubt as to the policy of awarding a medal to Messrs. Pintsch's railway lamp, inasmuch as he understood that the originality of the invention was contested.

Mr. Mast complained that for three years he had been applying to be allowed to read a paper before the Society, and had always met with refusal; on the last occasion the Secretary had informed him that it was useless his even bringing the matter before the Council. He maintained that a member had a right to read a paper if he wished to do so.

The Chairman said he was sure there was no necessity for him to refer to many of the points which had been raised. He would remind Mr. Hale that the Society had no control whatever over the surplus of 1851, though he need not say he should be glad to see the Society's funds augmented from that or any other source. With regard to Mr. Mast's complaint, it must of course rest with the Council to decide what papers were or were not suitable for acceptance by the Society.

The vote was then put to the meeting, and unanimously carried.

The Chairman then proposed a vote of thanks to the scrutineers, which was carried.

Mr. A. Cassels, in complimentary terms, proposed a vote of thanks to the officers, which was seconded by **Mr. Campin**, and supported by the **Chairman**.

This vote having been put and carried unanimously,

General Cotton proposed a vote of thanks to the Chairman, Lord Alfred Churchill, who after serving for two years was about to retire from his office. It was a matter of regret to all who knew how energetically he had worked for the Society, that the end of his term of office had expired, but he was glad to think that they would still have the advantage of his advice and assistance on the Council.

Mr. Hale seconded the motion.

Mr. Tennant, in supporting it, wished to say that so far from the Society being in a declining state, as one of the previous speakers had seemed to imply, he had never known it more flourishing since he joined it 40 years ago. At that time it was at a very low ebb, and he had, indeed, been asked to join it simply on the ground that it was badly in want of support. As for the *Journal*, he considered that it reflected great credit on all concerned, and he had often had occasion to notice the excellence of its reports. One instance had made a great impression on him. It happened that papers on the same subject were read almost simultaneously here and at another Society. A friend of his who was unable to be present applied to him for reports. The next Saturday he sent him a full report of the paper and discussion here, which gave him all he wanted, but it was six months before he could get a meagre and useless abstract of the other paper. He thought the members were sincerely to be congratulated on the position of the Society.

The vote having been duly put and carried unanimously, it was acknowledged by the **Chairman**.

The meeting then proceeded to ballot for the election of the candidates for membership, and they were duly elected members of the Society:—

Aberdeen, Earl of, Haddo-house, Aberdeenshire.
Alford, Henry William, 2, Southampton-buildings, Chancery-lane, W.C.
Browne, Dr. J. Collis, Ramsgate.
Coghlan, P. B., Borough Surveyor's Office, Bower-spring, Sheffield.
Collins, William, 139, Stirlings-road, Glasgow.
Denham, W. Hempson, Southsea, Portsmouth.
Feetum, C. Campbell, 158, Regent-street, W., and 59, Brompton-crescent, S.W.
Fuller, Edward Harrison, Withington Local Board, 66, Deansgate, Manchester.
Greenhill, William, Hampton court.
Holt, Henry Percy, 4, Westminster-chambers, S.W., and Royal Insurance-buildings, Leeds.
Howard, Eliot, 84 and 85, Upper Whitecross-street, E.C.
Howard, James, Bedford.
Insole, James Harvey, Ely-court, Llandaff.
Kerr, Robert, 23, Milton-place, and 10, Northgate, Halifax.
Lucas, Joseph, Tooting Graveney, S.W.
Marrable, George, 25, Onslow-square, S.W.
McNaught, James Aldren, Worcester.
Meyerstein, Emil, 14, Fellows-road, Haverstock-hill, N.W.
Nicholls, A. D. C., 5, Royal-avenue, Chelsea, S.W.
Richardson, Benjamin W., M.D., F.R.S., 12, Hinde-street, W., and Boundary-house, St. John's-wood, N.W.
Rowan, Frederick John, 108, Wool-exchange, Coleman-street, E.C., and 33, Bath-street, Glasgow.
Sandheim, Isaac, 16, Suffolk-street, Dublin.
Schloesser, William, College-hill, Cannon-street, E.C.
Shirley, Lionel H., F.R.G.S , 2, Storey's-gate, Westminster, S.W.
Smith, George Belk, 11, Melbourne-place, Bradford, Yorkshire.
Souttar, Robinson, Oxton, Birkenhead.

Soyres, Rev. Francis de, 13, Victoria-terrace, Mount-Radford, Exeter.
Stapley, Henry, Newtown, Montgomeryshire.
Thompson, John J., 15, Cottage-grove, Stockwell, S.W.
Thomson, William, Royal Institution, Manchester.

The ballot having remained open one hour, and the scrutineers having reported, the Chairman declared that the following had been elected to fill the several offices. The names in *Italics* are those of members who have not, during the past year, filled the offices to which they have been elected:—

PRESIDENT.

H.R.H the Prince of Wales, K.G.

VICE-PRESIDENTS.

H.R.H. the Duke of Edinburgh, K.G.
Lord Aberdare.
Sir George Campbell, M.P. K.C.S.I.
A. Cassels.
E. Chadwick, C.B.
Lord Alfred Churchill.
Hyde Clarke.
Sir Henry Cole, K.C.B.
Major Donnelly, R.E.
C. J. Freake.
Earl Granville, K.G., F.R.S.
Lord Hampton, F.R.S.
William Hawes, F.G.S.
Sir John Lubbock, Bart., M.P., F.R.G.S.
Lord Northbrook, K.C.S.I.
Vice-Admiral Erasmus Ommanney, C.B., F.R.S.
Robert Rawlinson, C.B.
John Simon, C.B., F.R.S.
F. Carleton Tufnell.
The Duke of Westminster, K.G.

ORDINARY MEMBERS OF COUNCIL.

F. J. Bramwell, F.R.S.
R. Brudenell Carter.
J. Brunlees.
Major-General Fred. C. Cotton, C.S.I.
Col. Du Cane, R.E., C.B.
Hon. Dudley Fortescue.
H. Danby Seymour.
Henry Doulton.
Sir U. J. Kay-Shuttleworth, Bart., M.P.
W. H. Perkin, F.R.S.
T. R. Tufnell.
J. A. Youl, C.M.G.

TREASURERS.

Ed. Brooke.
H. Reader Lack.

SECRETARY.

P. Le Neve Foster.

CONVERSAZIONE.

The Society's Conversazione was held on Wednesday evening last, June 27th, at South Kensington Museum, by permission of the Lords of the Council on Education. The Raphael Cartoons Gallery, the Sheepshanks' Galleries, the William Smith collection of water-colour drawings, the Dyce and Forster pictures and libraries, and the collection of paintings lent by Mr. Fuller Maitland and Lord Spencer, were open, and all the courts and corridors of the ground floors. The reception was held in the Throne Room of Akbar Khan in the Architectural Court, by Lord Alfred S. Churchill, Chairman, assisted by the following Vice-Presidents and Members of the Council:—Ed. Brooke, A. Cassels, Hyde Clarke, Sir Henry Cole, K.C.B., Major-General Fred. C. Cotton, C.S.I., the Hon. Dudley Fortescue, Wm. Hawes, F.G.S., H. Danby Seymour, and J. A. Youl, C.M.G.

A Promenade Concert was given by the Band of the Grenadier Guards (conductor, Mr. Dan Godfrey) in the North Court.

PROGRAMME.

Marche Heroique		Schubert.
Overture	"Le Philtre"	Auber.
Selection	"Le Petite Mariée"	Lecocq.
Valse	"Autographen"	Strauss.
Air	"Nazareth"	Gounod.
Euphonium Solo—Mr. Siddons.		
Descriptive Fantasia	"A Summer's Day in Norway"	Willmers.
Break of Day—Warblings at Morn—Morning Prayer—Dance of Peasants—The Vesper Bells—Finale.		
Valse	"Sweethearts"	D'Albert.
Selection of Scottish National Melodies		Godfrey.
Marche Romaine		Gounod.
Fantasia	"La Fille de Madame Angot"	Lecocq.
Pas des Marins		Jullien.
Selection	"Trial by Jury"	Sullivan.

MISCELLANEOUS.

THE NEW ELECTRIC LIGHT.

On Friday, the 15th inst., a trial was made of the electric lighting apparatus invented by M. Jablochkoff, and known as the "electric candle," at the West India Docks. Briefly described, the "candle" consists of two pencils of carbon set side by side with a strip of vitrified kaolin between them. As the carbons are consumed, the kaolin is volatilised, and burns away, thus exposing continually fresh surfaces of carbon. The electrical resistance being thus perfectly constant, it becomes possible to place more than one light in the line of the voltaic circuit, and thus a single battery or machine may serve for several lights. A further development of the invention consists in interposing a small plate of kaolin in the circuit from an induction coil, when the kaolin becomes incandescent, and when sufficiently heated throws out a pure white light. The following account of the experiments is given by the *Times* reporter:—

"The proceedings commenced soon after 9 p.m. with the lighting of four electric lamps in the court-yard at the entrance of the docks. The lamps were arranged at distances 45 ft. from each other in one direction, and 20 ft. in the other. The light of the electric candle in each lamp was subdued by being transmitted through ground glass globes. The light was steady after the first few minutes, and that of one lamp was sufficient to enable small print to be easily read 20 yards away. The light was produced from one of the Alliance Company's (Paris) electro-magnetic machines, having 32 magnets of six plates each, and being driven by a small portable steam-engine. After burning for a quarter of an hour, the electric lights were extinguished and four gas-lamps, each having four of Bray's No. 6 burners and four powerful reflectors, were lighted. The contrast was very marked, the gas burning with a dull yellow light which barely lighted the surrounding space. The visitors then proceeded to the top story of one of the larger warehouses, which was lighted with three of the electric candles, placed at considerable distances apart, and in the windows of the building. The floor was about 120 ft. long by 65 ft. wide, and the light was most efficient when not obstructed by the shadows of the visitors moving about. A portable electric light was next carried down into the hold of a large vessel, and its efficiency in that respect was fully demonstrated, as it was also by an electric light on the quay. By the aid of these lights, properly arranged, the loading and unloading of ships could be carried on at night. The carbon points, on candles, will only burn for about an hour, but M. Jablochkoff arranges four of these candles on each lamp, and as one is consumed another is ignited by a simple switch arrangement, so that the continuity of the light is hardly broken. The whole of the experiments were highly satisfactory, and indicate an important advance in the utilisation of electric light,—firstly, as regards the supersession of clock-work; and secondly, with respect to the divisibility of the stream of electricity, which renders it possible to burn several lights with a single current."

ADULT INSTRUCTION THROUGH PUBLIC MUSEUMS (*Subsidised by Parliament*).

The following results, giving important information bearing on public education, are obtained as correctly as possible, from inquiry and Parliamentary returns, in the hope that they may hereafter be officially collected and published periodically, like the Registrar-General's returns. The number of visitors for the months of March, April, and May, 1877, are stated. When they are counted by sight the letter "S" is used, when by turnstile the "M":—

INSTITUTIONS.	Amounts voted in 1876.	Number of Visitors in March.	Number of Visitors in April.	Number of Visitors in May.	How counted.	OBSERVATIONS.
1. British Museum	£ 108,947	33,270	50,757	58,942	S	Return refused. Open Mondays, Wednesdays, Fridays, and Saturdays. Closed, except to students, on Tuesdays and Thursdays. (1)
2. National Gallery, Charing-cross	6,898	155,835	643,266	193,907	S	Open Mondays, Tuesdays, Wednesdays, and Saturdays. Closed on Thursdays, and Fridays. Open from 10 to 5. (2)
3. Kew Gardens and Museum	22,622	..	..	..	S	Open on Sundays and week days. (3)
4. South Kensington Museum	39,058	..	..	..	M	Open morning and evening till 10, on Mondays, Tuesdays, & Saturdays. Students' days—Wednesday, Thursday, & Friday, 6d. entrance. Open from 10 till Sunset.
5. Bethnal-green Museum	7,200	..	..	..	M	Ditto. (5)
6. National Portrait Gallery, South Kensington	2,000	..	..	..	M	Return refused. Open daily except Sundays. (6)
7. School of Mines and Mining Record Office, Geological Museum, Jermyn-street	8,947	4,623	4,526	4,447	M	Open daily, except Sundays and Fridays, and in the evenings till 10 of Monday, Tuesday, and Saturday. (7)
8. Patent Office Museum, South Kensington	..	..	22,858	23,004	M	Open daily, except Sundays. (8)
9. Edinburgh National Gallery	2,100	5,347	4,941	7,898	M	(9)
10. Edinburgh Museum of Antiquities	..	6,237	4,949	8,717	M	(10)
11. Edinburgh Museum of Science and Art	10,320	27,857	23,923	24,590	M	Open daily (10 a.m. to 4 p.m.) except Sundays, and Friday and Saturday evenings (6 to 9). Students' days—Monday, Tuesday, & Thursday; admission 6d.; other days, admission free. (11)
12. Edinburgh Botanic Gardens	1,750	4,386	4,134	13,569	M	(12)
13. Dublin Museum of Natural History	1,742	9,115	9,910	10,935	M	Open daily, & in the evening. (13)
14. Glasnevin Botanical Gardens and Museum	2,224	10,342	21,528	25,903	M	Open daily, including Sundays. (14)
15. National Gallery of Ireland	2,339	8,265	7,208	6,946	M	(15)
16. Museum of Royal Irish Academy, Dublin	300	..	..	..	M	(16)
17. Zoological Gardens, Dublin	500	4,650	10,708	11,241	M	Open daily, including Sundays. Number of visitors in July, 15,281. (17)
18. Tower of London	1,590	..	..	..	S	Open daily, except Sundays. (18)
19. Royal Naval College, including Greenwich Painted Hall	38,051	23,157	31,962	37,752	S	Open daily, including Sundays. (19)
20. Royal Naval Museum, Greenwich	1,055	2,807	7,062	9,498	S	Open daily, except Fridays and Saturdays. (20)
21. India Museum, South Kensington	..	2,291	3,194	4,546	M	Paid for by Indian Government. Open on Mondays, Tuesdays, Fridays, and Saturdays, 1d. admission; on Wednesday and Thursday, 6d. admission. (21)
22. Hampton Court Palace	7,475	..	..	..	..	Open on Sundays, and on week days except Fridays. (22)

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(2) In the month of March, open 17 public days (10 to 5 o'clock); total for three months, ending March 31st, 453,074. In the month of April, open to the public 17 days (from 10 to 5 o'clock). In the month of May, open 18 public days, including the public holiday by statute, from 10 to 6 o'clock. The numbers are the visitors on public days only.

(9) (10) No information as to opening. (11) Total number of visitors during year 1876, 530,656. (12) (16) No information as to opening.

(22) As far back as 1855 returns of the number of visitors were made to Parliament and printed, but this practice, for the present at least, has been suspended. The statistics published by the Board of Trade every three years give returns.

CORRESPONDENCE.

ESCAPE OF SEWAGE GAS INTO HOUSES.

The public are daily becoming more alive to the paramount importance of this subject, and, thanks to the efforts which the Society of Arts has lately been making, it may safely be said that increased progress is observable towards the end in view, by attention having been drawn to the grievous insecurity arising from the impure state of the drains and soil-pipes of houses, with a view of discovering the best modes of overcoming the difficulties of removing the dangers we are all thus exposed to.

The object of the Society of Arts, clearly, is not only to gather the latest and best information on the subject, but to disseminate it everywhere, by means of the powerful influence, and through the excellent channels it is known to possess.

From the number alone of suggestions offered, a great deal of bewilderment must actually exist, and the difficulty is sometimes increased by a habit in some, who should fairly be looked to as guides, of straining the mind or the vision in search of very remote and merely possible difficulties—a habit which sometimes unwisely hinders activity, and by creating needless doubts, retards, and even prevents proper progress. The public however, will, as usual, apply the winnowing process to the various suggestions offered, and will, no doubt, as is their habit, in the long run, sooner or later, act upon the best.

Taking it as settled beyond dispute that it is imperatively necessary to exclude sewage gas and its fever-germ concomitants from dwelling houses, with the Council's permission, I will, as briefly as possible, show how such a most devoutly to be wished for consummation may be attained.

With all respect to Mr. Rogers Field, I must state that the plans he proposed, as illustrated by the diagrams exhibited at the Conference, not only do not satisfactorily accomplish that object, but, on the other hand, in some respects, have the reverse effect. Without repeating the criticisms of Drs. Vacher, Syson, and Ainley, and of Mr. Baldwin Latham, I will here only endorse those criticisms, and having described the system I suggest, leave with all confidence the verdict to the intelligence of your readers.

Tho system I advocate as the most or only perfect system, is that known to the world as the "Banner system." It consists of a trap inlet to soil-pipe and an exhaust cowl. The trap is fixed near the foot of the soil-pipe, whether it be inside or outside the wall of the house, or between the house and the sewer. This trap can never become unsyphoned, a liability of constant occurence in suggested syphon traps; and another good feature in it is that its condition can be inspected at any moment without any trouble or expense. The inlet is an opening for fresh air to the soil-pipe a little above the trap. This inlet will be referred to later on. The next feature is the exhaust cowl. This cowl, unlike all other cowls, really produces a draught, and this draught, though varying according to the wind, is constant. Air, in the "Banner system" is constantly being drawn in at the inlet, and made to flow up the drain or soil-pipe, until it is discharged at the cowl outlet; or, if preferred, and a little more expense not objected to, the current may be brought down the soil-pipe, over the inner trap and out up an independent pipe, having the cowl fixed upon it above the roof; but in either case no sewage gas can remain in, or by any possibility enter the house. Another advantage of the system is, that all abominable D and other traps are avoided; in short, slightly paraphrased, the physicians' motto is, *par excellence*, the Banner motto, "*Cito, jucunde, et tutissime.*" Being very simple, the system is economical. Without a cowl, an inlet is often worse than of no service; with no inlet, a cowl is of no service; with an ordinary cowl, no draught is ensured; with the Banner cowl, the draught is perpetual. Mr. Banner claims to have been the very first to have introduced this safe and comparatively perfect system of efficient trap, inlet, cowl, and perpetual through draught. This being debated ground shall not be discussed. I will only say that I believe this system to be the only one which fulfils its purpose effectually, and that at the Conference no plan approaching it was brought forward, save when it itself was alluded to by speakers, in pointing out defects and shortcomings in plans proposed.

Since the late Conference, a report has been received from the surveyor of Guy's Hospital, where the system has been applied on a large scale, and, coming from such a source, I give a copy of it for the information of the Council of the Society of Arts:—

Guy's Hospital, May 8th, 1877.

Sir,—I regretted I had not an opportunity, when at the late Conference at the Society of Arts, to have entered into the discussion in reference to your system of sanitation, as carried out to a portion of "Guy's Hospital." I intended to have stated that, having had it in operation now for upwards of six months, I was perfectly satisfied with its results, both as to the patent traps as well as to your patent wind cowls, neither one or the other having been found, after careful watching, to become unsyphoned or out of order.

I believe the action of your wind cowls, placed upon the top of the soil pipes, when coupled with the air inlet pipe, as in your complete system, to be quite effectual in maintaining a continuous upward current, not only through them, but also through the drains where they have been so arranged. And even more, their power of suction has been found, by repeated experiments of a lighted taper placed in the closet pans, to show the downward direction even of the current entering the soil-pipes.

You are, therefore, quite justified in dispensing with all D and other traps beneath each closet (which really are nothing better than cesspools on a small scale, proving always a constant source of annoyance and expense, as well as great danger, when retained); thus you are able to withdraw from the drains, as well as from the soil-pipes of the closets, sluice-pans, &c., of the different wards of the hospital where your system has been applied, during all winds and all weather, the foul air or gas from within them, and replace it entirely with a continuous current of fresh air. I consider this fact alone to show the great blessing it must have conferred upon the inmates of the hospital, and believe it to be worthy of universal adoption.—Yours faithfully,

(Signed) Arthur Billing,
Surveyor to the Hospital.

In conclusion, I will only add that the space and conditions dealt with at Guy's Hospital are equal to those of forty or fifty houses, and that the same system can readily be applied to the side of a street, or square, or to a crescent, or terrace of several houses, whether the sewer be at the back or in front of them. One delivery for the whole of them into the sewer will suffice, while thorough ventilation and ample flushing power can be easily secured. The system is simple, consequently inexpensive. Excreta are never exposed for a moment, no sewage gas can be generated, and the only escape for impure air is above the roof of the houses.

R. Barnes Austin, C.E.,

PROFESSOR MAYER'S ELECTRICAL TONOMETER.—A CORRECTION.

In describing this instrument in my paper on "Musical Pitch," in the *Journal of the Society of Arts*, for 25th May, pp. 672-3, I omitted to state that Professor Mayer's researches on the vibrations of tuning forks were specially undertaken to determine the law regulating the action of forks when used as chronoscopes for determining the velocity of projectiles. Consequently, the determination of the vibratory period when the fork was denuded of the attached foil, and was not scraping the smoked paper, did not come into question, and the effect of scraping had to be allowed for afterwards. These effects have to be allowed for by observing the beats of the fork before experimenting and during experimenting with some third fork and taking the difference. The name "Electrical Tonometer" was given by me at the moment to distinguish it from others.

Also on p. 673, line 14 from bottom of text, for: "The pressure of the point of foil attached to the fork also made no change in the vibratory period," read: "*Variation in* the pressure, &c." The words in italics had been accidentally omitted in the hurry of writing in Professor Mayer's letter to me of 24th April, whence I drew the description given. Professor Mayer has scores of tracings which prove that variation in the pressure produces no effect, but the pressure itself does produce an effect, which the circumstances of note 13 induce me at present to estimate at ·77 or about ¾ per cent. of the actual number of vibrations of the fork.

I take this opportunity of stating that the "Ancient Low Pitch, below C 500," forming my Group I., is under re-examination, and that probably a good deal more has to be said on the subject, and some corrections to be made. I hope next year to be able to communicate the results of my inquiries, and at present will not anticipate any by imperfect statements, except to say that Gibbons, at any rate, seems to have used a sharp and not a flat pitch. ALEXANDER J. ELLIS.

NOTES ON BOOKS.

Animal Products. By P. L. Simmonds. Chapman and Hall. 1877.

This is one of the series of handbooks to the Bethnal-green Museum prepared under Mr. Cunliffe Owen's directions. The intention of the series is that the treatises composing it should at once form guides to the various departments of the museum, and should serve also as text-books in the different subjects of which they treat. Three of these handbooks have already been published, "Economic Entomology" and "Food Products" forming the subjects of the other two. The collection of animal products was, it may be remembered, commenced by the Society of Arts, in co-operation with the Commissioners of the 1851 Exhibition, from which indeed many objects were obtained. The collection, first publicly exhibited in 1857, was in the following year presented to the Science and Art Department. After remaining several years at South Kensington, it was transferred to its present position at Bethnal-green. The present is a good-sized volume of over 400 pages, fully illustrated throughout. Looking at it as a handbook of Economic Zoology, it differs from the ordinary Natural History treatises, inasmuch as it deals throughout with the animals described, solely with regard to the products they afford; this has necessitated a somewhat arbitrary classification into wool-bearing animals, fur-bearing animals, and the like, though occasionally the author has felt obliged to revert to the usual scientific classification, and he gives us "Pachyderms, and their uses," "Carnivora," &c., "Aquatic Mammals, and their uses," and so on. The ordinary classification is, however, given in an introductory chapter. It is needless to say that the information is of a totally different character to that given in books on Natural History, the difference being perhaps fairly summed up by saying that the main tone of the book throughout is commercial and practical, instead of scientific, the result being that the work contains much and varied information which it would be hard to find elsewhere, at least, without great expenditure of time and trouble in the collection of facts. In almost every case abundant statistics are given, and, as above stated, there are illustrations whenever it appears necessary.

The Alkali Trade. By C. T. Kingzett. Longmans and Co.

When a single trade can establish and maintain a literature of its own, it is considerable evidence that the industry in question must have acquired great importance; that such is the case with the alkali trade need hardly be stated, but the fact is brought prominently forward when looking through Mr. Kingzett's book. The growth of this trade, which in England alone is estimated to employ a capital of £5,000,000, is quite unique, a fact which the statistics found in this work most conclusively show, and which is to be attributed greatly to the very large number of products obtained either directly or indirectly by its means. Mr. Kingzett thus enumerates the products which are obtained in the course of manufacture of "alkali:" iron, copper, silver, gold, sulphuric and hydrochloric acids, bleaching powder, potassic chlorate, calcic chloride, sulphate of soda, caustic soda, soda carbonate and bicarbonate, sulphur, sulphate of copper, hyposulphite of soda, phosphate of soda, and Epsom salts. As the nucleus of this trade is the manufacture of sulphuric acid, and as this acid was selling in the year 1797 for £220 per ton, while the same acid is now sold for £5 per ton, the rapid development of the industry is seen to be perfectly justified. This growth is found to extend to each product; thus, in 1805 bleaching powder sold for £120 per ton, it is now worth from £4 to £5; in 1801 "alkali" sold for £49 5s. per ton, and in 1806 soda crystals sold for £60 per ton, at the present time the selling price is £4 15s. per ton. As might naturally be expected where such large interests and so many processes are involved, there have been schemes and suggestions in plenty for the improvement of the manufacture, the number and constancy of which has sometimes caused alkali manufacturers to ask pathetically to be merely left alone by inventors and patentees. Some of these suggestions and processes have been the outcome of patient and careful work in the laboratory, and in such cases have usually proved more or less successful when introduced practically on the large scale, while others have been so crude and unworkable that failure has ensued. Mr. Kingzett's book is principally an account of the more successful of the processes, which have been introduced since the year 1840, and, as in all cases where practicable working figures and analyses are given, corrected down to the present year, the book becomes a valuable record for the reference of the manufacturer, as well as a means of spreading information on the subject. Many of the more modern processes described have been at work in English factories for some time, but others are to be found which are only worked in Germany, while others, again, appear at present only on paper, although seemingly feasible suggestions; the backbone of the process has, however, undergone little alteration since the time of its introduction by the ill-fated Le Blanc. Mr. Kingzett calls special attention to the utilisation of waste products; and, indeed, the success of this trade has very largely depended upon the recovery of what were at one time waste materials. No less than six processes—all of which are successfully at work—are described in detail in this book, having special reference to this point. The competition in the alkali trade is as keen as in most other trades, and it is necessary for a manufacturer, in order to maintain his position, to see that his processes are worked with as much scientific accuracy as possible; and, as this needs the constant supervision of each process by means of analyses, &c., the employment of thoroughly competent chemists in every alkali works is, no doubt, rightly insisted upon by Mr. Kingzett, who attributes the very large development of the trade during the last 10 years in Germany to the high class of chemists employed in the German works. A chapter on atmospheric and river pollution, &c., and one on the allied manufacture of soap, are also to be found in the work.

The Art of Electro-Metallurgy. By G. Gore, L.L.D., F.R.S. London: Longmans, Green, and Co., 1877.

This is the most recent of Messrs. Longman's "Text-books of Science," twenty of which have already been published, while nine more are announced as in preparation. The book is divided into four parts. The first part is historical, and gives a detailed account of the origin and development of the science of electro-metallurgy from the early experiments of Wollaston, Brugnatelli, and others, through the first practical applications by Jacobi, Spencer, and Jordan, down to the present state of the art. Following the "Historical Sketch," comes a "Theoretical Division," which treats of the principles and laws upon which the art is based. This chapter forms only a small portion of the book, and it is strictly confined to such concise information as it is necessary for the practical worker to have at his command. In the third part the practical portion of the book begins. This first gives an account of the general method of electro-deposition, from the simple immersion process down to the ordinary battery process. Next, after a few notes on "Practical Points to be Observed," we have a full and elaborate description of the special means of depositing the different metals, &c. This forms the main bulk of the book, for not only are the different processes given at length for treating metals generally used, but an account is given of the experiments that have been made in the deposition of the rarer metals, and, to make the treatise scientifically complete, even of the metalloids. Much of this has—at all events at present—a purely scientific interest, and indeed the author says in his preface that he hopes "not only students and practical workers in the art will find this section of value to them, but that even scientific investigators may find it useful for reference." In passing, it is of interest to note Dr. Gore's observation that a crystal of titanium, placed in the circuit of a battery of sixty of Smee's cells, became red-hot and omitted a splendid white light. The similar use of a plate of porcelain is one of the methods employed by M. Jablochkoff in the electric light now attracting so much attention. Although in this division of the book full directions are given for the deposition of all the metals employed in the arts, a final "Technical Section" is given in conclusion, in which are to be found suggestions for workshop arrangements, descriptions of and directions for managing batteries, instructions for cleaning and preparing articles, and similar points not included in previous chapters. In the appendix is a list of all books and of patents relating to the subject. In the former the book given as "Galvano-plastic Manipulation. A. Roseleur, 1872," is probably the American translation of Roseleur's book by A. Fesquet, published in 1872, at Philadelphia. In the list of patents the name of the agent taking out the patent is frequently the only name given, instead of that of the foreign inventor.

A fortnightly journal, specially devoted to all matters connected with British, Colonial, and Foreign Trade Marks, and for the promotion of a complete system of International Registration, is announced to appear July 2nd, with the title "Trade Marks."

GENERAL NOTES.

British Association.—The following is a list of the officers of the forty-seventh annual meeting of the British Association which will commence at Plymouth on Wednesday, August 15:—President Elect—Prof. Allen Thomson, M.D., LL.D., F.R.S., F.R.S.E. Vice-Presidents Elect—The Right Hon. the Earl of Mount-Edgcumbe, D.C.L., the Right Hon. Lord Blachford, K.C.M.G., Dr. William Spottiswoode, F.R.S., Dr. William Froude, C.E., F.R.S., Mr. Charles Spence Bate, F.R.S. General Secretaries—Capt. Douglas Galton, C.B., F.R.S., Dr. Philip Lutley Sclater, F.R.S. Assistant General Secretary—George Griffith, M.A., F.C.S. General Treasurer—Prof. A. W. Williamson, F.R.S. Local Secretaries—Messrs. William Adams, William Square, F.R.C.S., Hamilton Whitefore. Local Treasurer—Mr. Francis Hicks. The Presidents of the Sections are as follow:—Section A: Mathematical and Physical Science—President, Prof. G. C. Foster, F.R.S. Section B: Chemical Science—President, F. A. Abel, F.R.S. Section C: Geology—President, W. Pengelly, F.R.S. Section D: Biology—President, J. Gwyn Jeffreys, F.R.S., F.L.S. Department of Zoology and Botany, J. Gwyn Jeffreys, F.R.S., F.L.S. (President), will preside. Department of Anatomy and Physiology, Prof. Macalister, M.D. (Vice-President), will preside. Department of Anthropology, Sir Walter Elliot, K.C.S.I., F.L.S. (Vice-President), will preside. Section E: Geography—President, Admiral Ommanney, F.R S., F.R.G.S. Section F: Economic Science and Statistics—President, the Right Hon. the Earl of Fortescue. Section G: Mechanical Science—President Edward Woods, C.E. The reception room will be opened on Monday, August 13, at 1 p.m., and on the following days at 8 a.m., for the issue of tickets to members, associates, and ladies, and for supplying information. No tickets will be issued after 6 p.m. The first general meeting will be held on Wednesday, Auguest 15, at 8 p.m., when Prof. Andrews, F.R.S., will resign the chair, and Prof. Allen Thomson, F.R.S., President Elect, will assume the Presidency, and deliver an address.

NOTICES.

THE LIBRARY.

The following works have been presented to the Library:—

A Text-book of Mineralogy, by Edward S. Dana.
The Theory and Action of the Steam Engine (for practical men), by W. H. Northcott, C.E.
Annual Report of the Board of Regents of the Smithsonian Institution for 1875.

The following reports relating to the State of Massachusetts have been presented:—

Savings' Banks, 1875.
State Charities, 1876.
State Board of Health, 1876.
Railroad Commissioners, 1875.
Bureau of Statistics of Labour, 1876.
Board of Education, 1874.

The following have been presented by the Author, George Harris, F.S.A.:—

Treatise on Man, 2 vols.
The Theory of the Arts, 2 vols.
Civilisation Considered as a Science.

MEETINGS FOR THE ENSUING WEEK.

Mon.... Asiatic, 22, Albemarle-street, W., 3 p.m.
Tues.... Photographic, 5a, Pall-mall East, S.W., 8 p.m.
Biblical Archæology, 33, Bloomsbury-street, W.C., 8½ p.m.
Wed.... Entomological, 11, Chandos-street, W., 7 p.m.
Obstetrical, 53, Berners-street, Oxford-street, W., 8 p.m.
Royal Horticultural, South Kensington, S.W., 1 p.m.
Thur.... Zoological, 11, Hanover-square, W., 5 p.m. (Davis Lectures.) Dr. Murie, "Hornbills and their habits."
Fri....... Geologists' Association, University College, W.C., 8 p.m.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,285. Vol. XXV.

FRIDAY, JULY 6, 1877.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

DOMESTIC ECONOMY CONGRESS.

With the present *Journal* is issued a full Programme of the Congress on Domestic Economy, to be held at Birmingham on the 17th, 18th, and 19th inst.

CHAIRMAN OF COUNCIL.

On Wednesday last, at their first meeting after the annual election, the Council chose Major-General Frederick C. Cotton, R.E., C.S.I., as Chairman for the ensuing year. The various existing Committees were also re-appointed.

PRIZES IN DOMESTIC ECONOMY.

The Committee for considering the Syllabuses sent in, in reply to the offer of prizes in this subject, met on Tuesday, July 3rd. Present—Major Donnelly (in the chair), Miss Chessar, the Rev. Newton Price, and the Rev. Canon Tinling, with P. Le Neve Foster (Secretary), and Charles Critchett (Educational Officer).

CANTOR LECTURES.

THE CHEMISTRY OF GAS MANUFACTURE.

By A. Vernon Harcourt, Esq., M.A., F.R.S.,

Lee's Reader in Chemistry at Christ Church, Oxford, and one of the Metropolitan Gas Referees.

Lecture I.—Monday, March 5.

I propose, this evening, to give you, in the first place, a short account of the formation and chemical nature of coal, and afterwards to offer a general view of the subject, which I shall deal with more in detail in succeeding lectures—namely, the result of the application of heat to coal, especially in connection with the manufacture of coal gas.

Coal was formed from the air by a process the beginning of which we are all familiar with, through witnessing the growth of vegetation.

The air consists, as you know, chiefly of oxygen and nitrogen, so that in 100 volumes there are about 78·4 volumes of nitrogen, and 20·6 volumes of oxygen; but it contains also small quantities of two other substances, which, for vegetation, are much more important—namely, water and carbonic acid. Of water it contains, ordinarily, about 1 per cent., and of carbonic acid no more than ·04 per cent. Nevertheless, it is on the presence of these substances in the atmosphere that the growth of vegetation depends.

The plants which grew at the time when our main supplies of coal were formed, differed greatly from the plants which exist on the earth at the present time; so much so that very few of those whose forms have been preserved can now be referred by botanists to any existing genera. I owe to the kindness of Professor Tennant some diagrams which are now upon the walls, giving examples of a reconstruction of those plants. The remnants or impress of them are chiefly found, not in the coal, but in the shale which underlies the coal, and which has preserved the record more perfectly than the more alterable, softer matter of the coal itself.

Although the actual genera are different from those which now exist, yet we may compare these plants with various existing genera. For example, the *Lepidodendron*, of which a portion is drawn here, appears to be a plant of the same kind as the small club moss with which we are familiar, but on a gigantic scale.

Again, there are representatives of the tree ferns and of the conifers, of which I have here some drawings. Then there is what seems to have been a large tree, which is called *Sigillaria*, because of the marks, as if impressed by a seal, existing on its stem, and what was formerly supposed to be a separate plant, but has now been proved to be only the root on which the trunk grew. These roots or stools have been preserved more abundantly than the trunks, so that often, where the trunk seems to have entirely disappeared, the roots remain, and as they were supposed to be different, they received the distinct name of *Stigmaria*.

Then, again, another variety of plant, which seems to have abounded in the coal measures, corresponds to the Mares Tails, or *equiseta*, which now grow in marshy places. It is, however, uncertain whether the predominance of these varieties in the fossils of the coal measures depends on their greater abundance amongst the vegetation of that period, or rather upon the fact that they have better resisted the influences producing change to which this deposited vegetation has been subjected. Some interesting experiments were made several years ago by Professor Lindley, on the powers which different plants possess of resisting decomposition, and he found that out of 177 kinds of plants which he left for two or three years under water, there were only 56 which had not wholly disappeared, and among these were the representatives of those varieties which are found in abundance in the coal measures, rendering it thus probable that the preservation of the forms of these plants may be due rather to their being better able than others to resist the protracted action of water than to their greater abundance.

What may have been the nature and appearance of the forests or jungles which overspread a large portion of the earth's surface, for countless generations of vegetable life, must remain but dimly known. In coal itself the very traces of organic structure are almost wholly obliterated. All that we can say confidently is, that coal consists of the mineralised vegetation of a former period.

As to the way in which it has been accumulated, there were amongst geologists, some years ago, two rival theories. One view was that coal consists of the remnants of plants falling where they had stood, and that by a process of gradual decay, such as is now converting the heather of our moors into peat, these great masses of vegetable matter were accumulated, and madei nto a more or less homogeneous mass. The interstratification of these deposits with sandstone, limestone, and shale, is supposed to have come to pass in the following manner:—After these plants had grown and died for many generations, the portion of the earth where they grew was flooded, the vegetation was destroyed, and, during the time that it was submerged, mineral matters were deposited where the plants had grown. This submergence, also, we must suppose to have continued for a very long time; then the sea, or more often, it would seem, the fresh water, retiring, plants were again sown, and vegetation again throve for a long period; and thus the cycle of changes repeated itself.

Probably this is the true account of the formation, at any rate, of the greater part of the coal that we have. By this alternate deposition of vegetable and mineral matters would be produced the state of things which an examination of the earth's crust reveals, and which is well illustrated by the section of the coal measures of the Forest of Dean, which Mr. Warington Smyth has lent me. Represented by this grey band is the stratum of clay, which seems to have been the soil in which the plants of the coal measures grew. Then there is an accumulation of coal—the vegetable matter stored up; afterwards there was a period of inundation, and of deposition of mineral matter. The thickness of these strata represents in some sort the length of the periods of time which intervened between each change. The breadth of the black line represents, relatively to the rate of accumulation of the organic matter, the length of time during which the jungle flourished. Then followed the deposition over it of sand, now compacted to sandstone, for a length of time, and so on, through a long alternation of periods here recorded in strata.

Certainly, the tax on the imagination in receiving a view of this kind is very great, especially if we figure to ourselves how long a period is required for the storage of the amount of vegetable matter which a single coal-seam represents. The yearly increment of carbon assimilated by the plants growing on any unit of the earth's surface, would form an exceedingly thin layer when compressed to the density of coal; and, no doubt, the greater part of the carbon of these plants passed away into the air and disappeared, as the plants disappeared in Professor Lindley's experiments. Then we have further to suppose the alternations of dry land and flood happening far inland, and simultaneously over a great portion of the earth's surface.

The other hypothesis to which I referred is, that these deposits have been formed chiefly from vegetable matters carried down by rivers. There are examples of such accumulations at the mouths of the Mississippi, and other large rivers, where there are great floods, and quantities of vegetable matter are borne down and deposited in the delta of the rivers.

What seems likely is, that both these causes have been in operation. The extent, and continuity, and even thickness of the seams of coal, and the fact that trees are found standing upright with their roots still bedded in the underclay, make it probable that the former hypothesis represents the principal mode in which coal has been accumulated. But wherever the storage of vegetable matter, and the deposition of great masses of other materials upon it, so that the vegetable matter has become deeply buried in the earth's crust and subjected to a high temperature and great pressure—wherever this has happened, there has occurred the process by which coal is formed.

Besides explaining the accumulation beneath the earth of vegetable matter, we have also to account for the change which it has undergone. The two principal causes which have concurred in producing this change are pressure and a high temperature. We know that now, as we descend through the earth's crust, the temperature rises at the rate of about 1° Fahr. for every 60 feet that we descend. It is to be remembered also, that of the coal which we can now reach, or which comes within the 4,000 feet of depth fixed by the Royal Commission as the greatest depth from which we should ever be likely to succeed in winning coal, much, at any rate, has been at another time at a greater depth beneath the earth's surface than we now find it, and that afterwards, by disturbances in the crust of the earth, it has been carried up to its present level.

Bischof has inquired into the nature of the changes by which woody fibre may have been converted into coal, and has pointed out that there are various chemical reactions by which this may have been effected. The abstraction of water, carbonic acid, and carburetted hydrogen, or of any two of these, would equally produce an effect which may be described generally as a removal of a portion of the oxygen and hydrogen from the woody fibre—the carbon remaining behind in larger proportion. The principal difference between wood and coal is that oxygen and hydrogen exist in larger proportion in wood, and the change by which coal has been produced has consisted in the more or less complete abstraction of these elements, and of a portion of the carbon in the form of volatile compounds under the influence of heat.

Another change, and one, perhaps, harder to understand, has gone on at the same time. Not only does coal differ from wood in the proportion of its organic constituents, but it differs from it in a remarkable way in its mineral constituents. The ash of coal is a very different thing from the ash of wood. Moreover, the ash of coal is almost the same as the ash of shale, and we must, therefore, suppose further that the coal, or the material of the coal, has been exposed to the action of water carrying mineral matters, either in solution or in suspension, for a sufficient length of time for its own mineral ingredients to be washed out, and those which were borne in solution or suspension by the water to have been substituted for them.

On the wall is a diagram, showing the position of the coal measures in the series of strata down from the surface of the earth, which may serve to illustrate the great depth, where all these strata are super-posed, of the formation in which the coal lies.

I pass on now to the changes which are produced in coal by the application of heat. Such changes occurred independently of man's agency, and at a period long before man appeared upon the earth. We know that in several parts of the world it has been observed that inflammable gases issue from the ground. At Chat-Moss, in Lancashire, it was observed long ago that, by simply making a hole in the ground, placing a pipe in the hole, and applying a light, a flame could be maintained for a long time; and actually such gas has been applied to the lighting of buildings. Then, again, not only does nature make gas, but in making gas nature makes coke. Anthracite is natural coke—it is coal which has been exposed to a high temperature, and thus has undergone the same changes which we produce in coal by exposing it to artificial heat.

When coal is heated, the change which it undergoes depends upon the temperature to which it is heated, and also upon the rate at which it is heated. Probably the meaning of this is, not that coal, or any of its ingredients, undergoes different changes, according as it is heated quickly or slowly, but rather that, when it is heated quickly, the substances which are first produced by heating it at a lower temperature are exposed to a higher temperature before they can escape. Most likely the effect of heating coal quickly to a high temperature might be perfectly imitated by subjecting the products of its decomposition at a low temperature subsequently to a high temperature. This may be difficult to effect on a manufacturing scale, or may have no economical advantage. I believe something of the kind has been tried. In the ordinary process of gas manufacture, each portion of matter undergoes several changes in rapid succession. When coal is treated in the way in which it is treated in a gas-retort, and is suddenly exposed to a strong heat, the substances which would be distilled from it if it were first heated gently, come into contact with strongly heated surfaces, and thus undergo a further change. The difference in the result is, that coal which is gradually heated gives off a much larger proportion of liquid and a smaller proportion of gaseous products, than coal which is suddenly heated strongly.

When the process of heating coal for economical purposes was first introduced, I believe the object in view was not the production of gas, but of liquid and solid products. In 1781, Lord Dundonald took out a patent for the distillation of coal, his object being to produce brown oil, as it was called, naphtha, ammonia, and coke; but the gas was let go. Works for this purpose were in operation for nearly 50 years at Muirkirk, in Ayrshire. A curious circumstance in connexion with these works is, that among the coal which was thus treated was found some cannel, which was thought to be unsuitable and thrown away.

I have here a miniature gas-works, lent by my friend Mr. Fison, which is now in action, and shows every step in the manufacture of coal gas, the heating of coal in the retorts, the condensation of tar and ammoniacal liquor, washing, purifying, storage, and distribution. There are also on the walls a set of diagrams, lent me by Dr. Frankland, illustrating the same operations.

The solid residue, when coal has been treated in the retort, is the well-known substance called coke. The same substance, or very nearly the same substance, is also produced in coking-ovens for use in locomotives, and for other purposes. It contains some three-fourths of the total weight of the coal which is distilled; and when the coal employed is a caking coal—that is, a coal which, when it is heated, is sufficiently bituminous to partially fuse, and so aggregate itself together—the coke remains behind in a solid piece, such as I have here. In many respects coke is superior to coal as a fuel. It has over coal the same advantage for many purposes that anthracite or steam-coal has over other coal. You know that for use on board ship, and wherever a clean fire is required, the steam-coal or smokeless coal is greatly preferred to ordinary bituminous coal.

We do not commonly use coke for fires in our sitting-rooms; but I believe that this depends upon the form of grates which we are accustomed to use. A better form of grate has recently been advocated, under the name of Slow Combustion Grates, in which the air is not admitted to the fire from below, but only in the front. The effect of admitting air through an open grating beneath the fire, is to cause the coal to burn quickly away. If air enters from the front, combustion takes place, and each coal glows on the side towards the room. The grate should have a high and wide front, but be shallow from front to back, and have flat bars set edgewise, and rather far apart. The open space above the top bar should be no more than is sufficient for putting on coals. In a grate of this kind, as I can testify from my own experience, coke can be burnt, with the help of a little coal, just as well as coal, and with a better heating effect. I cannot but think that the consequence of the reform in our grates, which I hope to see, will be that this fuel will be largely substituted in domestic use for coal, to the advantage both of the householder and of the gas manufacturer. At times like the present, when the price of coal is lower than it has been, and the winter is mild, the quantity of coke which accumulates at gas-works is very large, and the value of it to the maker is often very much below its real value. The reason we now use the bright or blazing coal in our fires is, that the air being admitted through the bars below, the chief part of the combustion goes on there, radiating heat only upon the hearthstone; and the upper part of the fire, which is what we look upon, would be dull, unless we used a coal yielding a great deal of gas, in order that we may have a blaze at the upper surface and see something bright.

The gases which pass out from the retort consist partly of what are termed permanent gases, and partly of what are distinguished as vapours; that is, of gases which, under other circumstances, would not be gases but liquids.

This distinction between gases and vapours is more misleading than it is serviceable. When we speak of a substance which is perfectly gaseous, as a vapour, we recal by that word a circumstance which is generally quite irrelevant, namely, that under other conditions, if the temperature and pressure were different, this substance would be a liquid. Most probably the same is true of every gas; we know it to be true of all gases except six. It is as though we restricted the word "liquid" to permanent liquids, like alcohol, and had another word for liquids which could be frozen.

However, at the ordinary temperature, a great deal that is gaseous at the high temperature of the gas-retort becomes liquid, and so is collected separately. I have on the wall two long tables, giving the names and the chemical formulæ of the great variety of substances which have been found among the products of the destructive distillation of coal. You will see that in one table all the substances, whose names and formulæ are given, consist of combinations of two only of the elements of coal—hydrogen heading the list, and all the other substances being combinations of it with carbon. Those which stand first on the list—hydrogen and marsh gas—are both permanent gases, which have never been liquefied. The others are substances which exist in the gas, and which are also partially condensed with the tar. They are grouped here according to their chemical classification, not according to their volatility. Those which come lower down are liquids. Paraffin is the name generally given to a solid substance that is obtained from coal, and it is given also by chemists to both liquid and gaseous substances which have the same general formula, $C_nH_{2n}+_2$. Acetylene, again, is a gaseous hydrocarbon; then come some of the principal of the liquid bodies that are produced, such as benzol and its homologues. Naphthalene is sometimes gaseous and sometimes, unfortunately, solid. It is liable to be deposited, and to obstruct gas-pipes at a distance from the works. Anthracene—a substance of which I shall have more to say presently—is also a solid substance. Then there are others into which oxygen, nitrogen, and sulphur enter, in combination with carbon, or hydrogen, or both.

The varieties of coal range, shading one into the other, from that containing the largest proportion of carbon—namely, anthracite—to highly bituminous coals, passing on into cannel coal, and into a substance about which there has been a dispute whether it is coal or not. This is Boghead cannel. This still richer substance, of which Mr. Evans has kindly sent me a specimen—Boghead shale, as it has been called, from its resemblance to Boghead cannel—comes from Australia. You will see, from the specimens I have here, how extremely these substances differ in appearance from each other; indeed, different samples of cannel coal differ very much from one another, some being quite devoid of lustre, and some being brilliant, like anthracite. The more bituminous coals yield a larger proportion of liquid products. Coals are called bituminous, not because they contain bitumen—for this substance cannot be extracted from them—but because they yield it when they are heated. As to the actual substances existing in coal, very little is known, because the actual constituents of coal are extremely insoluble, and chemists have not succeeded, by the application of solvents, in extracting directly (by processes which will produce no change in the coal) substances which they can isolate and examine. Thus it happens that our knowledge is almost entirely of the substances producible from coal by heat, and not of the substances—equally definite, no doubt—which already exist in it.

I shall have to speak in a subsequent lecture of the substances which enter into ammoniacal liquor, as it is called, and will pass now to the other of the two liquid products of the destructive distillation—namely, tar, and will consider, in the time which remains, the nature of some of the products which have been obtained from it.

Tar is a mixture, in varying proportions, of a great number of different substances. When it is heated it is divided into more and less volatile parts. There distils from it, first, some water—indeed, a principal difficulty with the tar distiller is to get rid of the water with which the tar is mechanically mixed. After that there comes over a substance which the tar distiller calls "liquid naphtha," which is subjected to a subsequent distillation. Next, there comes over a substance of higher boiling point, of a consistency which is almost solid, a buttery substance, which is called "creasote;" and, lastly, there comes over a substance which is at first more fluid, but afterwards nearly solidifies, called "anthracene oil," because anthracene is obtained from it. That which first distils over has nothing characteristic in its appearance, being a limpid, colourless liquid. In these bottles are the products of the subsequent distillation.

The crude naphtha is first acted upon by soda. It is brought into contact with about one-third of its volume of a strong solution of soda. It contains, besides benzol and other similar hydrocarbons, a quantity of another important substance—namely, carbolic acid. This unites with the soda, and the two together form a heavy liquor, on the top of which the lighter naphtha floats. The liquor is drawn off and mixed with sulphuric acid; it separates, as it cools, into two layers, the lower one consisting of a solution of sulphate of soda, and the upper one of the crude carbolic acid. The tar-distiller carries the operation no further than to run away the sulphate of soda, of which he makes no further use, and to draw off the carbolic acid. The naphtha is next acted on with sulphuric acid, which combines with the organic bases, substances containing nitrogen as well as carbon and hydrogen, and the purified naphtha, now containing only hydrocarbons, is distilled.

In this first distillation the greater part is collected together, and a small quantity remains behind, which is rejected or mixed again with the crude naphtha. It is then what chemists call "fractionally distilled"—that is to say, distilled in a gradual continuous operation; while the runnings of the still are collected separately. The receivers employed are carboys; the order in which they are filled is noted; and, subsequently, an examination of their contents is made, and the liquid products classified accordingly. The examination consists in determining the boiling point of the liquid. According as the manufacturer wishes to have a hydrocarbon of a higher or lower boiling point—which depends on the demand in the market—he mixes with the first portions distilled a larger or smaller proportion of the subsequent distillate, so as to have either a larger quantity with a higher boiling point or a smaller quantity of lower boiling point. These two are called respectively 90 per cent. benzol and 50 per cent. benzol—meaning a liquid which is judged, from its boiling point, to contain 90 or 50 per cent. of pure benzol.

Benzol is a hydrocarbon, of which the formula is $C_6 H_6$, and it is associated with other substances—namely, toluol, xylol, cumol, and cymol—substances which are homologous with benzol. These substances form a series proceeding in arithmetical progression by a difference of one atom of carbon and two atoms of hydrogen, the first having the formula $C_6 H_6$, the next $C_7 H_8$, the next $C_8 H_{10}$, and so on. They are all mixed together in the naphtha, and they are, to some extent, separated from one another, in the fractional distillation, by the tar distiller. The purest benzol which is ever collected by the manufacturer contains some admixture of the other substances; but I have been lent, by Mr. John Williams, some samples of these different substances in a pure condition. Here are benzol, toluol, and xylol. Their appearance is absolutely similar; all are mobile, colourless liquids; but we should find, if we were to place them in a flask with a thermometer, and to heat them until they distilled freely, and observed the temperature, it would be in the three cases, 84°, 114°, 126°.

The actual distillates collected at the tar distillery consist of mixtures of these substances boiling at temperatures which differ according as the hydrocarbons of lower or higher boiling-point predominate. I have here some samples of the commercial products, which I obtained to-day, through the kindness of Messrs. Blott, from their distillery.

The sample next in volatility to benzol is called "solvent naphtha," the purpose for which it is employed being to dissolve india-rubber. After a time, as the temperature rises, the liquid which comes over is found to be of too high a specific gravity, and unfitted for this purpose; it is called "burning naphtha," and is sold for burning in such lamps as are used sometimes to light stalls in the open air.

The second product of the original distillation—namely, "creasote"—is a pasty mass, which, on standing, divides itself, to some extent, into an oil and a solid, the solid being naphthalene. The chief use of this substance is for pickling timber; especially, I believe, railway sleepers. The pieces of wood are placed in cylinders from which air is exhausted, and then this substance is let in upon them, and forced into their pores by the atmospheric pressure. The wood is thus rendered more capable of resisting exposure to moisture and the attacks of insects than it otherwise would be.

Some portion of the oil which drains from the semi-solid mass is also used for making lamp-black. It burns with a very luminous, fuliginous flame, and the soot which is formed is collected and called lamp-black.

The third product is "anthracene oil." This divides itself into a liquid and a solid. It is poured upon frames carrying a filtering material, and the oil runs through, while the solid remains upon the filter, and is afterwards transferred to bags, where it is allowed to drain, and is then more completely dried and freed from the adhering oil by pressure.

Here are the three substances: the anthracene oil, which has a solid layer now settling; the "green oil" (so called from its colour), which is used for making grease; and, thirdly, anthracene.

I have here a pure specimen of the naphthalene, which is the solid substance accompanying the creasote; and also one of anthracene and of carbolic acid.

Besides the three distillates, the tar yields a fixed residue constituting the solid substance called "pitch." This also is applied to various purposes, the principal, I believe, now being that of making artificial fuel. It is mixed with breeze, and the pitch serves as a sort of cement to compact together other combustible substances, the whole forming a serviceable fuel. It is also used for making artificial asphalte, and in preparing a kind of felt.

It has also been supposed that, by the distillation of this substance at a higher temperature, a further quantity of the valuable anthracene might be obtained; but I understand that, although the substance yielded by the destructive distillation of pitch greatly resembles anthracene, there is found to be some difference between them, which renders it not serviceable, as anthracene is. The solid residue of the distillation of pitch is that which I have here—pitch coke—a very pure form of carbon, being almost free from ash, since it is formed by the destructive distillation of a substance which itself has been gaseous.

I have only a few words to add about the substances which are formed from these; but it is the less necessary to go at length into that part of the subject, though it is very interesting and extensive, because a few years ago it formed the subject of a course of lectures given here by Mr. Perkin, who is the principal among those who have developed this important and beautiful industry.

One substance directly produced by the destructive distillation of coal is "aniline;" but this is not produced in large quantity, and is not easily isolated. Fortunately, benzol, which is produced much more abundantly, contains the same radicle as aniline, and can be transformed into it by a chemical process. It was found, first, that from benzol might be obtained, by the action of nitric acid, a substance of some use in perfumery, called nitro-benzol; and it was also found that by the reduction of this substance—that is to say, the replacement of its oxygen by hydrogen—it was converted into aniline. This reduction was first effected by the action of sulphide of ammonium; but it was afterwards discovered that it was effected equally well, and more economically, by the action of acetic acid and iron. Thus the process consists of two stages, the benzol being first transformed, by the action of a mixture of sulphuric and nitric acids, into nitro-benzol, and then the nitro-benzol being further transformed, by the action of reducing agents, into aniline.

The first great discovery was, that by the action of oxidising substances upon aniline, it was converted into a black powder which was serviceable as a dye. By the action of sulphuric acid and bichromate of potash, aniline was changed into a substance to which the name of "mauve" was given. Subsequently, in the hands of Mr. Perkin and others, this production of colouring matters from aniline received a very great development, and the consequence was the production of a number of brilliant pigments which are familiar to all of us, and of which I have here some specimens which Mr. Perkin has given me. There is, I think, no more striking or more beautiful result of the application of chemistry than that it should be possible, from such a substance as coal tar, to obtain substances at the very opposite end of the scale of mineral being, these exquisite coloured products.

There is one other point only which I would name. From the anthracene oil, anthracene is obtained; and from anthracene, by a series of processes, which it would take me too long to describe, a substance which had been known for many years, and used during a much longer period, —viz., "alizarin." The investigation of madder, some 30 years ago, showed that the colouring matter consisted principally of alizarin and purpurin, of which alizarin was the more important. Then followed the discovery that, by a succession of operations upon anthracene, it can be transformed into alizarin, the same substance which is the colouring matter of the madder root; so that now actually the use of madder as a dye stuff is, I believe, almost disappearing, its place being taken by what can be produced to greater advantage economically —namely, the very same material produced from coal tar.

This is really the crowning triumph—at least, it is difficult to suppose it can ever be surpassed—of the application of chemistry to the arts; and with this I conclude the present lecture.

MISCELLANEOUS.

MUSICAL PITCH.

The following appeared in *Nature* of last week:—

Koenig's Tuning Forks.

On vient d'attaquer en Angleterre l'exactitude du diapason officiel français. Mr. Alexander J. Ellis ayant trouvé que les notes d'un tonomètre, composé de 65 anches d'harmonium et construit par Mr. Appunn, ne s'accordaient pas avec ce diapason, a cru devoir déclarer dans un mémoire publié par le *Journal of the Society of Arts* (25 Mai, 1877), et dans votre journal (31 Mai, 1877), que le La_3 normal français donnait non pas 870 vibrations simples, comme on l'avait cru jusqu'à présent, mais bien 878 vibrations simples.

Mr. Ellis ayant constaté de plus que les diapasons de ma construction s'accordaient parfaitement avec le La_3 français, n'a pas hésité à affirmer que tous ces diapasons, y compris ceux de mon grand tonomètre, qu'il n'a probablement jamais vus, et en tout cas jamais pu examiner, étaient nécessairement inexacts. N'ayant pas à ma disposition l'instrument dont s'est servi Mr. Ellis, j'avoue que je me serais trouvé assez embarrassé pour dire immédiatement, par où péche cet instrument au point d'avoir donné entre les mains de Mr. Ellis des résultats si extraordinaires; heureusement je me suis rappelé une lettre de M. Helmholtz à Mr. Appunn et publiée par ce dernier lui-même dans une brochure sur les théories acoustiques de M. Helmholtz; cette lettre concerne justement un instrument de même nature du même constructeur et explique suffisamment les surprenantes découvertes de Mr. Ellis. "J'ai examiné à plusieurs reprises votre tonomètre," écrit M. Helmholtz à Mr. Appunn, "et je suis étonné de la constance de ses indications. Je n'aurais pas cru que les anches pussent donner des sons aussi constants que ceux que donne l'appareil, grace à votre méthode pour régler le vent. L'instrument varie un peu, il est vrai, avec la température, comme feraient aussi des diapasons; on ne peut donc s'en servir pour la détermination des nombres absolus de vibrations que lorsqu'on peut travailler dans une pièce qui n'est pas chauffée par un poêle. J'ai compté les battements à l'aide d'un chronomètre astronomique, et je crois que votre pendule à secondes a été légèrement inexact, car, si les nombres de battements s'accordent très bien entre eux, le nombre absolu en a été non pas de 240, mais de 237 à la minute. La température, qui était assez basse pendant mes expériences, a pu y être pour quelque chose, mais on peut éliminer cette influence en comptant jusqu'au bout les battements d'une tierce majeure, ce qui m'a pris un quart d'heure. J'ai trouvé ainsi pour mon diapason de Paris 435·01 vibrations, ce qui l'accorde à $\frac{1}{40,000}$ pris avec le nombre officiel de 435·00 vibrations."

Cette lettre prouve que le nombre entier des battements de l'octave du tonomètre essayé par M. Helmholtz était de $\frac{237}{60}\cdot 64 = 252\cdot 8$, et sa note fondamentale de 505·6 vibrations simples au lieu de 512 vibrations simples. En comparant cette note de 505·6 vibrations simples avec un diapason donnant réellement 512 vibrations simples, Mr. Ellis eût trouvé ce dernier de 6·4 vibrations simples plus aigu, et l'eût sans doute considéré comme donnant 518·4 vibrations simples. Or il a trouvé 516·7 seulement pour mes diapasons de 512 vibrations simples avec le tonomètre dont il s'est servi; on voit donc que la note fondamentale de ce dernier était déjà plus exacte que celle du tonomètre examiné par M. Helmholtz puisqu'elle donnait 507·3 vibrations simples mais qu'elle restait encore assez loin de la véritable valeur.

Le fait que M. Helmholtz a pu trouver le nombre de vibrations exact du diapason officiel français avec un instrument de cette nature (et même encore moins parfait que celui dont s'est servi Mr. Ellis), en déterminant d'abord la correction de cet instrument, montre à l'evidence que Mr. Ellis a négligé de déterminer la correction du sien; il s'est donc beaucoup trop hâté de déclarer que ces petits tonomètres à anches d'harmonium sont les plus parfaits et les plus exacts qui existent, et de contester si légèrement les résultats obtenus par les Lissajous, les Despretz, les Helmholtz, les Mayer, etc., etc.

Rudolph Koenig.

Paris, le 5 Juin.

GOVERNMENT AID TO SCIENTIFIC RESEARCH.

Below is given a list of the endowments for the present year, made by the Government in the aid of scientific research, on the recommendation of the Royal Society:—

Personal Payments.

Mr. J. A. Broun.—For Correction of the Errors in the published Observations of the Colonial Magnetic Observatories, £150.

Dr. Joule.—For Experimental Investigations into the Mechanical Equivalent of Heat, £200.

Prof. Parker.—For Assistance in Researches on the Morphology of the Vertebrate Skeleton and Relations of the Nervous to the Skeletal Structure, chiefly in the Head, £300.

Rev. W. H. Dallinger.—For Microscopic Investigations of Monads, Bacteria, and other low forms of life, £100.

Rev. F. J. Blake.—For compiling and publishing a "Synopsis of the British Fossil Cephalopoda," £100.

Prof. A. H. Garrod.—For Aid in preparing for Publication an Exhaustive Treatise on the Anatomy of Birds, £100.

Dr. Murie.—For completing and publishing three Memoirs:—"Anatomy of the Kingfisher," 4to., with five plates; on "Extinct Sirenia," 4to., with six plates; "Osteology of the Birds of Paradise," folio, three plates, £150.

Mr. H. Woodward.—For Continuation of Work on the Fossil Crustacea, especially with reference to the Trilobita and other Extinct Forms, and their Publication in the Volumes of the Palæontographical Society, £100.

Prof. Schorlemmer.—For Continuation of Researches into (1) the Normal Paraffins, (2) Suberone, (3) Aurin, £200.

Dr. H. E. Armstrong.—For Continuation of Researches into the Phenol Series, and into the Effect of Nitric Acid on Metals, £300.

Profs. King and Rowney.—For Researches to determine the Structural, Chemical, and Mineralogical Characters of a certain Group of Crystalline Rocks represented by Ophite, £60.

Mr. W. J. Harrison.—Towards the Expense of collecting and describing Specimens of the Rocks of Charnwood Forest, £50.

Non-Personal Payments.

In aid of Apparatus, Materials, and Assistance.

Dr. J. Kerr.—For Aid in Electro-Optic and Magneto-Optic Researches, £200.

Mr. J. E. H. Gordon.—For Experimental Measurements of the Specific Inductive Capacity of Dielectrics, £50.

Prof. Guthrie.—For Apparatus and Assistance in (1) the Determination of the Latent Heats of the Cryohydrates and the Vapour Tensions of Colloids; and (2) the Examination of Heat Spectra and Radiant Heat by means of varying Electrical Resistance in Thin Wires, £150.

Mr. J. T. Bottomley.—To aid in carrying out a Series of Experiments for Determining the Conductivity for Heat of Various Liquids and Solutions of Salts, £100.

Sir William Thomson.—For Assistance and Materials for a Continuation of Experiments on the Effects of Stress in Magnetism, £100.

Mr. W. Crookes.—For Assistance in continuing his Researches connected with "Repulsion resulting from Radiation," £300.

Messrs. Rücker and Thorpe.—For a Comparison of the Air and Mercurial Thermometers, £50.

Mr. F. D. Brown.—For an Investigation of the Physical Properties, the Specific Gravity, Expansion by Heat and Vapour Tension, of the Homologous and Isomeric Liquids of the $C_n H_{2n}$ Series, £100

Prof. Roscoe.—For Continuation and Extension of the Experiments on the Self-Registering Method of Measuring the Chemical Action of Light, £100.

Sir William Thomson.—For Investigation and Analysis of Tidal Observations and Periodic Changes of Sea Level, £200.

Dr. J. B. Balfour.—For the Expense of Illustrations for a "Monograph of the Pandanaceæ," £50.

Mr. H. T. Stainton.—For Aid in publishing the "Zoological Record." £100.

Dr. J. G. M'Kendrick.—For Apparatus for a Research into the Respiration of Fishes, £75.

Prof. Gamgee.—For a more Complete Survey than has yet been made of the Physiological Action of the Chemical Elements and their more Simple Compounds, with the Object, in the first instance, of establishing a Physiological Classification of the Elementary Bodies, £50.

Dr. Brunton.—For Researches into the Physiological Action of the most important Compounds of Nitrogen, and into the Action of certain Poisons, and for Apparatus, £80.

Mr. E. Schäfer.—To pay the Wages of an Assistant to give Mechanical Aid in Histological and Embryological Research, £50.

Dr. Burdon Sanderson.—For an Investigation of the Normal Relation between the Activity of the Heat-Producing Processes and the Temperature of the Body, £70.

Prof. Schorlemmer.—For Continuation of Researches into (1) the Normal Paraffins, (2) Suberone, (3) Aurin, £100.

Mr. W. N. Hartley.—For Researches into the Photographic Spectra of Organic Substances, into the Phosphates of Cerium, the Conditions under which Liquid Carbonic Acid is found in Rocks and Minerals, the Double Salts of Cobalt and Nickel, and for other Investigations, and for Assistance, £100.

Dr. Burghardt.—For a Research into the Origin of the Ores of Copper and (if possible) of Lead, their Mode of Formation, and the Chemical Connection (if any) between the Ore and its Matrix, £50.

Prof. Church.—For a Research into the Colouring Matters of Colein, of Red Beet, and for the Study of Plant Chemistry, £50.

INDUSTRIAL EDUCATION IN BELGIUM.

A school which is not much known in England, called the Maison de Melle, near Ghent, but which has been in existence for a quarter of a century, supplies an excellent example, not for servile imitation, but for consideration. It is described as a "literary, scientific, commercial, and industrial institution," and it deserves the title to a large extent. The establishment includes three distinct schools, one for children between eight and thirteen years of age, an intermediate school for those between thirteen and sixteen, and an upper school, where pupils are received from sixteen and may remain to the age of twenty. All are boarded in the establishment; there are no day scholars. Each of these schools has its own rooms, playgrounds, galleries, &c., there being nothing in common between them but the chapel, the hall for public examination, the gymnasium, and the swimming bath. The professors, forty in number, are members of a religious society called the "Joséphites."

The course of literary instruction embraces, in the three schools, all the subjects taught in the State schools and the Athénées. There are, however, special features in the system of the Melle Institution. Thus, while the younger pupils are taught the elements in the usual manner, they are afterwards trained with a special view to their position in life, occupations, &c.; for this purpose the instruction is sub-divided afterwards into three sections. The first of these is called the literary and scientific section, and is for those pupils who neither desire to study the classics, nor commercial or industrial subjects, the object, as stated, being to fit them to figure honourably in society, to manage their property wisely, and to fill properly certain positions in the public service, constitutional or administrative; secondly, it comprises pupils who are afterwards to go to the special schools of the university and of the State, civil engineering, mining, and military schools, for these there is a special course of mathematics, which occupies two years; thirdly, come those pupils who are to be brought up as notaries, or for the registration and tax offices, and these are prepared by a two years' course of law, to enable them to pass the examinations for the first step in each of these occupations.

The second section, that of the "humanities," requires no explanation, it includes the whole course of classical education.

The third section is that of commerce and industry, and the instruction given is such as is believed to be in harmony with wants of those destined to commercial and industrial careers. "Already," say the authorities of the school, "the courts of this section have been trod by thousands of pupils now dispersed all over the world, and established in all branches of commerce and industry, in banks and administrations in public and private."

One of the specialities of the school is the teaching of modern languages; every effort is made to give the pupils a thorough literary as well as grammatical acquaintance with the living tongues, and to enable them to express themselves with facility and correctness. This is effected by professors for each language, who live amidst the pupils and talk to them in class, at meals, and in the play-ground. In addition to this, there are many foreign youths in the school who are said to contribute much to the inculcation of their native tongues. When pupils in this section have passed through the entire course of the ordinary classes, that is to say, between the ages of seventeen and twenty, they enter upon a superior course, which brings them to the level of the instruction given in the highest commercial and industrial schools.

This immense establishment has for the use of the pupils a cabinet of physical science, a chemical laboratory, a drawing school, cosmographic apparatus, a collection of machinery illustrative of the mechanical powers, or used in the industrial arts, a museum containing specimens of raw materials and manufactured articles, a botanical garden, large mineralogical, geological, ethnographic, and numismatic collections, and a large library of books in the French, Flemish, English, German, Italian, Spanish, and some other languages.

Of these departments the museum is perhaps the most remarkable; it occupies a grand quadrangular apartment, which is disposed in the simplest and most convenient manner; each side is divided into seven compartments, one side being devoted to the products of the French colonies, those of China and Japan, flax and cotton, wools, other textile fibres, drugs, and dye stuffs; and the other side to cereals, coffee, cocoa, tea, sugar, spices, fruits, oils, chemical products, leather, caoutchouc, paper, materials of construction, &c. In the centre of the museum are four immense cases filled with woods, metals, marbles and stone, and tissues. Finally, on an estrade at the further end of the museum, are specimens of glass and ceramic manufactures of all kinds, chemical products, an ethnographical collection, and one of antiquities.

Twenty years since the museum attracted attention, and its contents have since been immensely enriched by the presents of numbers of former pupils of the school, established in various parts, and from many manufacturers, by exchanges made with other institutions, and by numerous examples obtained at the various international exhibitions held in London, Dublin, Paris, and Amsterdam. By these means the contents of the museum are kept up to the most recent date, and all the novelties are noted for the benefit of the pupils. Thus in a long list of the classes of raw and manufactured articles, we find notes on those which are least known or most interesting, a nomenclature with synomyms of 550 textile fibrous plants by the curator of the museum, and many other useful notes. The contents of the museum have been got together from all parts of the world, and no inconsiderable proportion from our own country.

It must be admitted that the Maison de Melle is an institution deserving of attention, and, as the question of cost is a serious matter connected with institutions for the great mass of the people, it must be mentioned that the charge for each junior pupil is but 700 francs per annum, and for the others 800 francs, while, in the case of brothers, a diminution of 50 francs is made for each, and for this are included all the ordinary lessons in languages, commerce, and the sciences, but there are a few specialities for which there is a special charge.

The Caledonian Railway Company have just had built for them eight special trucks or carriages for the conveyance of the American fresh meats. Each truck has a double roof, and through the space between these roofs the fresh air is carried into the body of the carriage where the meat in quarters is suspended.—*Iron.*

The Amsterdam Industrial Exhibition will be opened on the 9th inst., by the Prince of Orange and the Prince Alexander of the Netherlands. In consequence of the Dutch Court being in mourning, there will be no special ceremony.

PROPOSED SOUTH KENSINGTON PNEUMATIC RAILWAY.

Those who visit the South Kensington Museum, the Albert hall, or the Horticultural Gardens, know that certain difficulties stand in the way. The Metropolitan District Railway is very largely used for the purpose, but it is a quarter of a mile from the gardens, nearly as much from the museum, and half a mile from the Albert-hall. The District Railway Company have found it worth while to run omnibuses to carry passengers over these distances, especially in summer, and it can hardly be disputed that, short as the distances are, the public are quite prepared to pay a trifling sum to be carried over them.

No doubt all our readers are familiar with the pneumatic system of Mr. F. W. Rammell, of Westminster-chambers, in which passengers are blown through a tube by a gentle gale of two or three ounces pressure to the square inch, in well-lighted, comfortable carriages, free from smoke, dust, heat, and smell. About 15 years ago, this system was tried in Battersea-park on a small scale. Subsequently, an experimental line was made and worked in the Crystal Palace grounds. Then it will be remembered, the pneumatic dispatch line was laid down from Euston to St. Martin's, and it was proposed to make a subway from Scotland-yard to the other side of the river, near Waterloo Terminus. The last two projects have failed, but it is only fair to Mr. Rammell to state that, so far as we can ascertain, after careful inquiry, and an investigation of the system, the failures have had nothing whatever to do with the mechanical principles involved. There is no doubt that Mr. Rammell can blow a train loaded with passengers through a tube, say a mile long, with ease, certainty and economy, while the passengers will travel with a comfort, as regards ventilation, quite unknown on the steam-worked underground railway.

A company is now being formed to construct a pneumatic railway between the South Kensington Station of the District Railway and the Albert-hall. The line will rise the whole way to the Albert-hall, the ruling gradient being 1 in 48. The train will be blown through the tube by an ejector, in other words, a great centrifugal pump, 2ft. in diameter, fixed close to the District station, and worked by a pair of condensing engines exerting about 170 indicated horse-power. The tunnel will be of brick, and the floor will be paved, and, under certain circumstances, it will be opened to the public as a dry, well lighted foot-way between the Albert-hall and the railway station. Its cross sectional area will be 105·5 square feet; at the end of the train is fixed a screen or piston, with an area of 104 square feet, the difference being allowed for windage. The train will consist of six carriages, of very light build, the rail gauge being 4 ft. This train will hold 200 passengers, and the total load will be 32 tons, or ten tons less than the weight of a single engine on the Metropolitan Railway. The maximum resistance at twenty miles an hour will be about 2,420 lb., requiring to overcome it a pneumatic pressure of 2·6 ounces per square inch, and 162-horse power, assuming the useful effect to be 60 per cent.

No novelty is involved in the scheme, and of its mechanical success we have no doubt. It is quite beyond our province to deal with the commercial success or failure of a railway company, but we may say that the scheme has so far advanced that Mr. Rammell has got together a good board of directors for his company. The capital required is £60,000, and the Metropolitan and District Railway Companies are supporting the scheme in a very practical way, by guaranteeing a $4\frac{1}{2}$ per cent. dividend.

It is worth notice that nearly all the leading engineers in England regard Mr. Rammell's scheme with favour, as will be seen from the fact that a memorial has been addressed to the Commissioners for the Exhibition of 1851, which runs as follows:—"We, the undersigned members of the profession of civil engineers, and others, beg to represent that we have knowledge of the pneumatic system of propulsion, as applied by Mr. Rammell, and of his long devotion to the working out of the invention; that we are cognisant of his plans for a pneumatic railway at South Kensington the Parliamentary powers for which were granted in 1872, and are of opinion that, apart from the local usefulness of this line, and in view only of the importance of working out practically the principle involved in it, and thoroughly testing its applicability to railway purposes, the undertaking deserves encouragement and support from her Majesty's Commissioners.—Signed, Charles Hutton Gregory, M. Inst. C.E., W. H. Barlow, James Brunlees, T. Hawksley, F. J. Bramwell, John Coode, William Pole, Joseph Whitworth, J. W. Bazalgette, James Abernethy, Edward Woods, George R. Bruce, C. William Siemens, E. Frankland, Harrison Hayter, George Berkeley, J. Frederick Bateman, William Haywood, Latimer Clark, George Robert Stephenson.

With such an array of evidence in favour of the scheme, it is impossible to doubt the merits of Mr. Rammell's plans.—*Engineer.*

ECONOMIC PLANTS IN JAMAICA.

A very full report on the condition and progress of the botanical gardens and public plantations in Jamaica has recently been issued. This report treats largely of the cultivation and distribution of various important economic plants. In a coffee-growing country like Jamaica, the consideration of the introduction of the now celebrated Liberian coffee is a matter of great interest. This valuable coffee, which has recently been described and figured under the name of *Coffea liberica*, was introduced to Jamaica in 1874, and the plants were at first treated in one of the cinchona propagating houses, where the temperature was higher than in the open air. They soon attained a remarkable vigour, producing foliage several times larger than the common coffee. Soon after these plants were imported, about thirty of them were distributed among coffee planters, and placed in a variety of altitudes; the result of this was to prove that those grown at the lower elevations attained the greatest success. As an instance of the rapid growth to maturity of this kind of coffee, it may be mentioned that a plant, only a little over a year old, that had been planted out at an elevation of about 1,000 feet above the sea, produced fruit. There is every reason to believe that during the present year the Liberian coffee will be largely increased from seeds. The most promising feature about its cultivation in Jamaica is its adaptation to the conditions of climate existing at low altitudes. The common coffee is the most accommodating of all cultivated Jamaica products, inasmuch as it is grown at all heights, from the sea-level up to 5,000 feet. The superior qualities of coffee, however, are only produced at heights ranging above 2,000 feet; below that elevation the quality of the produce decreases in value as it approaches the level of the sea. Hence, as regards the production of good quality, the lower limit of cultivation is about 2,000 feet. As the peasantry, who are now the largest producers of coffee in the island, almost exclusively cultivate their coffee under 2,000 feet, and as the cultivation of the plant has been largely increased by them in recent years—in which time they have planted several thousand acres—the acquisition of a species especially adapted to the climate of the lowlands is a matter of great importance.

Notwithstanding the fact that the Jamaica plantation coffee is the finest in the world, no new plantation has been established for a long series of years. On the contrary, there is a gradual diminution in the area under coffee cultivation on large plantations. The soil in the Port Royal Mountains, in which all the famous coffee is grown, is becoming more and more impoverished from year to year, and all the land adjacent to these coffee plantations has been, in great measure, exhausted by coffee cultivation, so that there is very little available land to work upon in their immediate proximity. The coffee-fields in question are all confined to the southern slopes of the Blue Mountain range. The northern slopes, except near the sea, on the other hand, are covered with dense primeval forest, no attempt having been made in this new and extensive field to undertake the cultivation of this important plant, although these lands are by far the most valuable in Jamaica for coffee cultivation. Most fortunately, during the past few years, the Government has enacted a law whereby nearly all the said lands on the northern slopes have been forfeited to the Crown, from non-payment of quit rents. It is, therefore, of great importance that these precious lands should be reserved by the Government for the future expansion of coffee cultivation, as well as for other important products requiring a similar condition of climate, With enterprise and capital, this virgin soil is capable of yielding coffee crops that would vie with the famous returns obtained in Ceylon during its palmiest days of production. Thus the marked contrast between the scanty crops now obtained from the worn-out fields of the Southern slopes of these montains, and the crops obtainable in the fertile regions on the other side, will, some day, there is every reason to believe, attract private enterprise to embark in the extension of this agricultural industry. It is important, however, to bear in mind that the conditions of humidity are remarkably different respectively on the northern and on the southern slopes of these mountains; on the latter side the wholesale destruction of the forest for coffee cultivation has naturally lessened the rainfall and other conditions of moisture, thus rendering the climate comparatively dry, and, therefore, peculiarly fitted for the successful cultivation of coffee. Under the influence of the dense forest the condititions of humidity are perfectly different. Thus, to create a climate suited to the wants of the coffee plant, the extensive clearance of the forest is absolutely necessary.

The area of land eminently favourable for coffee on the unoccupied locality in question, including a considerable area of forest covered land on the eastern prolongation of the southern slopes, may be roughly estimated at from 60,000 to 80,000 acres, nearly all of which belongs to the Government. The total area in the island now under coffee cultivation, most of which at unsuitable elevations, is 22,000 acres. With regard to the export of coffee from Jamaica, it seems that the United States of America are becoming very large customers for this commodity, the quantity exported to North America increasing at a much more rapid rate than are the exports to England. The best quality of coffee, however, is not sent to America. Though not an important commodity from Jamaica at present, cocoa (*Theobroma cacao*) next claims attention in the report under consideration. As is well known, Trinidad is one of the head quarters of cocoa cultivation, and from this island some of the best varieties of cocoa have been introduced to Jamaica with a view of establishing the plants for extensive cultivation. Seeds were taken from Trinidad in 1873, and planted at Castleton, and the plants so raised are now beginning to bear fruit. A good deal of attention has been paid to the propagation of these plants, which are being increased as rapidly as possible. Though Jamaica grown cocoa has hitherto been of very poor quality, there seems no reason why it should not take a high place, as both climate and soil are reported to be extremely favourable to the production of a superior quality; moreover, the writer of the report says:—"As the Government has favourably entertained the advisability of promoting its cultivation, it has occured to me that this could be most certainly accomplished by offering prizes to the peasantry for the establishment of, say, every two acres containing a given number of plants, the prizes to be awarded as the plants arrive at the age of two or three years." In Trinidad, the numerous varieties of cocoa are known chiefly by the shape or form of the fruit, its size or colour; some are more spherical, and some more oval than others, some again are plain, and others are marked with distinct longitudinal ribs, varying likewise in number. In some varieties the colour, when ripe, is of a bright yellow, while in others it partakes of a reddish tinge. The best kinds for commercial purposes are well known to the growers, and these kinds were selected for trial in Jamaica. Next, perhaps, to coffee, the sugar-cane is the most valuable of all Jamaica products. Many useful varieties of this important grass have been introduced of late years from the Mauritius plantations. For the selection of suitable varieties, and their proper cultivation, many important conditions of soil and climate have to be ascertained. "Certain varieties are peculiarly adapted to humid conditions of climate, and other varieties are equally adapted to withstand droughts of considerable duration. Thus, in selecting a given variety for a dry part of the country, it is important to select one that produces a profusion of luxuriant foliage, which, densely covering the earth, intercepts excessive evaporation; the inherent nature of the cane itself also accommodates it to the circumstances in which it is placed. The conditions that are, therefore, necessary to establish the relative value of the new canes are so varied, that great care and discrimination have to be exercised." Systematic selection of the varieties likely to be of permanent value are being planted in the island, and a large number of cuttings of various kinds have also been sent to different parts of the island. The report points out the great importance of the introduction of new varieties, because the prolonged and excessive cultivation of any one variety conduces to its deterioration, and, further, often engenders diseases. The few varieties of sugar-cane now mostly cultivated in Jamaica have been so cultivated from time immemorial; therefore, to perpetuate its superiority, as well as to increase its saccharine richness, it is most important that valuable new varieties should be introduced. Of the newly imported canes, the Salangore is said to be the most noted, and of this variety there are, at the present time, hundreds of acres in all parts of the island. One planter has, of this particular kind, about 160 acres under cultivation, all the plants being raised from a single cutting obtained from the Castleton garden some four years since.

On the subject of pine-apple cultivation, the report says:—The plantation—embracing about four acres of this plant—formed at Hope three years ago, with the object of awakening private enterprise to an interest in this cultivation on a large scale, especially to meet the wants of the American market, progressed very favourably; indeed, for pine-apple plants, they attained an unusually vigorous growth until about nine months since, when some of the plants began to die off without any premonitory symptoms, and for several months the number of losses gradually increased. On examination being made as to the cause of this mortality, it was readily traced to the soil. It should be stated that all the soil at Hope is of a gravelly nature, but the rich surface soil in which these pines were planted was somewhat tenacious of moisture, especially after the continuous rains, the pine-apples were also flooded for about two days by the bursting of the conduit that supplies the Hope reservoirs. Before the loss of plants became large, they were removed to a more porous soil a few hundred yards off. In the operation of transplanting further loss was sustained, so that probably not more than half have survived. There is no doubt, as indicated in the foregoing remarks, that the excessive wet year has had a prejudicial influence on these plants, but the cause of the mortality amongst them was chiefly due to the too tenacious soil. It is well, therefore, to warn intending growers of this valuable plant of it sextreme impatience of dampness at the roots, hence the necessity of selecting soil of a sufficiently gravelly nature to ensure its being freely permeable to rain.

A good deal of attention has been paid to the cultivation of useful timber trees, foremost amongst them being teak (*Tectona grandis*). Seeds have been sown and plants raised, about fifty of which were planted out two years ago, and since that period about 500 more have been so planted. At the present time the teak plants occupy an area of about ten acres, and it is gratifying to learn that these trees have made remarkable progress, the majority of them having in little more than a year attained a height of from ten to twelve feet. One tree is reported to be yielding seed so abundantly that thousands have been sowed and are now being propagated. Of the Divi-Divi (*Cæsalpinia coriaria*), a well known tanning plant, about seven acres are under cultivation, containing 450 plants. The cultivation of the pindar or ground nut (*Arachis hypogœa*) has, it seems, been nearly abandoned for several years, but it is being now again restored by the negroes.

That most important of all tropical trees, the cocoa-nut, whether we consider the multitudinous use of its products, or its value in giving effect to tropical scenery, is, it seems, being very extensively planted in Jamaica. In the plantation known as the Palisadoes, upwards of 18,000 trees of *Cocos nucifera* are now planted, the bulk of these, however, are small plants at present, but hundreds of those that were planted previously are now beginning to bear fruits, so that in the course of a few years large crops may be expected, more especially as it is intended to increase the plantation to a total number of about 25,000 plants. One great desideratum seems to be the introduction of suitable machinery for expressing the oil, and this necessity is pointed out to the Government with the hope that they may take the matter up. A descriptive account of the manufacture of cocoa-nut oil and coir by improved machinery, as carried on in an extensive manufactory in Trinidad, is given, from which it seems that a thousand kernels or fruits yield twenty-five gallons of oil, the manufacture of each gallon costing eightpence, so high is the price of labour. Coir is manufactured only to a limited extent, vast quantities of the husk being left to decay everywhere. The crushing and separating of the fibres of the husk is effected first by passing it through a powerful mill, and afterwards passing it through a kind of combing machine, firstly of coarse, and afterwards of fine teeth. About six hundred husks give about one hundred pounds of fibre, which one man can prepare in the course of a day. Like most useful plants, the cocoa-nut is liable to disease about which little seems to be known, but the general opinion was that it was due to some insect. In Demerara, recently, the cocoa-nut groves have been fearfully devastated by the attack of a small beetle (*Passalus tridens*), and it is very probable that the disease referred to in the Jamaica report is identical with that of Demerara. It is to be hoped that decided measures will be taken to prevent the increase of these pests.

In the matter of medicinal plants, the cinchona plantations occupy the first notice. Eight years have elapsed since the first planting out of cinchonas took place at the Government plantations in Jamaica. *C. officinalis*, *C. succirubra*, and *C. calisaya* are the species mostly cultivated. Of the former, the tallest tree at the present time is 33 ft. 8 in. high, with a circumference near the ground of 25 in., the bark being ¼ in. thick. Of *C. succirubra* the tallest tree is 31½ ft. high and 26 in. circumference, 18 in. from the ground, and the bark slightly thicker than the last. The tallest trees of *C. calisaya* are about 25 ft., the trunk and bark of similar thicknesses to the preceding. *C. succirubra*, with its varieties, seems to be the plant which thrives best; of this, in the several plantations, at different aspects and altitudes, there are under cultivation about 50,000 plants, and of *C. calisaya* and its varieties nearly 20,000.

The cinchonas, though so flourishing, and though self-sown seedlings are constantly appearing in large numbers in the plantations, have shown signs of disease, almost exclusively amongst the seedlings, vast numbers of them perishing soon after germination. If propagated from cuttings, this mortality is considerably lessened. "There is still sufficient land cleared of forest for the extension of the plantations, in which to set some 20,000 plants, in addition to what have been propagated, and it is expected that this number will be prepared before the end of 1877. From a tree of *C. succirubra*, 25 ft. high and 18 in. in circumference near the ground, which was felled in the spring of last year, four pounds of dry bark was procured; but the bulk, or weight, of bark is largely increased by allowing the trees to live to an age of, say, 16 years, rather than denuding them of their bark at eight years," thus, "a tree, instead of being cut down at eight years old, and yielding three pounds of bark, would, at the age of 16 years, yield 16 pounds. It should also be remembered that bark 16 years old contains a considerably larger proportion of alkaloids than the younger tree, hence its greater commercial value. Again the older bark would shrink less in weight in the process of drying than a less matured bark." The branches of the cinchonas not being of a spreading habit, it is recommended to plant them only about 12 feet apart, at which distance the number of plants to the acre would be about 300. Calculating each tree to produce about 16 lbs. of bark, and the price realised to be 3s. per pound, the value of sale would be £2 8s. or a little over £724 per acre, and allowing for unseen causes, which perchance might diminish the yield by one half, or £350 per acre, "the actual cost of establishing and cultivating for a period of sixteen years would not, at the highest computation, including all expenses and interest on capital, exceed £60 per acre." After the practical experience which the superintendent of the Botanic Garden has had in the cultivation of these valuable plants, it is satisfactory to read his concluding remarks under this head, which are as follows:—"It has been abundantly proved that several species of cinchona are eminently fitted for cultivation in Jamaica. The enterprise has emerged from the purely experimental state, and can be now carried on as an established agricultural industry. Capital and enterprise are alone wanted to ensure the extension of the cultivation on the salubrious Blue Mountains. It is also a matter for the consideration of the Government to determine the advisability of extending this cultivation on the extensive tracts of land in the possession of the Government on these mountains. In this manner one hundred acres of *C. succirubra* or its varieties might be planted annually.

Attached to the cinchona plantation is a piece of land of nearly two acres extent, occupied by another medicinal plant, namely the Jalap (*Exogonium purgum*), a crop of 1,700 lbs. of this drug was obtained during the year, and it was estimated at the time this report was written that 3,000 lbs. more would be obtained in the course of a few months, which would be exported to England.

That the climate of Jamaica is suited to the growth of the now celebrated *Eucalyptus globulus* is evidenced from the fact that in a little over six years, when the seeds were first introduced and planted, the trees have grown to a height of sixty feet with trunks a foot in diameter. some thousands of plants of this species have been distributed in the island and planted chiefly in the lowlands where, however, contrary to the general expectation, they have not been successful, thus demonstrating against the popular belief of their suitability for general cultivation in tropical lowlands. The value of this species as a timber tree is very great, not only on account of its rapid growth, but also on account of the straightness, evenness, and durability of the wood.

From the foregoing abstracts and remarks, it would seem that economic plants are well looked after in Jamaica.

POPULATION AND INDUSTRIES OF THE ARGENTINE REPUBLIC.

Consul Cowper, in his report upon the commerce of Buenos Ayres, gives a general description of the rise and progress of the Argentine Republic. He states that the River Plate was discovered by the Spaniards, under Juan Deas de Solis, in 1515; in 1530, the city of Buenos Ayres was founded; in 1776, Buenos Ayres was made a vice-royalty; in 1810, the colonists revolted, and after a civil war of six years' duration, declared their independence of the mother country. From that period to 1852, when the Dictator Rosas was expelled, the country became a prey, like most other South American States, to military and unprincipled adventurers, and the present state of the republic can only be fairly dated from that time. The vice-royalty of Buenos Ayres contained at its last census in 1782, 170,832 inhabitants; it is now the Argentine Republic, with upwards of 2,000,000 inhabitants; its territory extends north and south from the tropic of Capricorn to Tierra del Fuego, and east and west from Buenos Ayres to the Andes; it is divided into fourteen provinces or states, and three territories, and its superficial area is said to be a million of square miles; there exist disputed questions of frontier of more or less importance, Paraguay claiming portions of the Gran Chaco, Brazil of Missiones, and Chili of Patagonia.

There are all varieties of climate and production in the republic, from the tropical, in its northern provinces, to absolute cold and sterility at its southern extremity, whilst all the productions of the temperate zone are to be found in its central provinces, which enjoy a climate unsurpassed by any in the world. The natural means of communication are magnificent. The estuary of the Plate is the gate by which the commerce of the world finds entrance to the grand water-courses of the interior. At its extremity, and near the embouchure of the Parana and Uruguay, the port of Buenos Ayres is situated. Hence the Parana is navigable for a thousand miles, passing the provinces of Entre Rios, Santa Fé, and Corrientes into the neighbouring republic of Paraguay, whilst the Upper Parana and Paraguay rivers open a communication with the provinces of Brazil as far as Cuyaba in Matto Grosso, for another thousand miles. Numerous grand tributaries, such as the Salado and Verniego rivers, are highways to the north-western provinces, whilst the Colerado and Negro connect the Atlantic provinces of the south with the Andes and Pacific, and the great Uruguay, starting from the Brazilian provinces of Santa Catarina and Rio Grande do Sul, and flowing down the eastern shores of Corrientes and Entro Rios to the Plate, both forms the frontier, and places the republic in easy communication with all parts of the neighbouring republic of Uruguay. In speaking of the natural means of communication, the great plains of the Pampas must not be omitted. Without forests and other various obstructions, but covered by luxuriant herbage, upon which are fed vast herds of cattle, flocks of sheep, and droves of horses, they extend from the Plate to the Andes, and down to the border of Patagonia, presenting a level as if prepared by nature herself for through railroads, which are gradually intersecting them.

It is not surprising that a country possessing such natural advantages should have made such rapid progress in the arts. sciences, and material prosperity. Its capital, Santa Trinidad de Buenos Ayres, commonly called "Buenos Ayres," is probably, as regards architecture, thanks to its Italian population, the finest upon the South American Continent. Its geographical position is not good; it is built upon a dead level, and its port is unworthy of the name; the arrangement of the streets is rectangular, the houses, of which there are 36,000, being built in square blocks of 150 yards; it covers about 2,000 acres of land, and contains a population of 220,000, more than one-half of whom are foreigners, or of foreign origin; indeed, it is almost as common to hear Italian and English spoken as Spanish. Every street is intersected by tramways. There are good schools, churches, both Catholic and Protestant, an opera-house, theatres, concert rooms, clubs, boat and shore races, athletic sports, and cricket clubs, &c. Twenty daily newspapers are published in Spanish, English, French, German, and Italian. There is an exchange, and companies of all sorts, joint-stock, railway, banking, insurance, &c. Buenos Ayres is the seat alike of the Federal and Provincial Governments, and the residence of the foreign legations. It has a municipality, and its inhabitants are devoted to commercial pursuits, and equally so to luxury, pleasure, and extravagance, Buenos Ayres may be described as one of the most agreeable, but most expensive capitals in the world.

The population of the republic is stated to be 2,150,000, ethnologically of many and mixed nationalities; it is impossible to form a correct conjecture of the admixture there may be in the outlying provinces, but there is probably a considerable amalgamation of Spanish and Indian blood. The labouring classes employ themselves in the Estancias and Saladeros, as herdsmen in the former, and slayers of sheep and cattle in the latter, and are the "gauchos" of the country; the French, Spanish, and Basques, as small shopkeepers, waiters in hotels and cafés, and as domestic servants, or as artisans in different trades; the Italians as peons and porters, keepers of wine shops, pedlars, and small shopkeepers; and the British, and particularly the Irish, in sheep-farming, or as grooms; the Germans also apply themselves to sheep-farming; in skilled labour, the English are the engineers and mechanicians of Buenos Ayres; the French, watchmakers, coach-builders, modistes, &c.; the Germans, tailors. Amongst the upper classes there are merchants, bankers, medical men of all nationalities; in music, the Italians are in the ascendant; and the army, navy, and civil service, including the Congress and members of the Government, are all Argentines.

The imports consist of the manufactures and produce of the principal nations of Europe and America, too numerous to be named in detail. The increase in their value has been very remarkable; in 1870, their gross value was £9,324,955; in 1873, £13,285,766. The exports consist of wool, sheep-skins, ox and cow-hides, jerked beef, tallow, live cattle, other animals, minerals, bones, skins, horn, hay, tobacco, and flour, of the value of £9,158,515. Twenty years ago the value of the exports was only £1,400,000, and the gross trade of the country has more than doubled within the last ten years. The chief agricultural productions are wheat and Indian corn, but sufficient only is raised for home consumption, whilst there exist in the country 80,000,000 sheep, 15,000,000 horned cattle, and 4,000,000 horses. These are economically fed upon the natural inexhaustible grasses of the Pampas. Their value is estimated at £30,000,000 sterling. About 500,000 mares and cows, and 12,000,000 sheep are annually killed and boiled down for tallow, or turned into Liebig's Extract of Meat. These, with wool, hides, sheep skins, horns, &c., are exported to the value of £9,000,000. Various attempts have been made to improve the port of Buenos Ayres, but they are for the present abandoned. There are no roads in the republic, owing to the absence of stone, and no canals or bridges of any importance. There are twelve lines of railway open, measuring in the aggregate about 1,000 miles. There are seven others in construction, and eleven projected. There are 80 miles of tramways in the city of Buenos Ayres alone, and they also exist in many of the principal towns of the republic. There are also 4,000 miles of telegraphs in working order, and the construction continues at the rate of about 500 miles a year.

In common with many other South American States, the Argentine Republic is redoubling its efforts to obtain European immigrants, but although it is (with Chili) incomparably the most desirable field upon that continent for their selection, particularly as regards climate, yet the insecurity of life and property is so great, and the impunity with which crime is perpetrated so notorious, that it becomes the positive duty of a British agent to warn his countrymen from adopting it. The great body of British emigrants to the republic are Irish, and a more exemplary, laborious, and altogether admirable set of colonists it is impossible for any nation to be favoured with. The republic owes its sheep-farming industry and wealth entirely to them, yet they are outraged, robbed, and murdered by the savage gauchos, while scarcely any effort is made to protect or to punish their aggressors.

GENERAL NOTES.

The Telephone.—It appears that within the next few days we are to have an opportunity of hearing the telephone in London—not, indeed, the American instrument which attracted the notice of Sir William Thomson, and was referred to by him at the last meeting of the British Association, but another, and, it is believed, earlier instrument, though its inventor, Mr. Cromwell Varley, seems to have let his invention remain dormant till attention was attracted to Mr. Bell's experiments in America. Wires have been laid from the Queen's Theatre to the Canterbury-hall, on the south side of the river, and the proprietors of these places have arranged for a telephonic concert, in which the audience in one house will hear the music played at the other. The arrangements are nearly complete, and the projectors state that their experiments leave them no doubt of success. It is hardly needful to say that in no system of telephony are the actual sounds produced at one end of a wire made audible at the other end. The vibrations of the sounding body are caused to interrupt an electric current, and by its means to produce a precisely similar set of vibrations in a suitable receiving apparatus at the other end of the wire. In Mr. Varley's instrument the sending apparatus is fitted with a number of tuning forks, each of which vibrates when its own note is sounded. The vibrations are reproduced at the other end of the wire in a suitable apparatus, and therefore give rise to the same sound as that which first started the fork at the sending end. It is obvious that this involves an arrangement of sounding bodies, whether forks, reeds, strings, or other appliances, of which there shall be one for each note. In the speaking telephone of Mr. Bell the vibrating body is a stretched membrane, and, according to accounts from America, even the tone of the voice is transmitted. With the musical telephone the quality of the music must depend, to a great extent, on the nature of the apparatus employed for reproducing it, as it does not appear that the instrument to be used can do more than reproduce the notes, without giving their tone or character.—*Times.*

NOTICES.

MEETINGS FOR THE ENSUING WEEK.

Wed....Royal Literary Fund, 10, John-street, Adelphi, W.C., 3 p.m.

Thur....Royal Historical, 11, Chandos-street, W., 8 p.m. 1. Dr. Heineman, "History of Baron Stein, the Prussian Statesman" 2. Rev. Charles Rogers, "Historical Notices of the Priory of Crail."
Zoological, Society's Gardens, Regent's-park, N.W., 5 p.m. (Davis Lectures.) Mr. R. B. Sharpe, "Birds of Prey."

Fri.......Quekett Club, University College, W.C., 8 p.m.
Royal Botanic, Inner Circle, Regent's-park, N.W., 3¾ p.m.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,286. Vol. XXV.

FRIDAY, JULY 13, 1877.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

ALBERT MEDAL.

The Council attended at Marlborough-house on Saturday last, the 7th inst., when H.R.H. the Prince of Wales, as President of the Society, presented to Sir George B. Airy, K.C.B., the Albert Medal, awarded to him "for eminent services rendered to Commerce by his researches in nautical astronomy, and in magnetism, and by his improvements in the application of the mariner's compass to the navigation of iron ships."

The Council present were Major-General Fred. C. Cotton, R.E., C.S.I. (chairman), Earl Granville, K.G., Earl Northbrook, K.C.S.I., Lord Hampton, F.R.S., Lord Alfred Churchill, Sir U. J. Kay-Shuttleworth, Bart., M.P., the Hon. Dudley Fortescue, E. Brooke, J. Brunlees, R. Brudenell Carter, Andrew Cassels, E. Chadwick, C.B., Major Donnelly, R E., Henry Doulton, Col. Du Cane, C.B., C. J. Freake, W. Hawes, F.G.S., Vice-Admiral Ommanney, C.B., F.R.S., W. H. Perkin, F.R.S., R. Rawlinson, C.B., E. C. Tufnell, and J. A. Youl, C.M.G., with P. Le Neve Foster, Secretary, and H. T. Wood, Assistant-Secretary.

DOMESTIC ECOMOMY CONGRESS.

The first annual Congress will be held in Birmingham, on the 17th, 18th and 19th July, by permission of the Royal Birmingham Society of Artists, at their Rooms, New-street. The Congress will be opened by a *conversazione*, at 8 o'clock, on the evening of the 17th, and the Sections will meet on the 18th. The following is the order of proceedings:—

Wednesday, July 18th, *Morning Sitting*, 10.30 to 1.30. Section A.—(1) Needlework—Clothing and its Materials, 10.30 to 11.55; (2) Cleanliness—Washing, 11.55 to 12.45; (3) Thrift—Savings Banks, 12.45 to 1.30. *Afternoon Sitting*, 2.30 to 5.30. Section B.—(1) Health—Sickness, 2.30 to 4.20; (2) The Dwelling—Warming and Ventilation, 4.20 to 5.30.

Thursday, July 19th, *Morning Sitting*, 10.30 to 1.30. Section C.—(1) Methods of Teaching Domestic Economy—Text Books, 10.30 to 11.40; (2) Inspectors—Government Grant—Female Inspectors—Working of the Society of Arts' Examinations, 11.40 to 12.30. *Afternoon Sitting*, 2.30 to 5.30. Section A. (continued)—Food and Cookery.

The subjects will be discussed in the order laid down in the Programme. Each speech will be limited to ten minutes on each separate head specified in the Programme. The Papers, which will, as far as practicable, be printed and distributed in the room, will not (except under special circumstances, at the discretion of the Chairman) be read, but each writer of a Paper will be allowed five minutes for stating the substance of it, in addition to any speech. Writers of Papers may speak immediately after they have introduced their subjects, or at the close of the discussion. Speakers will be called upon in the order in which their names are sent up to the Chairman.

Members of the Society of Arts, and Delegates from the Institutions in Union with the Society, are admitted free to all Meetings of the Congress. It is requested that those proposing to attend will forward their names to the Secretary of the Society of Arts, when tickets of admission will be sent to them. Other persons can become Members of the Congress, and attend all the Meetings, on purchase of a Ticket, price Five Shillings; or Family Tickets, admitting four persons, can be purchased for Ten Shillings. Applications for these Tickets should be addressed to the Assistant-Secretary of the Congress, Mr. Allen Edwards, 38, Edmund-street (next Easy-row), Birmingham.

It is proposed to hold in Birmingham, during the sitting of the Congress, an Exhibition of Books, Diagrams, Drawings, Models, Apparatus, Appliances, and other objects, which can in any way illustrate the subjects of discussion; and it is in contemplation to keep the Exhibition open for some weeks after the close of the Congress.

CANTOR LECTURES.

THE CHEMISTRY OF GAS MANUFACTURE.

By A. Vernon Harcourt, Esq., M.A., F.R.S.,

Lee's Reader in Chemistry at Christ Church, Oxford, and one of the Metropolitan Gas Referees.

Second Lecture.—Monday, March 12.

The condensation, as it is called, of coal gas consists in cooling the products of the destructive distillation of coal to the temperature of the atmosphere. A separation is thus caused between those portions which remain gaseous at this temperature, which becomes the common temperature of all the intermixed gases, and at a pressure which is different for each gas, and those portions which are liquefied under these conditions. The pressure to which each gas is subjected is the atmospheric pressure, minus the tension of all the other gases.

This separation is not a separation of different kinds of matter one from another, but of different portions of the same kinds, each kind dividing itself between the gaseous and liquid product in a proportion depending upon its specific volatility or solubility. So completely is this the case, that, of all the substances forming the crude heated gas, there is, probably, not one which does not divide itself, however unequally, between the portion which remains gaseous and that which becomes liquid when the crude gas is cooled. Some hydrogen, to take the extreme cases, is dissolved in the liquor, and some vapour of the solid hydrocarbons remains in the gas. One or two of the more volatile hydrocarbons, such as benzol, probably divide themselves pretty equally between the condensed liquid and the gas.

I have here a drawing of a set of gas-retorts, showing the position which the retorts occupy in the furnace. They are long boxes of fire-clay, very often made in the shape here shown—the shape of the letter D, with the straight side downwards, sometimes closed at the far end, and sometimes open at both ends. Into these the coal is put, either thrown in with a shovel, or thrust in with a scoop. Then a lid is fixed air-tight over the mouth, the temperature being kept constantly at bright redness, so that for five or six hours the coal is exposed to this degree of heat, the maintenance of which is essential to the production of a large quantity of gas. The only issue for the gases, formed from the heated coal, is by the ascension-pipes, which pass upwards from the mouth-pieces of the retorts. Through them the gas passes, and thence enters a large and long pipe, into which the ends of the smaller pipes descend for a certain distance, so as to open below the level at which the condensed liquid runs off. This pipe remains partly full of liquid, consisting chiefly of the less volatile portions of tar, and the gas, as it is formed, bubbles through the liquid, and so goes off.

What I propose now to follow is not the permanent gas, but that which becomes liquid when the heated mixture of gases is cooled. Some of this liquid is deposited, as already mentioned, immediately on leaving the ascension-pipes, and forms the first portion of what is separated from the gas by condensation. The gas, however, is still quite hot when it leaves the "hydraulic main," as it is termed. It passes from thence through a system of pipes so arranged as to present a large cooling surface to the gas, in order to the more complete separation from it of those parts which are liquefiable. The drawing represents an arrangement of the condensers, in which the gas ascends in one pipe and descends in the other, so that it is exposed during its course through a considerable length of piping packed into a small compass to the cooling influence of the air, the heat of the gas traversing the sides of the iron pipe, and thus an exchange of temperature between the gas and the surrounding air going on during the whole of the passage. Under these influences a further portion of liquid is condensed out of the gas, which runs down into a tank, and is collected in a well beneath. The liquid divides itself into two parts, a lower layer of tar, of the nature of which I gave you some account in my last lecture, and an upper layer of water holding various substances in solution, which is commonly called gas liquor or ammoniacal liqor, of which I have to speak to-night.

A list is placed on the wall of the substances derived from the destructive distillation of coal, and I will refer to those which are found in gas liquor. At the head of the list comes water, which is the first substance given off when coal is heated; and it is by its solvent action that many other substances are removed from the crude gas at this stage.

The compounds of hydrogen with carbon are sparingly soluble. Hence in spite of the abundance of these substances in coal gas, very little of any of them dissolves in the condensed water. The compounds of hydrogen with nitrogen and with sulphur are both soluble in water, and the substance produced by their union is soluble. Carbonic acid also dissolves in water to some extent, and abundantly in water containing ammonia. By the action of ammonia upon carbon bisulphide, ammonium sulphocyanide, another soluble salt, is formed. In some coal mines a stream of salt water has been found, and chlorine, probably existing as sodium chloride, is an element present in small quantities in the ash of coal. Like the elements already named—carbon, oxygen, nitrogen, and sulphur—chlorine escapes from the heated retort in combination with hydrogen, and this compound, or rather the product of its union with ammonia, is found in gas liquor.

Acetic acid, which is produced largely by the destructive distillation of wood, is also formed in small quantity from coal, and dissolves as ammonium acetate. The presence of sulphate of ammonia, to a small extent, may be due either to oxidation of sulphur compounds in the heated gas, or to the subsequent action of the air upon the sulphur compounds in solution. Of this latter action, the principal product is a salt, corresponding to the sodium salt used as a "fixing" agent by photographers — ammonium hyposulphite. Another secondary product of a reaction between the cyanides of the liquor and the iron of the condensing-pipes, is ammonium ferrocyanide.

I come now to the treatment of this ammoniacal liquor. It is a substance of which the value was at one time not appreciated. It used to be got rid of, and probably still is so at many gas-works, as a waste product. But commonly it is converted into sulphate of ammonia, either at the works or by the chemical manufacturer.

From the tank in which it is stored, it is pumped to the top of a vessel, like that which at gas-works is called a "scrubber"—a tower filled with coke or pebbles, or it may be an arrangement of alternate shelves, down which the liquor trickles, exposing a large and constantly renewed surface. The liquid runs off from the bottom of this tower into a tank or boiler, and into this tank or boiler there is blown a current of steam, and there is also injected a little stream of milk of lime.

Let us consider first what passes in the tank. There the liquor, which has already lost a part of its ammonia, is strongly heated by the steam which is blown into it, and it is also exposed to the action of the lime. Lime decomposes the substances of which I was speaking just now, sometimes called the fixed salts of ammonia, substances which contain ammonia in a condition in which heat alone will not drive it off. A mutual decomposition takes place between these salts, such as ammonium chloride and sulphate, and the lime which is in the tank; and salts of lime are formed, and ammonia is driven upwards with the steam.

This steam, then, already mixed with ammonia, passes into the tower, and as it rises up meets a descending stream of gas liquor. The proportion between the two is such that the high temperature of the steam reaches just to the bottom of the tower, and when the liquor that comes over meets the ascending heated current, it gives off at once so much of its ammonia in a free condition, as is combined with substances which leave it still volatile. So that from the top of the tower there passes over a quantity of gas, consisting of ammonia and the volatile acids which were combined with ammonia, principally carbonic acid and sulphuretted hydrogen.

These gases are conducted into a wooden tank lined with lead, which is filled with sulphuric acid, the ordinary brown oil of vitriol, and there the ammonia is condensed. It combines at once, producing great heat, with the sulphuric acid, and as the quantity accumulates, it crystallises in combination with the sulphuric acid as ammonium sulphate. I have here a specimen of gas liquor before treatment, and a specimen of the salt which is formed from it. This is the white sulphate of ammonium which is got by the process I have described. The carbonic acid and the sulphuretted hydrogen are got rid of either by conducting them to the bottom of the furnace of the works, so as to destroy the sulphuretted hydrogen, or else by passing them through a purifier containing oxide of iron; or else, which is the best plan, the gases are burnt, and the products mixed with nitrous fumes, are passed into lead chambers, and thus the sulphuretted hydrogen is converted immediately into sulphuric acid by the same process by which the vitriol maker converts native sulphur, or iron pyrites, into sulphuric acid.

It is a question of some importance in what way the ammoniacal liquor, which is sold by the gas manufacturer to the chemical manufacturer, should be estimated. The ordinary way, I believe, of estimating its value is by mixing directly the ammoniacal liquor with sulphuric acid, and observing how much acid of a known degree of dilution must be added to a measured quantity of the liquor before it is completely neutralised. The strength of the liquor is ordinarily described by a statement of the quantity of sulphuric acid that a gallon of it is capable of neutralising, so that the expression 10-ounce liquor means that a gallon of the liquor contains ammonia enough exactly to combine with and neutralise 10 ounces by weight of sulphuric acid. The direct determination of ammonia in this way gives a very imperfect and unequal estimate of the value of the ammoniacal liquor. Imperfect, for the reason that besides free ammonia and compounds of ammonia with weak volatile acids, which alone neutralise the sulphuric acid, the ammoniacal liquor contains also, in the form of neutral salts, combined ammonia, which is got out of it and turned to account by the chemical manufacturer, and which is not estimated by this mode of testing. It is also an unequal mode of testing, because the proportion of free to fixed ammonia appears to vary greatly in different samples of liquor. Therefore it must be very much better, and I have no doubt it will ultimately become the general practice, to use some means of determining the value of ammoniacal liquor more exactly. The most obvious way of doing it is by means of such an apparatus as I have here set up.

It consists of a little flask connected with a Liebig's condenser, in which the steam formed on boiling the liquid in the flask passes along a narrow tube surrounded by a larger tube, through which cold water is kept flowing. The ammonia from the liquor, and from the fixed ammoniacal salts—for I have placed in the flask besides ammoniacal liquor a small quantity of lime—passes along the inner tube. It is dissolved by the water which distils with it, and drops into the coloured liquid which has been placed beforehand in the receiver into which the tube passes. The liquid is dilute sulphuric acid, a measured quantity of an acid of known strength, coloured with a little litmus. I have taken, for convenience of calculation, 16 c.c. of ammoniacal liquor, which, before being distilled, was mixed with twice its volume of water. In the receiver I have placed 16 c.c. of the standard acid which is commonly employed—namely, the acid which contains one pound of strong sulphuric acid in one gallon of dilute. This measure of acid will be sufficient to neutralise all the ammonia that can be given off, unless the liquor is more than 16-ounce liquor. It is only necessary to carry on the distillation until about one-third of the liquid in the flask has passed over. At the outlet of the receiver is a tube with two bulbs blown upon it, which hold a little of the liquid. By turning it round, it is made to serve also as a funnel for bringing the acid into the receiver. At the end of the distillation this tube is turned round, and the liquid which is in the bulbs runs back into the body of the receiver. By substituting a solid cork for that which holds the bulb-tube, and removing the receiver with its contents, and running in standard ammonia from a burette till the litmus changes colour, the quantity neutralised, and the quantity of ammonia in the volume of liquor operated upon, are known. The solution of ammonia is made of just half the strength of the acid, so that two measures of this solution will neutralise one measure of the acid. Now, supposing the liquor I am testing is exactly 16-ounce liquor, I should find, when the distillation was complete, that the litmus would just have acquired a neutral colour. But supposing the liquor is not so strong, and that 4 c.c. of standard ammonia have to be added at the end of the operation to neutralise the remaining acid, the volume of acid neutralised by the distillate is 14 c.c., and the liquor tested is 14-ounce liquor. That is a very simple and convenient way of estimating the value of a sample of liquor.

Another process, which is still simpler, requiring no application of heat, and no watching, but occupying a rather longer time, can be executed with the compact apparatus which I hold in my hand.

It consists of a ground-glass plate, a small dish into which a measure of acid is put, a crucible supported on a triangle over the dish, which is charged with a measured quantity of liquor and a pinch of lime, and, lastly, a bell-glass which stands upon the glass plate, and encloses the smaller vessels.

The ammonia is not given off very quickly, so that there is no fear of any loss during the half-minute required to discharge the pipette into the crucible, and place the bell-jar over it again. Ammonia is so volatile when in aqueous solution, that if we take some solution of ammonia and pour it into a flat dish, and examine it a few hours afterwards, we find it contains no ammonia at all. The ammonia escapes wholly into the air. Therefore, if we have in separate vessels, within the same enclosure, a solution of ammonia and a liquid which will combine with ammonia, and will absorb and fix it, in the course of time—and it is only a few hours that is required—the whole of the ammonia will have transferred itself to the liquid which is capable of combining with it. So that, having measured the acid into the lower vessel, and the ammoniacal liquor into the upper vessel, it only remains to let them stand through the night, and in the morning to determine as before, with standard ammonia, the quantity of acid which remains unneutralised. The calculation is just the same as in the former case.

I come now to the question of the purification of gas from ammonia, an operation which needs to be accomplished for two reasons. The presence of ammonia in gas is undesirable, because ammonia has a prejudicial action, especially upon brasswork, and its combustion produces some of the corrosive oxides of nitrogen. But also the whole of the ammonia is very well worth collecting.

Owing to the volatility of which I was speaking just now, the condensation of the gas does not remove the ammonia completely, and it is necessary to employ some other means. That which is commonly employed is washing with water; and the most usual mode of applying water is by means of a scrubber. In this vessel the gas which still holds ammonia ascends through the material with which the scrubber is filled, which is most commonly coke, or it may be boards or other materials, and a current of water is allowed to descend through the same.

But it is not easy to secure the distribution of both gas and water over the whole of the contents of the scrubber. If we fill such a tower as is shown in the drawing with any material, say coke, and allow a small quantity of water to run down, the water will by no means spread itself over the whole of the contents of the tower, but, on the contrary, it will make for itself a watercourse, and will follow that. This depends upon a fact which we have often occasion to observe, that solid materials are not so readily wetted by water when they are dry as when they have already been wetted. If we watch rain falling on a window-pane, we see the drops run quickly where the glass is already wet, and hang, or move slowly, where the glass is dry. Thus it happens with the coke in the scrubber; where the water has trickled and found its way, the water will continue to run, but where the surface has once got dry, that part will remain dry. But, of course, the gas chooses its route independently, and prefers those open spaces where there is no counteracting current of water descending. Therefore, it may well be the case that the water which we use to take out the ammonia will follow one set of channels, and the gas will follow another. A systematic arrangement of shelves, after the manner of Coffey's still, is better than any hap-hazard arrangement, such as filling the tower with a material like coke. Besides scrubbers, there is also another class of vessels for applying water, called "washers." I shall not attempt to describe the various forms of washers which have been proposed. The principle common to them all is that the liquid is stored in a tank, and the gas is forced through a few inches of the liquid in streams of bubbles, at a multitude of different points.

I have set up here, partly in illustration, partly because I venture to think the particular form a good one for the purpose, a small washer, which I have made out of a piece of glass tubing. An obtuse double bend has been made in the tube at intervals of four inches, so that it consists of several portions which are parallel, and are now placed horizontally, connected by shorter portions, which are inclined. Two smaller tubes at each end, passing through the corks which close it, serve for the inlet and outlet of gas and water. At the upper end water enters at the rate of one drop every two or three seconds. The water stands in a series of shallow pools, where the tube is horizontal, and flows in a slow stream down the inclined portions.

The gas passes first into this three-necked bottle, at the bottom of which I have placed some dilute ammonia, and thence into the lower end of the bent tube. A small jet is attached to the third neck of the bottle; and the gas, after passing through the tube, escapes by a similar jet.

I will now try whether there is any difference in the amount of ammonia in the gas as it issues from the bottle, and after it has passed through the tube. I hold over the first jet a piece of red litmus paper. It becomes blue at once where the gas impinges upon it. This shows that the gas which enters the tube contains abundance of ammonia. I now apply the same test to the gas which has passed through the tube. You see that the colour of the paper remains wholly unchanged.

The way in which my small apparatus works is by exposing each portion of the gas to successive portions of water, of which each is purer than its predecessor. The gas does not bubble through the water, but only passes over its surface, and, therefore, the apparatus does not so much resemble a washer as a Coffey's still, with its shelves spread out horizontally. I doubt whether its action could be improved by forcing the gas through the liquid or agitating it with each portion of the liquid successively.

According to the molecular theory of the constitution of gases, which has now attained a high degree of probability, gases are not at rest when we are not causing them to move, but are of themselves in a state of continual and rapid motion. It has been calculated that the molecules of hydrogen, at the ordinary pressure, and at the temperature of the freezing point, are moving about with an average velocity exceeding one mile a second. Now, if it is the case that gases are moving about, striking in all directions, causing a pressure, which their elasticity exhibits, by virtue of the continual impact of their molecules on the sides of the containing vessel, they also, without our using force to drive them through, must be coming—each molecule in its turn—into collision with any liquid surface with which they are in contact, or over which they pass. And, therefore, when, as in this case, the gas is not anywhere bubbling through the liquid, or forced into contact with it, but only streaming over its surface, nevertheless, as each particle of gas is, with an inconceivable rapidity, zig-zagging backwards and forwards between the upper surface of the glass and the water, this motion produces, without requiring the application of any external force, actual contact between every part of the gas and the liquid spread out beneath it.

But what is required, in order that the purification should be complete, is that the gas should be successively exposed to fresh portions of the liquid used to purify it. This is absolutely necessary where the liquid, as in the case of a solution of ammonia in water, is one which does not fix the gas, but only reduces its tension.

When ammonia is dissolved in water, it still possses a certain tension, according to the strength of the solution; and if we have a solution of ammonia sufficiently saturated, ammonia will remain as a gas undissolved upon its surface as it would over the surface of mercury; and this tension of ammonia in solution only ceases when the solution becomes indefinitely dilute. Thus, by no amount of agitation, and no length of exposure, could we wash ammonia out of another gas with water which already contains a small quantity of ammonia. A short time will serve; but the time must be occupied in the exposure of the gas to successive quantities of liquid—that which contains some ammonia being removed, and other water, which does not contain any, being substituted for it. And no arrangement of washer or scrubber will accomplish anything like a perfect purification of gas from ammonia, which does not provide for a complete renewal of the washing liquid. Where that which is employed to remove the ammonia is a substance which can fix it, this condition is not necessary. For example, if I take a bottle of ammonia, and pour into it some water, and shake up the water in the bottle, and then hold a piece of litmus or turmeric paper in the bottle, to see whether the ammonia is removed, I find it is not; and if I were to prolong the shaking for any length of time, still, however much the volume of water exceeded that required to dissolve the ammonia, it would never so take it out but that I should find enough in the bottle to show with test-paper that ammonia was present. But if, instead of water, I took sulphuric acid, or a solution of sulphate of iron, or any liquid which combines with ammonia to form a fixed substance, then the removal would be complete. But, using water only, the frequent and complete renewal of the water is essential to the success of the operation.

I have spoken of the substances which are condensed in the form of tar, as we call the mixed liquid, from gas. Now, it is a question which must have occurred to every one who has seen the process of tar distillation, how it comes to pass that substances so volatile as are the lighter distillates from coal tar, and so exceedingly valuable in respect of their illuminating power, are always being removed in the process of coal gas manufacture. I may perhaps illustrate the illuminating power and volatility of one of these substances by a simple experiment. I have here an apparatus for making hydrogen, and I have arranged a pair of tubes so that I can either pass the hydrogen directly to a burner, where it gives a very feeble light, as you see, or I can make it pass over some of this substance which has been got out of the coal gas—namely, benzol, which is the first of the substances distilled off from coal tar, and the most volatile. When the hydrogen gas is passed over the benzol, it mixes with the vapour of benzol, and the mixture of the two burns with a very luminous flame; but if I open the communication again, so as to allow the hydrogen to pass directly to the burner, there is hardly any light produced. That illustrates the volatility and illuminating power of one of the substances which are removed from coal gas. How comes it to pass that these substances are removed?

I will try to illustrate the matter by another experiment. I have here a little coal gas in a glass cylinder over water, and I have placed an india-rubber band round the cylinder, so as to mark the height at which the water stands. Now, I will pass up through the water into the cylinder a few drops of a volatile hydrocarbon. You see at once, to some extent, and rather more when I agitate the liquid so as to promote its diffusion, that the water sinks to a lower level. That happens because the substance, being very volatile, exercises a considerable tension. We have now under the same pressure, and at the same temperature as before, a volume of gas which is increased by about one-half. If I now take a portion, not of the same liquid, chemically speaking, but still of a liquid which was distilled from the very same sample of petroleum, differing only in being of a higher boiling point than the portion which I first passed up, what is the effect I shall produce? I shake the cylinder a little, to bring the liquid last added into contact with its other contents, and the effect is, that instead of this liquid adding its portion of vapour to that which the jar already contained, on the contrary, it has produced a considerable reduction of volume; and if I were to add a little more, the volume would nearly return to that which the coal gas occupied originally. This illustrates what happens in the condensation of the hydrocarbons produced by the destructive distillation of coal. If they were without action one upon another, we should have some little addition to the volume of the gas, and a more considerable addition to its illuminating power. But these substances are, in fact, solvents one of the other; and just as we can wash ammonia out of gas by the action of water, so the lighter of these hydrocarbons are washed out of the gas by the solvent action of those substances of the same class which have higher boiling points.

I have still a few words to say about the purification of gas from two other ingredients—carbonic acid and sulphuretted hydrogen. You know that, for the removal of sulphuretted hydrogen, there are two substances which are commonly employed—lime and oxide of iron. Either of these substances is perfectly good for the purpose for which it is employed, and will completely purify gas from sulphuretted hydrogen.

Oxide of iron has over lime this great advantage, that the sulphur which the gas contains, when removed by oxide of iron, appears ultimately in the uncombined state, and can be made into sulphuric acid, whereas the sulphur which is removed by lime cannot, as far as we know, be turned to any account afterwards. Another advantage of the oxide of iron is that it may be used over and over again. It is a much more costly substance than lime, and it never could be used for purification if it could be used but once. I have here a sample of it ready for work, and another in the condition in which it comes out from the purifiers after it has been used. The second sample has already lost a little of the black colour which it had when I first poured it out; and gradually, by exposure to the air, it loses that black colour entirely, and becomes of the same red colour as the other sample, which is in the condition in which it is placed in the purifier. The chemical change which is now taking place is that, by the action of the oxygen of the air, the iron, which was oxide when first put in, and which has been converted into sulphide by the action of the sulphuretted hydrogen of the gas, is being reconverted into oxide; the sulphur which had combined with it being separated in the elementary condition.

Now, although oxide of iron serves equally well with lime the purpose of removing sulphuretted hydrogen, it does not serve in any degree the purpose of removing carbonic acid. The presence of carbonic acid in gas is injurious, not to the consumer, but to the maker of gas, for it affects the illuminating power; and if the illuminating power is deficient owing to the presence of carbonic acid, it has to be increased by the production of a larger proportion of illuminating gases, which must be effected by the addition of a larger dose of cannel to the coal used in making the gas. Therefore, it is desirable that the carbonic acid should be removed; and either lime or some other mode of removing the carbonic acid is generally employed. To some extent the carbonic acid is removed in the operations of condensation and scrubbing, for it combines with ammonia and forms a solid and soluble substance. Both it and sulphuretted hydrogen can be removed from gas by the action of ammonia, if the ammonia can be readily obtained, and can in a suitable manner be brought to bear on the gas.

The process devised by Mr. Hills, which is now in use in the South Metropolitan Gas Works, appears to me to be an admirable process for the production of ammonia in a condition suitable for the purification of gas. This process consists in exposing gas liquor to conditions exceedingly similar to those I endeavoured to explain in describing the manufacture of sulphate of ammonia, with this difference, that the quantity of steam is less relatively to the amount of ammoniacal liquor, and therefore the temperature is not raised so high. The result of this limited heating may be explained as follows:—We may regard ammoniacal liquor as being a solution of three gases—ammonia, sulphuretted hydrogen, and carbonic acid. These three gases are unequally soluble, ammonia being very much the most soluble; sulphuretted hydrogen next in order, but much less soluble than ammonia; and carbonic acid much less soluble still. Now, gases are less soluble in proportion as the temperature of the dissolving liquid is higher, and consequently, when by heating the water we diminish the solubility of these gases, they are given off in a proportion corresponding in inverse order to their solubility. When ammoniacal liquor is heated so that the escaping gases have to pass over an entering stream of cold liquor, it parts first and most readily with carbonic acid, then with sulphuretted hydrogen, and not until it is pushed much harder does it part with ammonia. By so regulating the temperature that there shall be always passing down a sufficient quantity of cold ammoniacal liquor, the heat may be kept at that point at which carbonic acid and sulphuretted hydrogen are driven out and ammonia is retained; and by carrying on this process continuously, the liquid which is drawn off contains ammonia which is practically free from carbonic acid and sulphuretted hydrogen. The carbonic acid and sulphuretted hydrogen are passed through a purifier containing oxide of iron. The carbonic acid escapes into the air—and it is clearly better that it should go right away into the air than that lime should be used to remove it, which has first had to be freed from its own carbonic acid by burning in a kiln. The sulphuretted hydrogen is stopped, so that no nuisance is produced, and the sulphur is not lost.

I will show you, by an experiment, the different solubility of these gases upon which the above process depends. I have here three tubes, each of which I have filled with one of the three gases, and I will now open them under water. In the first, which is filled with carbonic acid, you see the water hardly rises at all, the gas being only sparingly soluble. In the one containing sulphuretted hydrogen, it rises rather more, and in course of time, and with the help of agitation the tube becomes filled with water, the gas being wholly dissolved; but you see that in both cases solution proceeds slowly. Now I will compare the effect on the tube filled with ammonia. The moment I remove the cork, the water shoots up to the end of the tube. You see the great difference as regards solubility between these gases.

I will only detain you for a few moments to illustrate the removal of sulphuretted hydrogen from gas by washing it with ammonia, using again the bent tube with the liquid flowing along it.

Here, again, I have to make my gas impure to show the test. I have placed in the three-necked bottle some ammoniacal liquor, which will no doubt yield a sufficient quantity of sulphuretted hydrogen. On testing the gas, as it leaves the bottle, by a piece of lead paper, you see the paper is blackened directly; now I will test it at the other end, after it has passed along the bent glass tube down which the solution of ammonia is trickling. No effect is produced on the lead paper, though such paper furnishes a most delicate taste for minute quantities of sulphuretted hydrogen. I have repeated this experiment several times; for the little apparatus really surprised me by its efficiency—that it should be possible thus, with ammonia dropping at this slow rate, to remove sulphuretted hydrogen from gas so completely. On trying the experiment in the same way when gas was passing through even more rapidly, not being forced into contact with the ammonia, but simply exposed successively to fresh portions of the liquid, the sulphuretted hydrogen has been completely removed.

MISCELLANEOUS.

MUSICAL PITCH.

The following correspondence appeared in the *Athenæum* :—

Since my articles on Tonometry in the *Athenæum*, of the 2nd and 30th of December, I have obtained much information, which is included in my paper printed in the *Journal of the Society of Arts* for May 25. The main point that has come out is that since 1860, on the Continent, French pitch, A 439 = c 522, has been generally adopted, with slight unintentional variations, amounting to one vibration either way; but that before that pitch was introduced there was a much higher pitch, varying from A 450 = c 535 (Broadwood's "medium") to A 453 = c 539, which was used at the Leipzig Gewandhaus Concerts, and was that which prevailed in Paris, when the pitch was there officially lowered to A 439 (intended for A 435). In Brussels a higher pitch prevailed, and apparently still prevails, quite up to the highest English.

At the time the Philharmonic Society was founded, in 1813, a low pitch prevailed, the piano for those concerts being tuned to c 510·8, according to a copy of the fork still preserved by Messrs. Broadwood. In 1826, as I mentioned previously, Sir G. Smart's fork was c 521·2; and he used as his Philharmonic pitch A 437, giving in the old tuning, which he employed, c $522\frac{3}{4}$. The equal tuning would give c $519\frac{3}{4}$. Now, this corresponds to the French pitch very closely, and it is interesting to know that the principal A of the Norwich Cathedral organ in June last gave nearly the same, A 435·6, or old c 521·2. The old c derived from A is about three vibrations sharper than the equal c, and two vibrations flatter than the just c. For this Norwich pitch I am indebted to Mr. Hipkins, who kindly induced Dr. Buck to tune a fork to the pitch last month. We may probably take this to be about the regular pitch of organs when turned in the old way. At present they are sharper, St. Paul's organ at Easter having been c 533·2 = A 448·4, according to Mr. Hipkins, through Westminster Abbey in May was as low as A 442 = c 525·6, according to Dr. Stone.

As to the present pitch, Mr. Hipkins informs me that he has measured the pitch of the two operas in June. He took the sharpest average pitch because that is the one by which the voices were guided, on the principle that, when two pitches are presented, the ear instinctively tunes by the sharper, and in one of these bands the wind was much out of tune. The result is that on June 23, Her Majesty's Theatre (Costa's band) was playing at A 455 = c 541·1; while Covent-garden Royal Italian Opera, on the 21st and 25th of June, was up to A 458 = c 544·7, if not a trifle more, which was the pitch of the Crystal Palace band in March, according to a fork procured and lent to me by Dr. W. H. Stone. From Dr. Stone I have also just received information that at the Handel Festival performance of "Israel in Egypt," at the Crystal Palace last week, with the sun at 85° in the shade, the band reached the highest pitch yet recorded, A 461 = c $548\frac{1}{4}$, about which I understand that he has written to the *Choir*. But observe that this was for Handel, whose own fork gives A 426·4, so that it was sung at the festival dedicated especially to him nearly seven-tenths of a tone higher than he imagined it!

These numbers were obtained by means of forks previously measured with which the pitch was compared, and, owing to the very experienced ears of the gentlemen who made them, are probably correct within one or two vibrations at most. In the same way, with a fork subsequently measured, Mr. Hipkins observed that soon after the pitch was lowered at Covent-garden a few years ago, the pitch was about c 533, that is, about A 448. It has not been long in regaining its old pitch, A 458! This has been accomplished by many successive cuttings, which have had the effect of putting the wind instruments hopelessly out of tune, because they were made originally to the French scale. This information I get from both Dr. Stone and Mr. Hipkins.

At the Floral-hall this season, two grand pianofortes of Broadwood's were used for accompaniments tuned to the French pitch, probably the only time it has been heard in London, and nearly the same as that at Norwich. Would it not be better to fix one pitch, and keep to it, for all bands—either the French pitch or the English pitch? In England the latter is only feasible, and it may be taken as A 458 = c 545 nearly. There is no advantage in the two opera-houses differing by three twenth-fifths of a semitone.

For comparing intervals between measured forks it is convenient to remember that for A, each vibration represents about one twenty-fifth of an equal semitone, and about c, each vibration represents one-thirtieth of an equal semitone. This is very nearly correct for the whole range of pitch in actual use. Also, in order to compare with commas and skhismas, it should be noted that a comma is very nearly twenty-two hundredths, and a skhisma two hundredths of an equal semitone.

Alexander J. Ellis.

25, Argyll-road, Kensington, July 2. 1877.

Mr. Alexander J. Ellis has done good service by comparing the tuning forks of different countries and of various dates by the standard of Appun's tonometer. It is, perhaps, the most accurate test of pitch hitherto brought into use for music, and it throws into shade such instruments as the siren, which depends upon equal turning by the hand, and upon the power of arresting them at the precise instant of a vibration. The tonometer may be employed upon sounds of so low a pitch as to be but just within the limits of audibility as music, indeed so low that the vibrations may be counted. All musical scales should be commenced upon their lowest note, because true scales are formed by aliquot parts of the string or pipe which produces the sound in question, and all the consonances—indeed, all the musical intervals of a scale—are multiples of its vibrations in inverse ratio to the aliquot length of string or pipe which produces them. Being all multiples, there can be no fractions of vibrations in a true scale. This is an essential point in music, but it is one which Mr. Ellis has not taken into account.

The most satisfactory result from Mr. Ellis's application of the test in question is that the French normal pitch appears to be more accurate in practice than in theory. Instead of the supposed 435 vibrations for A, Kœnig's tuning forks, as tested by Mr. Ellis, show the French A to make 439 vibrations in a second. If we add but one more, to make it 440 instead of 439—a nicety in which the best ears may have been deceived—the French standard will agree with that recommended for adoption by the committee appointed by the Society of Arts. The advantage of 440 is that A will then be the twentieth multiple of an F with 22 vibrations, as it should be, and this F with 22 will have its perfect fifth in a c with 33 vibrations, as 3 to 2 of F. The fourth octave of c with 33 vibrations is c 528. Thus, instruments tuned from A or from c will agree in pitch. Mr. Ellis would have an A with 444 vibrations, so that standards shall not agree.

It is impossible to consider Mr. Ellis's proposals for tempering the musical scale as at all happy. He would have certain numbers of vibrations and fractions of vibrations, which added together shall shall equal the 2 to 1 of the octave. But the calculations are purely geometrical, without consideration for the consonance of the intermediate intervals, and he has readily fallen into this error by a thorough misconception of the nature of a musical scale. "The pianoforte," says Mr. Ellis "shows us an octave divided sensibly into twelve equa parts, called equal semitones." If music were geometry, there might have been twelve equal semitones in an octave, just as there are twelve equal inches in a foot, but in music, as it is, no two semitones are equal. Mr. Ellis should at least have known that, because when in Edinburgh he attended the lectures of the late Prof. Donaldson upon the elementary science of music. When an octave is divided into semitones, the ratios range between 16 and 32. Mr. Ellis selected 24 to 25 for the model semitone in a recent communication. Such is the ratio of the fifth above the key-note with the semitone immediately above it. The rule applies to every justly tuned scale. So that, in the key of C, 24–25 is from G to G sharp; in the key of F, it is from C to C sharp; and, in the key of G, it is from D to D sharp. Thus, whether ascending or descending, we are supplied with 24 to 25 for every key. Mr. Ellis supposes "equal temperament" to mean a collection of those twelve semitones into one octave. It was fortunate that no wag was present at the meeting of the Society of Arts who was sufficiently malicious to call upon the lecturer for a musical illustration of this new model octave. We can fancy the dismay pictured upon the faces of the audience to have to listen to eleven notes out of tune in every twelve, and this not in one key only, but in every key. In C the semitones between C and E are 16-17; 17-18; 18-19; and 19-20. If all these were changed to the smaller ratio of 24 to 25, there would be no major tone, no minor tone, and no Third from C to E in the scale.

Conscious of his own powers to divide vibrations into fractions, upon paper, Mr. Ellis has, perhaps, overlooked that they are not divisible in practice. Suppose the interval of a Fourth vibrating in its cycle of 4 to 3. If at the end of the first cycle the 4 should have gained a quarter of a vibration over 3, it could not be arrested and made to begin again. It would increase its gain to half a vibration in the next cycle, and would then vibrate in a diametrically opposite direction to No. 3. Each would thus neutralise the sound of the other so far as their proximity would permit.

The objection to the French standard of an A with 435 vibrations is that no octave below it could be perfect. The one immediately beneath would be 217½.

Those periodic coincidences of vibration which constitute the charm of music to the ear, under the name of consonance, are more or less affected by all fractions of vibrations in excess. It is thus that all tempering detracts from the fulness and the quality of musical tone, even when the inequalities are so slight as to escape notice by the many. Some ears are peculiarly sensitive, and it detracts much from their pleasure in music, while their ears will admit tempering in excess.

Wm. Chappell.

A provisional association, formed for constructing a tunnel under the British Channel between England and France, has held a meeting in Paris, to receive a report on certain geological explorations and soundings executed last year. The report stated that the clay of the zone through which it was proposed to carry the tunnel was perfectly continuous and homogeneous, and the engineers concerned considered the contemplated tunnel quite practicable.

Within ten years, no less than 12,000,000 acres of forest have been cut down or burned over in the United States. Much of the timber is used for fuel, twenty-five cities being on record as consuming from 5,000 acres to 10,000 acres each. Fences use up much timber, and railway sleepers require the product of 150,000 acres per annum. The amount of pine and lumber timber yet standing in the forests of the timber States is estimated at 225,000,000 feet. The sum of 144,000.000 dollars is invested in the timber industry, employing 200,000 men.

A French official return shows that from the date of the establishment of the decimal system of coinage in France down to December 31, 1876, gold and silver money was coined in France to the aggregate extent of £519,799,823.

PHILADELPHIA EXHIBITION.

The first volume of the reports on the Philadelphia Exhibition has just been issued by the Education Department. The first part of the volume is composed of the formal official reports, including those of the Duke of Richmond, Sir H. Sandford, and Prof. Archer. In this part also of the book are found the resolutions of thanks formally passed by the Centennial Commission and Board of Finance, to her Majesty, and to all those officially connected with the Exhibition, including Mr. Cunliffe Owen, to whom much of the success of the Exhibition is attributed by the American authorities.

Sir H. Sandford's report is the longest, and gives in some detail a history of the official proceedings in connection with the Exhibition, from the appointment of the Commission, down to the close of the Exhibition and the removal of the goods. Prof. Archer, on the contrary, dismisses his portion of the subject in a couple of pages, which merely state that the arrangements for "installation" were satisfactorily carried out in spite of certain difficulties caused by the American system of classification.

The reports on the different sections are as follows:—"Iron Manufacture of the United States, and comparison with that of Great Britain," Mr. Lowthian Bell; "Ceramic and Glass Wares," Mr. R. Soden Smith; "Chemical Products," Dr. Odling; "Cotton, Linen, and other Fabrics," Mr. J. Watts; "Flexible Machinery," Mr. W. Hulse; "Wool and Silk Fabrics," Mr. H. Mitchell; "Paper, Stationery, Printing, and Bookmaking," Sir S. Waterlow; "Hardware used in construction of Buildings," Hon. J. Bain; "Edge Tools, Cutlery, Polishing and Burnishing Materials, Metal Hollow Wares and Ornamental Castings, Hardware, Fireproof and other Safes," Mr. D. McHardy; "Military and Sporting Arms, Weapons, &c.," Major Noble; "Railway Appliances," Capt. Douglas Galton; "Vessels and Apparatus for Transportation," Col. Rich; "Motors and Transmitters, Hydraulic Apparatus, &c.," Mr. W. H. Barlow; "Machines and Tools for Working Metals, Wood, and Stone," Dr. Anderson; "Machines and Apparatus used in Sewing and Clothing," Mr. F. A. Paget; "Agricultural Machinery," Mr. J. Coleman; "Electric and Telegraphic Apparatus," Sir William Thomson; "Architecture and Engineering," Sir J. Hawkshaw; "Plastic and Graphic Art," Mr. C. W. Cope; "Industrial and Architectural Designs, Models and Decorations, Decoration with Ceramic and Vitreous Materials, Mosaic, and Inlaid Work," Mr. P. Graham; "Section of Education," Sir Charles Reed. There are also reports on the additional exhibitions of horses, cattle, &c.

Iron Manufacture.

Mr. Lowthian Bell, in his report, devotes himself to one portion of the group in which he was appointed a judge, and treats solely of coal and iron, leaving to the other judges the duty of reporting on other portions of Group I, which includes mining, metallurgy, &c. His first remark is, that the natural gifts of Great Britain, as regards her coal and iron, are less special to our country than is generally believed. Apart from the other iron-producing countries of Europe, it was made evident that America and Australasia both possessed vast stores of mineral wealth, needing only to be worked in the same way as our own mines. Most of the European countries were, indeed, poorly represented, nor was there any reason why the iron masters should undertake the labour and expense of sending specimens to a market so distant. One exception there was in the case of Sweden, the superior quality of whose iron keeps her above rivalry. With America and Australia it was different. The American ironmasters were on their own ground, and the Australians were instigated by a desire, not to sell their products, but to attract capital to a promising field. After a few more preliminary observations, and a brief notice of some few special foreign exhibits, Mr. Bell passes at once to the consideration of the American iron trade, availing himself in this, of what information he gathered from external sources in America, instead of confining himself to a report on what he actually saw in the Exhibition.

The diminution in our iron exports to the States cannot, Mr. Bell thinks, be entirely set down to the high import duties charged. It is concurrent with a manifest decrease in the American make also, a decrease caused by over production in the years preceding 1873. In those years the vast extension of railways caused the erection of a number of furnaces and rolling mills, for which, eventually, work could not be found. Hence the panic f 1873, followed by continued depression.

The condition of workmen in the trade seemed to be somewhat better than at home, but Mr. Bell could not agree with statements put forth in the report of the American Iron and Steel Association, as to the greatly improved state of those who had emigrated from this country.

The next point taken up is the tariff, and Mr. Bell takes some pains to prove that high duties are not necessary to protect a new industry, and that they do not fall wholly on the foreign producer. With regard to the former case, the manufacture of Bessemer steel is given in illustration. This was a new industry here, as well as in America, but it did not require protection in this country. As regards the incidence of the duties, it is shown that they lead to trade being all in one direction so to speak. Vessels go out in ballast to bring home a cargo, say of grain, and the shipowners loses the profit of his outward voyage. Hence he has to charge a higher freight, and the American shipper has to be content with lower prices.

The reporter next proceeds to examine in some detail the circumstances which influence the position of the United States in the manufacture of iron as compared with Great Britain. First the landowners' royalty is always much less, and often the land has been bought at a nominal price, so that practically no royalty at all is paid. Though the wages of coal hewers per day are higher, yet the working day is so much longer that for the amount of coal raised more is paid than in this country. The coal is abundant and good, anthracite being abundant and capable of being cheaply worked. On this point Mr. Bell says, "I have no reason for supposing that the coal fields of America do not contain fuel quite as pure and quite as suitable for iron purposes as the average of the produce of our British collieries." The use of natural gas is referred to as being of importance in the petroleum country. One fact noticed is curious if true. It is said that 3,500 feet of gas are sufficient to make a ton of puddled iron. A ton of coal contains nearly three times this quantity of gas, but it is only sufficient to make a ton of iron. Charcoal is still used to some extent in the States.

Mr. Bell next goes on to treat of the different ores of America, and to compare them with the corresponding ores of this country. Without following him through the details, it may be sufficient to quote his conclusions. Taking all the ore raised in Great Britain, he estimates its average per-centage of iron at a trifle under 35 per cent. Similarly the produce of the United States is almost 56 per cent "which means that for each ton of iron made there are 20 cwts. less ore to be dealt with by the American ironmaster than by ourselves." As regards freedom from deleterious ingredients, a most important consideration now that the Bessemer processs is so largly used, the American ore is much superior. Less than 12½ per cent. of the total quantity of ore raised in Great Britain is good enough to make Bessemer steel, but almost a third of the American iron can be thus employed.

The skill in extracting the raw material seems about the same here as in America, and "the machinery generally employed on the American mining establishments will compare favourably with those I have visited in any part of Europe." As regards conveyance of raw materials to the point of production, and of the iron thence to the point where it is to be used, England occupies a tolerably favourable position so far as the sea-board of America is concerned, but the further westward the iron is carried the less favourably of course are our coal-producing districts situated for competition with those of the country itself.

Passing from the raw materials, Mr. Bell now treats of the manufacturing processes. As regards smelting, he found American ironmasters as fully alive as our own to the importance of the application of chemical science to the originally rude and empirical processes by which the metal was obtained from the ore. In the actual process one noticeable feature was the amount of anthracite used, and the successful nature of the special operations applied to overcome the difficulties attendant on it. Another fact noted was that the recent great increase in the size of English blast furnaces hardly seems yet to have been imitated in America. Mechanical puddling has not yet advanced further in the States than in this country, for only one of Danks' furnaces is now running regularly. In the subsequent processes of manufacture there seems to have been little to remark. The novel process of "cold rolling" here first came under Mr. Bell's notice. In this, bar iron is passed cold through rolls about a dozen times, the reduction being an eighth of an inch in a bar two inches thick. "The iron comes out with a surface so bright and clean as to serve, without further preparation, for shafting, or even for piston rods; and not only its hardness, but also its tenacity, is said to be materially increased." Several improvements in the Bessemer process have been introduced by American iron makers, but the simple experiment of running the pig direct into the converter does not seem to have been adopted anywhere in America. As much as 60,000 tons are made in forges of the primitive Catalan type; the Siemens-Martin process is used to the extent of 4,500 tons; while the annual make of crucible and other steel equals 108,250 tons.

At the conclusion of his report, Mr. Bell again recurs to the consideration of the causes of the depression of the iron trade, both in this country and in the States. He also refers to the idea that the natural advantages of the States will enable them to compete with us, and with the rest of Europe, in the markets of the world, and points out the inconsistency of such hopes with the existence of a protective tariff. His own opinion is that unmanufactured American iron will never be an article of purchase in any part of Europe, much less in Great Britain.

Summing up his observations, he gives us his conclusions, as follows:—

"1st. That the powers of iron production between the years 1870 and 1875 were increased in the United States far beyond any possible requirements of the country.

"2nd. That the high prices which led to this, permitted and induced the manufacturers to accede to demands from certain sections of the workmen which are now acting adversely to the true interests of the trade.

"3rd. That the same causes, re-acting on the value of the raw materials, along with the increased value of labour, as above stated, have unduly added to the cost of iron.

"4th. That the interference with the laws which regulate the price of commodities has, in the case of anthracite coal, added to the difficulties of the iron smelters; and the sudden demand made on mines incapable of meeting it has increased those difficulties by an unhealthy addition to the selling price of iron ore.

"5th. That the protective duties levied on foreign iron entering the United States, by raising the price there, are chargeable with a portion of the mischief.

"6th. That the natural resources of the United States of America are such as to render any protective tariff on iron unnecessary, which tariff, moreover, is an injustice to other branches of industry."

PRESERVING VEGETABLES GREEN.

Two French chemists, MM. A. Guillemare and F. Lecourt, have made a communication to the Paris Academy of Sciences which, besides having great importance from a sanitary point of view, is peculiarly interesting as a scientific application. It is well known that, in consequence of the change of colour caused by the application of heat, sulphate of copper is added to give conserved vegetables and fruits a bright green colour, and it is quite unnecessary to dilate on the danger of such a practice. But the brilliant green appearance is so attractive to the uninformed that some means of retaining it is a commercial desideratum. MM. Guillemare and Lecourt propose the substitution of chlorophyl, the natural colouring substance of leaves, &c., for salts of copper, and they have communicated the results of their experiments during four years to the Academy.

The chlorophyl continuing in a vegetable disappears by boiling all the more rapidly and completely in proportion to its small amount; but vegetables at a heat of about 100° C., brought into contact with soluble chlorophyl, become saturated with it, and when thus saturated, or only half saturated, they retain their colour during cooking.

Those facts having been brought out by experiment, MM. Guillemare and Lecourt proceeded to act upon spinach and other leaves by means of a lye of caustic soda; the liquor thus obtained, treated with common alum, gave a lake of chlorophyl, which was carefully washed to clear it of all traces of sulphate of soda. To render this lake soluble, akaline phosphate and earthy alkalis were used. Thus a soluble compound was obtained of a rather unstable character, containing chlorophyl, alumina, and phosphate of soda. This liquor was added to the water in which the vegetables to be conserved were boiled, when the chlorophyl was taken up by the vegetables more or less completely, according to the duration of the action. The vegetables were then put up in air-tight tins, and cooked in the usual way.

A glass was exhibited, containing peas which had been boiled in pure water as usual, and then raised to 117° C, and kept at that sufficiently long to ensure their preservation; they had lost their chlorophyl. A second was shown, in which were more peas, which had been half saturated with chlorophyl during the boiling, and then cooked in the same way as the preceding; they retained a green colour similar to that given by sulphate of copper. A third glass vessel contained peas which had been completely saturated during boiling, and then cooked in the same way as the others; their colour was more natural than that given by copper, and it was said that they had no taint of astringency in flavour.

The experiments succeeded equally with haricots, cucumbers, plums, &c. The Academy has appointed a commission to inquire into the subject by means of a series of experiments conducted on a large, practical scale.

THE MANUFACTURE OF GONGS.

The effect of hammering renders Chinese gongs extremely brittle, a sharp, sudden blow causing them to fly to pieces like glass. The Chinese, therefore, use them with great care near the outer edge, tapping them gently with a padded stick, and cause the vibrations to increase very gradually until their full sound is evolved. When by accident they are broken, the pieces are collected with great care for the fabrication of new gongs. These pieces are heated to a dull red, and when cooled are easily broken into fragments. The best of these are selected, and, being mixed with the metal scraped off the gongs in the manufacture, are melted in common crucibles like those used in England, each crucible containing 7 lbs. or 8 lbs. of the metal, in a special furnace which holds two crucibles. The fuel used is a kind of short-flamed coal, something like anthracite in appearance. The combustion is conducted with much care, the coal being placed around the crucibles by means of large tongs through a circular aperture in the furnace; and the heat is maintained by means of a simple blower, which consists of a long rectangular box with a wooden piston and clappers.

When the contents of a crucible are melted, the latter is taken from the furnace and weighed, and as soon as it is emptied it is refilled and replaced in the furnace. The temperature is very high, and it is in the upper part of the furnace that the broken metal is heated to redness, as already stated.

When melted, the metal is well stirred in the crucible before being turned out, the oxide and scum being at the same time carefully removed from the surface. It is then poured out into a mould, which consists of a disc of iron lying on a stone slab, and on which is placed a rim of clay to form the edge of the mould. The whole is then greased with oil obtained from oleaginous peas and sprinkled with fine sand; a conical cover of burnt clay is placed on the moist clay ring, and an orifice at the top of the cone is fitted with a funnel, through which the molten metal is poured. The object of all this arrangement is double; it prevents the metal cooling too rapidly in the mould, and it protects the workmen from the spitting of the metal. When the metal is set, but still red, the cover and the clay are removed, and the cake, which is less than half an inch thick, is well scrubbed with a sort of wooden brush on both sides to remove all impurities.

The first hammering is performed while the gong metal is still red, on a piece of cast iron about 6 in. high and 10 in. to 12 in. in diameter, and mounted on a block of wood. The disc is then beaten with a hammer which has a spherical head, and which, having a long and flexible bamboo handle, allows the workman to strike a hard but not dead blow. Two men are employed in this operation, one wielding the hammer and the other turning the metal disc in such a manner that it is gradually rendered concave. When this first hammering is finished, a disc of 14 in. diameter is raised to 2½ in. to 3 in.; the piece is then carried into another shop, where there is a furnace about 4 ft. in diameter, heated with charcoal, and furnished, like the former, with a blowing-box. A skilled workman, who is seated by the furnace, removes the disc from the latter at the critical moment to an anvil close at hand, and guides it while it is being hammered. On one side is a cistern of cold water, level with the floor of the shop, and on the other is a simple machine on which the disc is clipped round the edge by a cold chisel. While being heated, the workman turns the partly-formed gong round and round and over and over on the mass of incandescent charcoal, so that the metal may be heated thoroughly throughout; and when on the anvil—which, like the former, is a mass of cast iron—it is directed by the chief workman and beaten by five men with hammers and long handles. A peculiarity in the arrangement is that three of the men hammer continually in regular rotation, while the other two wield larger hammers, but beat in unison with the rest. The ability and precision which these men show with their heavy hammers is said to be marvellous. The chief workman stops the operation when the sound of the metal tells him when it is getting cool, places it again in the furnace, and, when sufficiently heated, it is hammered a second time in the same manner. When this is done the gong is nearly of the proper form, and five or six in the same stage of fabrication are then heated together, and aftewards hammered together on the anvil. While this is being performed, all the five strikers aim at the same spot, the fireman turning and directing the work. By this system all the gongs are brought to the same shape and thickness one with the other. But the hammering is continued even after this, the two strikers exchanging their heavy hammers for wooden mallets with flat faces; this hammering is continued for a long time—three-quarters of an hour, says M. Champion, for gongs only 20 in. in diameter. Finally, the gongs are separated, and each one again hammered alone—principally, it would appear, in order to make any corrections in form—and the edges are carefully pared with a cold chisel. At this stage the gongs are very brittle, clippings being easily broken between the fingers; they are, therefore, heated to dull redness, and plunged for a few seconds in cold water, which is said not to contain any added substances to aid in the tempering.

The gongs are then taken into another shop, where they are scrubbed with a woollen rag and salt water; the water in evaporating leaves a small amount of salt on the metal, and the gong in this condition is again placed in the furnace, turned about in every direction, and again hammered. When the central portion of the gong is finished, the edges alone are heated, in order that any faults may be corrected. During these last operations, in order that the action of the fire may be more regular, and that no heat may be lost unnecessarily, a large sheet-iron cover, suspended to a bamboo handle, is held over the gong while in the fire, and is lifted from time to time to allow the firemen to see and turn the work.

Still the work is not yet completed: the edge of the gong has to be turned up to the proper angle, which operation is described as requiring the greatest ability in the workmen, for a single false blow would cause the metal to crack. The gong is now heated to redness for the last time, and thrown into cold water, where it is left for two or three minutes, when it is taken out and briskly rubbed with a wooden mallet to remove any oxide or foreign matter that may adhere to the surface. The final correction of the edge of the gong is affected by a workman who sits on the ground, and who uses two hammers with short handles, one to strike with and the other as an anvil. When he has completed his work, another man takes the gong, places it on an anvil about eight in. square in the face, and with a round-faced hammer, weighing about 1lb., with a short handle, passes over the surface, systematically commencing at the centre and proceeding by concentric rings to the outer edge. Sometimes, however, the blows are given in the direction of the radii, but the reason of this is not explained. The blows are vigorous, but the wrist of the workmen must be elastic, as it were, so that the shock shall not last too long; but, with all possible care, the work sometimes fails at this point, and should a crack occur, which the workman knows immediately by the sound, the piece is thrown with the waste metal. The traces of this last series of blows are generally apparent in the finished gongs, although before leaving the factory they are scraped with steel tools, either entirely or partially, the scraping being always effected from the centre to the circle indicated.

The composition of these gongs has been found by the analysis of many specimens to be as follows:—

Copper	82·00	parts.
Tin	17·00	„
Iron	1·00	„
Nickel....................	traces.	„

The last-named metal can only be discovered by operating upon several grammes of the alloy.

In the manufactory inspected, the men were, on account of the excessive heat, working only during the night. They were paid fixed sums, and were bound to produce a certain number of gongs; the foreman who had the complete direction of the work received one piastre (about 4s. 6d.) per day, and the workman half that sum. The whole of them worked all but naked.

At Pekin and other places in the north of China, gongs may sometimes be seen a yard and even more in diameter; but these are rarely seen in the shops; they are said to be made in Cochin-China. A remarkably fine example was shown in the Japanese section of the Paris Exhibition of 1867; it was suspended, as usual, by means of silk-covered cords, and was struck by means of a piece of wood weighing probably 20 lb., which was also suspended with one end opposite the centre of the gong. The sound of this instrument was superb. The resonance of gongs varies materially, and the Chinese class their tones as male or female; those which have been subjected to the most careful and prolonged hammering produce the male tones.

M. Champion remarks that the Chinese gong-makers have a careless and apathetic air, but the skill, sureness of hand, and vigour which they exhibit in effecting the above long and tedious operations are surprising; their activity and energy is such that it is questionable whether any European workman could conduct such an operation successfully in the same time. The most celebrated place for the production of gongs is Su-tchou, a town remarkable for many manufactures. The work is not carried on during the hottest months, on account of its laborious nature. The tam-tam is a necessary instrument at all marriages, funerals, public and religious fêtes, in short, in all ceremonies, and even on the occasion of visits of the superior mandarins; the demand for them is consequently enormous, and their production gives employment to a large number of men.—"*Metal Work*," by G. W. Yapp.

A METHOD OF TEACHING DRAWING.

The *Moniteur des Arts* of Paris has the following article on the important subject of the teaching of drawing. Introducing to its readers a work on the subject, it says:—

"The name of the author is already familiar to artists and to the public which occupies itself with art, it is M. Horace Lecoq de Boisbaudran, formerly director of the Normal school. *

"This method seems to us to be particularly distinguished by the attraction which it offers to pupils, and for the attachment with which it must of necessity inspire them for the object of their studies. To teach is not sufficient, a taste for work must be created if any best fruits are to be culled. A wise gradation of exercises, a judicious employment of the faculties, great liberty in the choice of subjects and processes, form so many conditions of success; such, moreover, is the fundamental basis of the system which experience has consecrated, but of which the efficacy is not yet apparently recognised by overybody.

"M. Lecoq de Boisbaudran has thrown his work into the form of letters addressed to a young professor, and in five letters the author explains his method with perfect cleverness, and all in a hundred pages without dryness or without omissions. The *brochure* takes up the pupil at the moment of his first handling a pencil, and leads him up to high art, without painful efforts, by the logical development of his faculties. From the outset the lessons inculcate the art of seeing correctly, judgment of distances, order and progression in the work. These results being obtained, the second period may be entered upon in which the difficulties have to be surmounted of studying models in relief, which enlightens the young draughtsman, and makes him understand not only the forms, but the play of light and shadow. M. de Boisbaudran recommends the alternate employment of drawn or engraved with relief models, and the taking up at once the human figure, which combines all difficulties, and after which all other subjects become easy.

"At this phase of instruction, the first germs of artistic sentiment begin to appear, and the third stage may be approached. Here the pupil commences his study of the round, commencing with parts of heads moulded separately, and proceeding gradually to the whole head, and finally to the entire figure. Above everything the models must be correct and uniform; and the professor can only assure this by the employment of tact and patience, for every one knows how very rare are well designed models. The author now introduces one of the most interesting exercises of his system, namely, drawing from memory, which, proceeding gradually from the simplest to compound forms, constitutes excellent practice both for the intellect and the hand of the pupil. Commencing with the profile of a nose in outline, the student finishes at last with the interior of a museum of sculpture. We have seen studies of this kind executed under the severe control of the Academy of Beaux Arts (Paris), where no deception could possibly be introduced, and it would be difficult to imagine anything more interesting. But we have not yet arrived at this last position; in this third stage tact and experience are of extreme importance, for the lessons must be varied, and graduated to suit the ability and the taste of the pupil; but the exercise of the memory must not be allowed in any way to interfere with the ordinary studies.

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* Lettres à un jeune professeur. Soumaire d'une méthode pour l'enseignement du dessin et de la peinture. Paris, A. Morel and Co.

"The fourth degree is reached when the pupil has overcome the first difficulties of his art; this period therefore comprises the study of the antique and of the old masters, and of the living model, anatomy, perspective, architectural drawing, painting, the exercise of memory, and, finally, composition. The mission of the professor develops and becomes elevated as the instruction progresses, for his duty is at once to inculcate taste for the works of the masters, and yet to protect the individuality of each of his pupils. M. Lecoq de Boisbaudran insists, and with reason, 'that no unvarying mode of working shall be imposed on a pupil, but that all shall be encouraged to try several modes in order that they may judge, choose, and make for themselves in painting, a mode of expression appropriate to their turn of mind.'

"The fifth stage supposes the pupil practised in all the exercises of the calling, and attracted towards high art; it is that of superior instruction, which includes anatomy and perspective, no longer studied on paper but from nature, and where many models allow of complicated exercises; then the professor may ask of the young painter graphic *comptes rendus*, so to speak, of what he has observed in his works or during an excursion—a new and valuable occasion of exercising the memory and the pencil.

"In an appendix, amidst other interesting notes, M. Lecoq de Boisbaudran sums up in the following terms the duties of those who teach:—'The true professor must exclude any fixed idea from his judgment. Instead of appearing to be attached exclusively to any one particular conception of art, he must learn to appreciate all those which have already appeared, and gather together for the benefit of his pupils any new impressions that may arise; above all, he must never propose his own works as examples, for the more completely impersonal he appears, the more will he preserve to all of his pupils their own personality.'

"It must be understood then that the functions of a professor call for abnegation, devotion, learning, elevation of ideas, and finally, that he should be esteemed as he merits to be. This is one of the indispensable means of regenerating instruction, and consequently art itself."

The average annual value of musical instruments made in Paris during the last six years has been 23,000,000fr., divided among 360 makers, employing no fewer than 5,000 workmen. Paris turns out every year 1,320,000 francs' worth of accordions. Pianos figure for 11,400,000fr.; organs for nearly 5,500,000fr.; wind, wood, and metal instruments for nearly 4,000,000fr.; but bowed instruments for less than 500,000fr.

THE BENEFIT OF A PATENT-LAW.

Although the opposition to the Patent-laws has considerably abated of late, there is still a somewhat numerous party in favour of a policy of repression. It is the avowed object of these persons to make the granting of patents more difficult than it is at present. Ostensibly, they are acting in the interest of inventors themselves, but the advantages of their proposals are in many cases, at least, open to considerable doubt. Until the last month or two, Germany enjoyed the distinction of possessing perhaps the most harsh and grudging Patent-law which ever existed. That defect has now been remedied in a great measure by the new law which lately came into operation, but the effects upon German industry of the long-continued existence of an illiberal system has probably been much greater than is generally supposed. Professor Reuleaux speaks in no uncertain manner on the question, and in his preface to his *Theoretische Kinematik* he says:—

"In the majority of cases there is a wide distance between tho theoretical mechanism and the practical machine, and I consider it a duty to support the claims of the inventor in this respect. For this reason I am personally an advocate for patents, and I have thought it desirable to express this view here, lest I should be accused of holding the opposite view in consequence of my chapter on the synthesis of machines. The patent question is, in my opinion, an eminently practical one. As the grant by the State of favourable concessions for the constructions of railways, for instance, calls forth the necessary capital, there should, in my opinion, be also legislative protection for inventions—not, however, of very excessive duration—so as to put within the reach of the new invention the capital always necessary for carrying into practice. In Germany capital avoids invention, but in foreign countries which enjoy a good Patent-law it is readily placed at the inventor's command. It is for this reason that we have, unfortunately, to chronicle but a very small 'intensive' progress in the construction of machinery, although Germany turns out a larger number of trained workmen than any other country. It is this which has led to the preponderating imports of new machines from abroad, just as fashions are imported. Hence arises the circumstance that to carry out an invention to a practical issue demands with us a degree of courage bordering on commercial insanity. To this we owe the system of trade secrets wherever a manufacturer has been bold enough to undertake such an enterprise. It is this which causes the degenerative imitation of good inventions to flourish—one of the most dangerous weeds of industry—which not only injures the public, but destroys the credit of the really good invention. It is thus that we are, as a matter of fact, deprived of many good contrivances, the foreign inventor receiving no encouragement to carry out his invention in this country. That particular school of political economists who have been for the last half century successfully endeavouring to do away with the Patent-laws altogether, and with the scanty remains left—by which, indeed, they honestly thought to benefit trade—must now admit that they are at the end of their tether, as the experiment has not had the expected result. It is to be hoped that the enlightened guardians of the industrial code will not shut their eyes to this conviction. A thousand eyes are awaiting the issue."

The passage does not appear in the recently-published English translation of Reuleaux's book, though why it should have been omitted is not clear. It is known that Professor Reuleaux's strictures on the German exhibits at Philadelphia were not well received, and that his claims to be regarded as an authority on industrial questions are by no means universally admitted by his countrymen. The severe criticisms of the "Philadelphia Letters" have, however, hurt the national pride, and "friends at a distance" are perhaps better able to form a correct judgment as to the injurious influence of the German Patent-law on German industry.

EDUCATION IN SYRIA.

The superiority of the Christians, whether of the plains or of the hill country, is as conspicuous in Syria as in other parts of Turkey, both in respect to general intelligence as to matters of comfort, and to comparative prosperity. The causes of this difference can hardly be ascribed to accident of race, as in those provinces of Turkey proper inhabited by divers nationalities, each of distinct origin and characteristic, such as the Turk, Greek, Armenian, Bulgarian, &c., inasmuch as the present inhabitants of Syria may be almost said to spring from one common stock; they must, therefore, be sought elsewhere, and among the influences which have been at work to bring about this prosperity, education among the Christian, and the almost entire lack of it among the non-Christian sects are not the least.

Vice-Consul Jago has devoted a considerable amount of attention and research to this subject. He states that the facilities for education which present themselves to the Syrian Christian are far greater than those which are within the reach of their less fortunate fellow countrymen of a different religion, who may be said to possess, rarely, if ever, the means of acquiring any attainments beyond those of mere reading and writing, and that too of a very imperfect kind. Their ignorance of anything, apart from the narrow limits of the little world in which they are born and bred, prevents them from endeavouring to better their condition by seeking out other modes of livelihood, even if the same sources of employment were open to them as to the Christian, which is, however, far from being the case. Their facilities, however, are not of long duration. Fifty years ago, the condition of Christian education in Syria was of the same meagre description as that which now characterises the Moslem. Reading and writing, and sometimes a little arithmetic, were all the instruction the country possessed the means of affording, and even these attainments, for want of properly qualified teachers, were elementary and imperfect. The Maronite, and later the Jesuit, Lazarist, and Franciscan convents in the country, chiefly in Mount Lebanon, had schools for the education of a few boys for the clerical profession, where, in addition to religious duties, grammar, logic, and philosophy were taught. The few secular schools of the towns were not worthy of the name; and thus the means of intellectual enlightment were totally wanting. Female education did not exist in any sense of the word; sewing and embroidery were alone considered necessary. Books in the Arabic vernacular, of an educational, medical, or scientific character, were confined to the few works which, translated from the French and English, under the auspices of Mehemet Ali Pasha of Egypt, found their way into the country. All this is now, however, changed through the efforts in the cause of education made by the numerous foreign missions which private benevolence has established in the country, such as the American, English, French, &c.

The number of educational establishments, both foreign and native, is now yearly on the increase. Greater development is given to those already in existence, while many other new institutions of the same character are being added. At the present time, the Maronite community of Beyrout is building a large college to contain some hundred students; and the Jesuits, whose local numbers have considerably augmented, are constructing a large college and seminary, in addition to their other scholastic establishment. It will, therefore, be apparent that by the efforts of so many, education even in its higher branches is within easy reach of most of the Syrian Christian youths; and thanks to the numerous establishments throughout the country, at small cost. Indeed, these institutions may be said to vie with each other for the privilege of educating the children of Syria, so much so that large numbers receive either a gratuitous education, or at merely a nominal fee.

Apart from Beyrout and Mount Lebanon, which are, so to say, the focus of education in Syria, where foreign and native scholastic institutions are almost in excess of the requirements of the population, and which are, moreover, availed of by residents in all parts of the country, not a town of any importance, possessing to any extent a Christian element, but has besides its native primary schools, others supported and conducted by the missionary societies of Europe and by American and other agents, and the success which attends the effects of directors and teachers in the cause of education is largely supplemented by the recognition by all classes of the Christian population of the necessity of imparting to their children a better education than they themselves had the means of obtaining, such as is now freely offered to them on all sides. Thus, the lower classes of people have ample facilities within their power of obtaining gratuitously an elemenmentary education, while the higher class schools afford to the better classes, at an almost nominal cost, tuition of a better description. Opportunity is also offered to native talent of getting at a most moderate outlay a thorough literary, scientific, and professional education at the hands of the foreign professors. The curriculum of the American College, for instance, embraces a period of four years, and the studies are the Arabic language and literature, mathematics, the natural sciences, modern languages, Turkish law and jurisprudence, and medicine. The sects represented are the Protestant, Orthodox Greek, Greek Catholic, Latin, Maronite, Druze, and Armenian. No doubt much of the instruction imparted partakes of a somewhat superficial character, but this is hardly surprising in view of the fact that the present generation alone has had the means of getting any educa- at all. The instruction of the people may be said to be only just begun, and time must be given before its full benefits can accrue.

To the Syrian Moslem the same facilities do not exist as to the Christian, owing to lack of properly directed and well-sustained efforts on the part of the Government, and to the apathy and discouragement of those immediately concerned. Private benevolence or patriotism have not, so far, stepped in to aid in any degree, and thus the attainments necessary to enable the Moslem youth to compete successfully, or even to hold his own, with his better educated Christian fellow-countrymen in matters of trade and commerce, are neglected. Although belonging to the favoured class, he is distanced by the superior intelligence and greater knowledge possessed by the latter in those few channels of employment which the country possesses, and which are already overcrowded, and he is thus practically unable to profit by or take part in those commercial, industrial, and financial undertakings which foreign enterprise is slowly importing into the land. Thus, while the intellect and energy of the small Christian population of Syria are being strenuously cultivated and rendered capable of one day profiting by circumstances which may permit the development of the country, the intellectual progress of the Moslems is, on the other hand, being entirely neglected and stultified, and the power thereby withheld of participating on equal terms in any advantages which time may have in store.

In the last six months, compared with the like period in the previous year, there was a large increase in the importations of wheat from Russia. The declared value in 1876 in the period mentioned was £1,725,002, and this year £2,613,122.

There was an increase in printed books exported in the last six months on the same period in 1876. The value was £401,124, against £394,274 last year.

NATIONAL TRAINING SCHOOL FOR COOKERY.

The fourth annual meeting of this institution was held on Monday, the 2nd July, at the school in Exhibition-road, South Kensington. The chair was taken by the **Duke of Westminster, K.G.**, the president of the school.

The **Chairman**, in opening the meeting, observed that he had already presided at a meeting in aid of the establishment of a coffee and cocoa club, and at another for setting up drinking fountains, and he thought that improved cookery among the working class would equally assist in the suppression of the vice of drunkenness; if wholesome and better prepared meals were provided for the working man, there would be less frequent visits to the public-house to wash away the indigestion and dyspepsia produced by ill-cooked and unwholesome food. With reference to the report of the Executive Committee for the year ending 31st March last, it would be found that there had been a falling off in the public support as far as donations and subscriptions were concerned, but this was not viewed very seriously, as in every other respect the prospects of the school were satisfactory. Their landlords, Her Majesty's Commissioners for the Exhibition of 1851, had advanced them £500 without interest, and with this sum all the liabilities of the school had been paid off, leaving a balance at the bankers, and the school might now be considered nearly self-supporting, as it was originally intended to be. If the Government would insist on a more practical form of cookery examination, and would divide the grant of 4s. per scholar now made to elementary schools under the head of domestic economy, giving 2s. to food and its preparation, and 2s. to clothing and materials, it would greatly encourage the study of cookery.

The report of the Executive Committee for the past year was then read by the Secretary.

The Hon. E. F. Leveson Gower, M.P., Chairman of the Executive Committee, moved the adoption of the report. He considered instruction in cookery a necessity in all middle class and Board schools. Alluding to the great increase that had taken place in the number of schools of cookery that had been established throughout the country, he urged that it would be better if localities requiring teachers would apply direct to South Kensington, instead of engaging teachers without inquiry as to their capabilities, as instances have occurred where towns had employed teachers not recommended by the school, and the teachers not giving satisfaction the school at South Kensington had been held responsible. Apart from the decrease in the amount of donations and subscriptions, he considered the school progressing very satisfactorily. During the year ending 31st March, 2,444 pupils had passed through the school. Thirty-four of this number had taken teachers' diplomas, and there were 37 students in training as teachers of cookery. The large attendance at the local classes that had been opened under the lady superintendent, in London and the suburbs, showed the great want of instruction by the public, and their readiness to avail themselves of it. With regard to the diminution in the amount of the subscriptions and donations, it was not so much money that was asked for as assistance, in persuading educated persons to take up the subject as a profession, so that, after proper training, they might, by spreading the knowledge they had received, promote the general welfare. He invited attention to the report of the lady superintendent, Mrs. Charles Clarke, whom, on behalf of the committee, he begged to thank for her valuable services.

Sir Daniel Cooper, Bart., in seconding the resolution, said that the figures had been so well handled, that, as treasurer, he had little left him to say. He was of opinion that the decrease in the subscriptions was not a subject for great regret, as it showed how self-supporting the school had practically become. The Society of Arts had again this year given five free teacherships in the school, which were competed for shortly before Easter, and the Cooks' Company had also sent 12 children from their ward schools to receive practice lessons in artisan cookery. It was hoped that the Government would render assistance to the movement, by the division of the grant in the manner suggested.

The **Chairman** having invited remarks,

Mr. G. Godwin, F.R.S., spoke as to the disadvantages of the school not being sufficiently known, and suggested it being more widely advertised. He also thought that there was not quite the accommodation for ladies attending the classes that was desirable.

Sir Henry Cole, K.C.B., rose to propose a vote of thanks to the President. With reference to the want of accomodation, he was quite sensible of the need for more commodious premises, and he hoped they would soon be able to obtain a grant from Government for the erection of a suitable school. In his opinion the instruction of living persons in such an important subject as cookery was quite as deserving a suitable building as the housing of stuffed tigers and lions, and he hoped the subject would soon engage the attention of Government. Though he had latterly been engrossed in other matters he had not lost sight of the School of Cookery, and at the approaching Conference on Domestic Economy at Birmingham cookery took a prominent part as a matter for discussion.

Sir Harcourt Johnstone proposed that Sir Charles Reed and Dr. Gladstone be invited to join the Executive Committee of the school, which **Mr. Macgregor** seconded, and the meeting terminated with a vote of thanks to the Chairman of the Executive Committee, and an assurance of support in his endeavour to bring the question of Government aid to the school before the House of Commons.

INDUSTRIES OF DAMASCUS.

Under more favourable circumstances than exist at the present time, Damascus offers the greatest advantages for the development of trade. Its situation at a short distance from the sea and from Beyrout, one of the most important seaports in the Turkish dominions, and its connection with Bagdad, Aleppo, and Jerusalem by means of constant caravans, make it a favourable centre for the distribution in the interior of European goods and manufactures. Encouragement in the importation of goods is only needed, and the demand will not be wanting. British manufactures, such as linen and other goods, cloths, and hardware, are highly prized, and are sought after with greater eagerness than similar manufactures of other countries. However, it is a regrettable fact that of late years English goods have rather diminished than increased in quantity in the market, and many other articles from Germany and other countries have taken their place. Although English articles of commerce are generally dearer, on account of their better quality, and at first may not meet with a ready sale, yet a little persistence in keeping them in the market is only required, and as soon as their superiority over other articles is discovered, the demand for them will be constant and increasing.

Vice-Consul Dickson states that, in consequence of the removal of the Custom-house to Beyrout, it is impossible to obtain anything like a correct statement of the amount of imports and exports of Damascus; but the chief articles that have been imported are calicoes and cotton stuffs. As regards exports, the principal articles have been wool, kid-skins, and lamb-skins. There are about 500 silk looms at work in Damascus. In 1875, about 45,000 pieces of silk were woven, while in the previous year there were 75,000, there having been a large falling off. For the working of cotton and silk stuffs mixed there are 12,000 looms, and, in 1875, 100,000 pieces were produced against 300,000 for the previous year. Keffiehs (a sort of covering for the head, made of silk or a mixture of silk and cotton) to the amount of 8,000 were manufactured in 1875, and there are about fifty machines for weaving them. It will thus be observed that silks and mixed stuffs form the principal articles of manufacture in Damascus.

The calling out of the redifs, or reserve forces, has caused a great lull in business, as many persons who were carrying on a brisk trade have been obliged to attend the military call. The agricultural prospects of the land are, however, good, and the mildness of the winter had enabled the peasants to pay more attention to farming, and to look forward to favourable crops. The Hauran, which is the granary of Damascus, offers every advantage to the cultivator of the soil for reaping a large and speedy profit from the productions of the earth, in consequence of the richness and fertility of the ground, and the abundance of rain which annually falls there. The means of transport, however, of grain to Damascus, is of the most difficult kind, on account of the very bad and insecure state of the road, and the plundering habits of the Arabs in the vicinity. The poor peasant who wishes to bring a kilo of wheat to Damascus or Acre for sale, is obliged to give the half to the person who consents to carry it for him, to pay the tithe and other expenses to the Government, and is lucky if he escapes pillage by the Bedouins of the desert, and brings what is left into the market. The enormous fertility of the soil alone makes it possible for a farmer in the Hauran to reap any profit from his labours. Grain, especially wheat, in a good season, is considered to yield nearly a hundred times the amount sown, and a dependence on this very great increase, or an approximation to it, is what raises the hopes of the peasant and induces him to till the ground, and which also enables the supply sufficiently to compensate for the demands of the inhabitants. Good communication between different parts of Syria is largely called for, but there are especially needed three good roads, one from the Hauran to Damascus, another from Hauran to Acre, and the third from Hamah to Tripoli.

CORRESPONDENCE.

THE NEW SODA PROCESS.

I have waited for Mr. Weldon to show where I had stated that 11·9 per cent. of the total caustic soda produced was left in the lime mud; and by his not replying, I conclude that he admits his error and that 11·9 per cent. is not so lost. I now reply to Mr. Mactear's letter in the *Journal* of date June 1st.

Mr. Mactear has mistaken my intentions if he thinks that I intended to depreciate his process, or that I undervalue it. Allow me to state that I think most highly of his improvements, and he will see that I stated to my hearers that the process was a very good one, enabling a large quantity to be turned out per furnace, and I have, likewise, on several occasions reported favourably to my clients when consulted with regard to it. Admitting the foregoing, I must now explain why I uttered the remarks which Mr. Mactear is anxious to modify.

In the first place, Mr. Mactear's process and mine are both new processes, and the majority of alkali makers use the old or Le Blanc's method. Now I hold that in drawing a comparison it is obviously unfair to quote the minority, and as I naturally think my process so much superior to Mr. Mactear's, in that it produces no noxious waste, while Mr. Mactear's produces one more concentrated in its vileness than that at present produced by the old method, I naturally objected to the comparison because I deemed it unfair, and will reply to Mr. Mactear's objections *seriatim.*

On the first count I consider I was correct in saying that the process was not generally used. Mr. Mactear admits that, and as compared with Mr. Weldon's figures, there seems to be 80 per cent. of the alkali still manufactured by the old process, and the modification proposed by Mr. Mactear being totally inapplicable to hand furnaces, this justified me in saying that the process was not generally used.

On the second count, in alluding to the fact "that several manufacturers who had used the process had gone back to the old one." There is a great art in making a statement, and it matters not to me whether the manufacturers I alluded to were licensees or not—it is clear from Mr. Mactear's letter they were not—yet the fact remains as I stated. What I stated to the meeting upon the 10th of May had no bearing upon my trials as Mr. Mactear seems to imagine; I only made three charges which showed me that several alterations were necessary; but in the face of existing contracts I could not see my way to alter my method of working just then. With regard to the licence not being signed, Mr. Mactear knows very well that it was not I with whom he had to deal in that matter, and that so far from anything being done secretly, he had a letter from me, not only telling him what I had done, but giving him analyses of the products.

On the third count I may say that when a workman or a foreman speaks of a black-ash ball being "short of limestone," in reality he means that it contains an abnormal amount of sulphide of sodium. This is what I wished to indicate, and as I was speaking before practical men, I am sure they understood it in that sense.

In order to prove that the process as explained and shown to me by Mr. Mactear produced more sulphides than the old process as I was then working it, I append the following results:—

Samples A and B, liquor from vats given me by Mr. Mactear.

Samples C and D, liquor made under my superintendence by the old process and from Hargreaves saltcakes:—

	A.	B.	C.	D.
Total alkali	100·0	100·0	100·0	100·0
Caustic alkali............	22·8	25·5	25·5	23·6
Chloride of sodium	7·5	8·9	13·0	11·7
Sulphide ditto.	4·0	3·2	1·9	1·8
Sulphate ditto.	3·7	3·4	1·5	2·4
Total sulphate of sodium after oxidation	14·9	14·5	9·8	9·7

In the face of these analyses I cannot understand Mr. Mactear's statement, that a better decomposition is obtained than by the old process. I grant him that more work is turned out from a given furnace; there should be, or what advantage would be derived by burning good house coal in the revolver fires, in the place of dross or slack, which the followers of the old process generally employ.

There is no doubt, also, that more weight of soda-ash is also turned out per 100 of sulphate of soda used, for has not Scheurer Kestner long since proved that the more soda is obtained, the less limestone is used in the black-ash mixing.

With regard to the question of less waste, I regard this as of very small importance to the public. The manufacturer is benefitted by having less refuse to cart away, but the waste is a still more concentrated sulphide of calcium than waste by the old process; and, from given weights, Mr. Mactear's residue will give off more sulphuretted hydrogen on treatment with acids.

George E. Davis.

Barton-arcade, Manchester, July 7th, 1877.

HEALTH AND SEWAGE OF TOWNS.

In perusing the reports on the Conference on Health and Sewage of Towns, I found charcoal mentioned not only as a deodorant, but as a powerful disinfectant also. With regard to this opinion, which has been brought forward in Holland also, I take the liberty to bring before the Society some experiments made by Dr. Hoogewerff and Dr. Dupont, of Rotterdam, with the object of ascertaining in how far charcoal, prepared from various substances, would prevent urine from putrefaction. The results arrived at are shown in the annexed table, in which "infected urine" means fresh urine, with one or two drops of stale urine added to it.

	Microzoa begin to develop after hours in		Alkaline reaction after hours in		Average Temperature in degrees Cent.
	Mixture	Unmixed.	Mixture	Unmixed.	
1. Infected urine with 20 per cent. powdered wood-charcoal	22	18	60	84	23°
2. „ 20 „ „	22	12	54	48	25°
3. „ 20 „ charcoal A	18	18	60	84	23°
4. „ 35 „ „	18	18	48	84	23°
5. „ 50 „ charcoal B	18	18	44	84	23°
6. „ 20 „ „	36	39	32	312	19°
7. „ 35 „ „	36	39	29	312	19°
8. „ 50 „ „	39	39	16	312	19°
9. Non-infected urine with 20 per cent. charcoal B	30	46	24	384	22°
10. „ 35 „ „	33	46	22	384	22°
11. „ 50 „ „	46	46	17	384	22°
12. „ 30 „ „	32	70	24	648	18°
13. „ 30 „ „ A	32	70	24	648	18°
14. Infected urine with 20 per cent. charcoal A from seaweed	144	18	48	84	22°
15. „ 10 „ „ „	48	12	12	48	25°
16. „ 20 „ insoluble portion of seaweed coal	46	12	12	48	25°
17. „ 10 „ „ „	29	16	2	528	15°
18. „ the extract from 20 per cent. coal of seaweed	67	12	98	24	21°
19. „ „ 30 „ „	228	12	156	24	20°
20. „ 6 per cent. chloride of sodium	348	16	360	528	15°
21. „ 6 „ „ and 14 „ charcoal B	144	16	24	528	14·5°
22. „ 20 „ „	16	16	50	528	14·5°

This was done in order to use liquids as similar as possible to those found in public urinals. As the process of decomposition of normal urine varies very much without apparent reason for the observed differences, the urine in every experiment was divided in two parts, one of which received no addition of the materials named in the first column. The observations on both parts are recorded; on the unmixed under that head, and on the admixed part under "Mixture." Charcoal A and B are different samples of charcoal prepared from a mixture of street sweepings and kitchen refuse. This table shows that the alkaline reaction of the urine and its putrefaction, as shown by the presence of bacteria and other microzoa, stand in no relation whatever. It shows, moreover, that charcoal of various descriptions, with the exception of that from seaweed, is of no use as a disinfectant for urine. The result arrived at by the use of the latter charcoal is most probably due to its containing much salt (·24 per cent. chloride of sodium, 1·5 per cent. chloride of potassium in the tested sample). It might perhaps be considered preposterous to consider the results of these experiments on urine as applying to sewage or night soil generally, but I think they must at least warn us from the belief that charcoal is a disinfectant because it takes away bad smells.

I have also procured some information on the manufacture of poudrette at Dordrecht, additional to that produced by Mr. Adam Scott in the Conference. The two first boiling vats are supplied with waste steam from the engine, which drives the air-pumps of the Liernur collecting apparatus. Out of 160 parts of fæcal matter, as collected by the Liernur system, these two vats evaporate 55 parts each, and convert the remainder to the consistence of treacle. This matter shows no signs of putrefaction (no microzoa) after having been exposed for weeks to the ambient air. It might be sold for manure in this state. The third boiling vat—an ordinary vacuum pan—is heated by fresh steam from the boiler, but Messsrs. Liernur and de Bruyn Kops are making arrangements which will enable them to use waste steam for this vat also. It evaporates 25 parts more, and the cylinder 15 parts, whilst 10 parts out of 160 remain as poudrette. In most cases, however, it will be sufficient to reduce the fæcal matter to one-tenth of its original bulk to produce a sealable manure. At Dordrecht, the manufacture of poudrette from the fæcal matter costs 17d. per head and per annum, whilst the collection by Liernur's apparatus costs 19½d. per head and per annum. These figures would probably be higher in an English town, but, even in the supposition that the expense amount to double that of Liernur's system, the latter would prove an economy, as the receipts from the sale of the poudrette are not included in the above calculation. Dr. J. G. Kramers.

Delft, July 3rd, 1877.

MEETINGS FOR THE ENSUING WEEK.

Thur.....Zoological, Society's Gardens, Regent's-park, N.W., 5 p.m. (Davis Lectures.) Prof. Mivart, "Frogs and Toads."

Fri.......Working Men's Club and Institute Union (at the House of the Society of Arts), 3 p.m. Annual Meeting.

Sat.......Working Men's Club and Institute Union (at the House of the Society of Arts), 3 p.m. Conference of Delegates.
Royal Botanic, Inner Circle, Regent's-park, N.W., 3 p.m.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,287. Vol. XXV.

FRIDAY, JULY 20, 1877.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

THE CHEMISTRY OF GAS MANUFACTURE.

By A. Vernon Harcourt, Esq., M.A., F.R.S.,

Lee's Reader in Chemistry at Christ Church, Oxford, and one of the Metropolitan Gas Referees.

Lecture III.—Monday, March 19th.

The substances which we have considered hitherto have been those removed from coal gas in the processes of condensation and purification. Means have been found in the manufacture of coal gas for retaining those substances which are valuable in giving light or heat, and removing those which either diminish the power which the gas has of giving light, or are in other ways injurious. I spoke in my last lecture of the two alternative materials employed for the removal of sulphuretted hydrogen. This diagram represents an iron box with two layers of oxide of iron, through which the gas passes; and either by this material or by lime, sulphuretted hydrogen is wholly removed from the gas. There is another ingredient always present in the crude gas, which is more or less completely removed by purification —namely, carbonic acid.

The table to the right gives the results of some analyses made by Dr. Frankland, of the composition of gas as it is supplied to the consumer. The constituents of the gas are here divided into what are termed illuminating hydrocarbons, of which ethylene or olefiant gas is the principal; marsh gas, and hydrogen, which together form, by volume, much the largest part; carbonic oxide, which comes third in order of quantity; and, besides these, in small proportions, carbonic acid, nitrogen and oxygen. I propose, in my next lecture, to speak of those constituents of coal gas which are the more important for the purposes for which we use it; and, in the present one, to direct your attention to this substance (carbonic acid), and to another substance chemically resembling it, in which the carbon is combined, not with two atoms of oxygen, but with two atoms of sulphur—namely, carbon bisulphide.

I will show you, in the first place, a familiar experiment, to illustrate the formation and properties of carbonic acid. When a piece of charcoal is heated in the air, we all know that it burns, but not very readily; that, in fact, many pieces must be placed together, in order, by the exchange of heat between them, to maintain a sufficient temperature for their combustion with the oxygen of the air. But if I take, instead of air, a bottle of oxygen, and transfer the piece of charcoal, which is still alight, to the oxygen, you see the brilliant combustion which takes place. That combustion consists in the union of the carbon and the oxygen, the two substances which the bottle contains. They combine directly together, forming carbonic acid, or carbon dioxide.

I will allow the carbon to burn, and I will show you the properties of the gas which is formed, using another bottle which has been previously filled with it. Observe, first, the property which carbonic acid has of extinguishing flame. A lighted taper lowered into the bottle is extinguished. This, of course, is a negative property, and shows only that carbonic acid is not air or oxygen, and will not do what air or oxygen will do, namely, combine with the carbon and hydrogen of the taper producing light and heat. Another property of the gas is its high specific gravity as compared with air. If I take this bottle of carbonic acid, and pour it into what we call an empty bottle—that is, a bottle filled with air, we shall, owing to the difference of specific gravity between them, obtain an exchange of their contents. The difference is not like that between water and air; the gas pours rather slowly, but probably I have now effected a transference. The uppermost bottle has lost its carbonic acid, and becomes filled with air, as you see from the way in which the taper burns in it. The lower bottle has been filled with carbonic acid, as you see from the extinction of the taper.

Another property of carbonic acid is the power which it has of uniting with lime. I have here a solution of lime in water. If I take this solution, which is now perfectly clear, so that it looks like pure water, and pour it into the bottle of carbonic acid, and bring it in contact with the gas by shaking the bottle, you see the milkiness which is produced. This illustrates a chemical change which occurs in the manufacture of coal gas. It is on the affinity between carbonic acid and lime, manifested by the precipitation of the lime in this experiment, that the purification of coal gas from carbonic acid by the action of lime depends.

The formation of carbonic acid in the manufacture of coal gas is probably due to a very small extent, if at all, to the direct action of the air upon the carbon of the coal. Such action can only happen where the exhaustion—as the pumping of the gas out of the retorts is called—is carried too far, so that the pressure in the retorts is less than the atmospheric pressure. In this case some of the air or furnace gas, from outside, would enter through the pores or cracks in the clay retorts, and become mixed with the gas. The small per-centage of nitrogen which is usually found when coal gas is analysed, and the further fact that the nitrogen is generally accompanied by oxygen, show that this over-exhaustion is not a common occurrence. The main source of carbonic acid, no doubt, is a reaction between the water, which the coal placed in the retorts contains, and the heated carbon. In the manufacture of what is called water-gas—that is, gas produced by the action of steam upon red-hot coke—there are formed three gases, hydrogen, carbonic oxide, and carbonic acid, the proportion between them depending on the temperature at which the coke is maintained. The same reaction happens to some extent in the gas-retort in the manufacture of coal gas. There is always water in the coal, and as the outer part of the charge lying next to the heated sides of the retort becomes red-hot before the water is wholly expelled from the interior of the charge, this same action of steam upon heated coke takes place, and one of the products is carbonic acid.

For the removal of the carbonic acid, purification by lime is perfectly sufficient, if only the lime is applied in sufficient quantity, and renewed sufficiently often. The presence of carbonic acid in the gas is no injury to the consumer, provided the gas supplied is of sufficiently high illuminating power; that is to say, provided the illuminating power of the gas is fixed, it matters nothing to the consumer whether he is supplied with a gas which is somewhat richer, and whose illuminating power is to some extent diminished by the presence of carbonic acid, or with a gas otherwise poorer, but free from carbonic acid. Although this substance is injurious when present in any large proportion in the air, yet no objection to the presence of carbonic acid in coal gas can reasonably be made on this ground, since the quantity of carbonic acid yielded by burning gas is not materially affected by its presence in the unburnt gas. Two of the ingredients of coal gas—marsh gas and carbonic oxide—yield their own volume of carbonic acid when they are burnt; and the olefines yield twice, or more than twice, their volume. On the whole, the volume of carbonic acid discharged into a room where gas is burnt is more than it would be if the gas contained 50 per cent. of carbonic acid, the rest being hydrogen. It has, however, been proved that the presence of carbonic acid in coal gas has a decidedly injurious effect upon its illuminating power; and since the formation of carbonic acid cannot practically be avoided, either it must be removed by some subsequent process, or the proportion of illuminating constituents must be increased by mixing with the ordinary coal a larger proportion of the more costly cannel, or by heating the retorts less strongly, which improves the quality at the expense of the quantity of the gas. Therefore, in the interest of the maker of gas, it is desirable to remove carbonic acid. This is accomplished to some extent during the condensation and washing of the gas, the carbonic acid being removed in combination with ammonia, but at present the only mode which is in general use for effecting this object thoroughly is passing the gas through trays or sieves on which damp slaked lime is placed.

I come next to the substance which I spoke of as being chemically analogous to carbonic acid—carbon bisulphide. I have here a little bottle containing a small quantity of this substance. When pure, it is quite colourless, and of an odour which is not unpleasant, resembling the odour of chloroform. Commonly, it is not pure, and has a slightly yellow colour, and an unpleasant smell. It is very volatile, having a low boiling point and a high vapour-tension at the ordinary temperature. If I pour a few drops of this liquid into a bottle of air, and cause the vapour to displace and diffuse through the air, by shaking the bottle and at intervals raising the stopper, and then pour the heavy gas out of the bottle into this beaker, leaving any liquid there may be still remaining at the bottom of the bottle, and apply a light to the contents of the beaker, you see the inflammation and gradual combustion of the gaseous carbon bisulphide. This experiment shows, in the first place, that the liquid is very volatile, for it has in a few moments formed sufficient gas to have nearly filled the bottle into which it was dropped; in the next place, that it is heavy, for I poured it quickly through the air, from one vessel into another; in the third place, that it is inflammable—it lights and burns readily. But I might have shown you that it is very much more inflammable than most substances—that is to say, that the temperature required for its inflammation is much lower than the temperature required for the inflammation of coal gas, or of most inflammable substances; for if, instead of applying a taper, I had simply heated a glass rod in the lamp, and dipped that into the beaker, I should have succeeded equally well in lighting the carbon bisulphide. Its presence, even in small quantity, when mixed with hydrogen, imparts this property of ready inflammability to the gas; and, just as the vapour of the liquid hydrogen phosphide imparts to hydrogen or other inflammable gas the property of what we term "spontaneous" inflammability—that is, inflammability at the ordinary temperature—so the vapour of carbon bisulphide communicates the property of inflaming at a temperature above the ordinary temperature, but very much below that at which hydrogen would otherwise inflame.

You saw that the beaker in which I burnt the gas just now became opaque. This arises from the imperfect combustion which has taken place. The sulphur of the carbon bisulphide was only partially burnt, and so a part of it remains deposited as flowers of sulphur on the sides of the beaker. That part of the sulphur which was burnt, united with the oxygen of the air to form sulphur dioxide, or sulphurous acid. When coal gas, or hydrogen containing the vapour of carbon bisulphide, is burnt in the air, probably in the first instance, the same substance—sulphurous acid—is formed. This oxide of sulphur is readily converted in the presence of air and moisture into another substance containing an additional atom of oxygen—sulphur trioxide; or into that which is formed by the union of this body with water—sulphuric acid. I will illustrate to you, in the first place, one or two of the properties of the gas, formed by burning carbon bisulphide or sulphur itself. I have here some sulphur burning dimly with a pale blue flame. You observe that the transference from the air to a bottle of oxygen produces the same increased vividness in its combustion which you saw before in the case of charcoal. The sulphur now burns with a comparatively bright violet flame; and here also, although in oxygen, the combustion is imperfect. The white smoke which partly escapes from the bottle, and is partly deposited on its sides, is due to some of the sulphur which is now boiling, passing through the flame, escaping unconsumed, and then being condensed as a fine dust. I will try to collect some of the gas by letting the sulphur burn for a little while longer in the bottle of oxygen, and I will then examine its properties.

Sulphurous acid is readily soluble in water, and when coal gas is burnt the two substances are formed and travel away together, the volume of steam being, of course, very large relatively to the volume of sulphurous acid. If we dissolve some of this gas in water, we have at first simply a solution of it, but if that solution is allowed to stand for some while exposed to the air, and we examine it from time to time, we shall find there is in it an increasing quantity of the more oxidised and more permanent product of the union of sulphur and oxygen—namely, sulphuric acid. I have here an apparatus which is used for testing the amount of sulphur in coal gas, and which I have placed here intending to speak of it presently in referring to the modes in which the amount of sulphur in coal gas is ascertained. I will, however, refer to it now for another purpose.

If the little burner at the bottom of the tube is lighted, and the products of the combustion of the gas are allowed to pass up by themselves, without the addition of ammonia which is made when the apparatus is used as a sulphur test, and the condensed water, with what it holds in solution, is collected in the usual way, we shall find that the liquid contains sulphuric acid; but not nearly so much as when the pieces of ammonium carbonate, ordinarily employed, are placed upon the stand around the burner. In some experiments that I made, I found that about one-fourth of the total sulphur which the gas contains is obtained as sulphuric acid, when no ammonium carbonate is used. It has been contended, on the one hand, that, when gas containing carbon bisulphide burns in the air, the sulphur is wholly converted into sulphuric acid; and it has also been contended, on the other hand, that the only product is sulphurous acid, and that no sulphuric acid at all is formed. I feel confident, from the experiments I have made, that the truth, as so often happens, lies between the two. No sulphuric acid is formed by the combustion of coal gas; if sulphuric acid were in the flame it would, on the contrary, be decomposed into sulphurous acid and oxygen. But when that which is formed in the combustion, steam and sulphurous acid, is condensed on a cold surface, sulphuric acid is produced by a secondary and gradual action of the oxygen of the air.

If the experiment is made of placing pieces of ammonium carbonate within the lower chamber of the condensing-tube, instead of round the burner, or some pieces of caustic soda on the top of the glass balls,—in either way keeping the condensing surface bathed in alkali, instead of allowing the condensed water to become acid, and the sulphurous acid which is formed to be exposed to the current of air which is passing through—we find that the whole of the sulphur in the gas is present in the liquid at the bottom of the apparatus in the form of sulphate. This does not prove that when the gas is burnt the sulphur in it is converted into sulphuric acid, but only that when the glass balls are steeped in an alkaline liquid the sulphurous acid is retained, and that, by the time the solution has trickled down into the beaker below, the salt formed is in the condition of sulphate. In the other case, where no alkali is used, but only condensed water, to arrest the products of combustion, sulphuric acid would be fixed as readily as before, since its aqueous solution surrenders none of it to a current of warm air, but sulphurous acid would be imperfectly retained. There is a very large volume of air passing up through the apparatus, and into this atmosphere the sulphurous acid readily diffuses out of the aqueous solution. I mentioned to you, in a former lecture, that a much more soluble substance than sulphurous acid—namely, ammonia—escapes entirely out of a solution freely exposed to the air. And that which happens to the solution of ammonia happens also to the solution of sulphurous acid. Allowed to stand, with a continuously renewed atmosphere over it, the gas diffuses out of its solution, consequently, a good deal of the gas which is formed escapes into the air, and it is necessary that there should be some alkali present in order to combine with the sulphurous acid, and to form a fixed substance, such as sulphite of ammonium or sulphite of sodium, for it to be permanently retained. When it is thus retained, and exposed for a little time to a current of air, it is oxidised, and the final product is an alkaline sulphate.

I will now examine some of the properties of the sulphurous acid which I have formed in this bottle by the combustion of sulphur. I have here two coloured liquids, and I will show you the effect which the gas has upon these liquids. I pour some of the sulphurous acid, which is more than twice as heavy as air, over the blue and over the red liquid in these two beakers, and stir with a glass rod. You see that in both cases the colour disappears.

Now the substances which I have here used are delicate chemical reagents; the blue liquid was iodide of starch, and the red liquid was permanganic acid—an acid solution of permanganate of potash. I would not have you suppose that the effect which sulphurous acid has on these liquids at all represents the action of the diluted gas upon ordinary colouring matters. It is true that by the gas, in so concentrated a form, many colouring matters are bleached; but when it is in a dilute form, its action upon colouring matters is, at any rate, exceedingly slight.

A question of much importance, both to the manufacturers and consumers of gas, is that of the injury which is supposed to occur through the presence of small quantities of sulphurous or sulphuric acid in the air of rooms lighted by gas. As to its effect upon health, I do not believe that there is any evidence that the small proportion of sulphurous acid which can be present in the atmosphere of a fairly well-ventilated room, through the combustion in the room of an ordinary quantity of coal gas, containing no more than an ordinary quantity of sulphur, is prejudicial to health.

Fears have been entertained, with more reason, as to its effect upon objects in the room—articles of furniture or books. The strongest evidence of an injurious effect thus produced appears to be in the case of the decay of the binding of books. Several years ago there was a very careful investigation made into this matter at the Athenæum Club, by Faraday, Brande, and others. It was shown that the binding of the books was decaying; and it was observed also that the bindings of books placed in the upper shelves suffered more than those of books in the lower shelves; and it was believed that this injury resulted from the introduction of gas for the lighting of the rooms of the club. It was proved also that sulphuric acid could be found in the air of the rooms. Vessels of water, exposing a large surface, were placed in different parts of the room, and it was shown that by degrees a considerable quantity of sulphuric acid was accumulated. But the evidence as to the injurious effect being due to the sulphur from the coal gas is very imperfect. Evidence was given by bookbinders that there had been a change in the mode of preparation of the leather used in the binding of books—that more acid had been used after a certain date than before, and, in consequence, the bindings had not lasted so well. There were cases also of other libraries, in which no gas was used, where a similar decay in the bindings of the books had occurred, though to a less extent. Then as to the manner in which the injury was done. Supposing it were produced in some way or other by the gas, there was the further uncertainty whether it was due to the sulphur in the gas, or to the heat produced by the large quantity of gas burnt. As to the effect on pictures, it is certain that some pigments—ultramarine, for example—are injuriously affected by the deposition upon them of acid liquid, and the canvas at the back of pictures is said to be destroyed by the same agency. But I believe it is found in picture galleries which are now lighted by gas, and where, as no doubt should be the case, great care is taken with the ventilation, that no injury has resulted.

There is, however, an objection which is very much more difficult to meet—namely, that persons living in rooms which are lighted with gas, containing rather a large proportion of sulphur, find it disagreeable. Nor is this an objection which can be simply laughed at. It is not enough to say to a man who complains that he finds the atmosphere of his room unpleasant, that there is no evidence that that which he complains of is injurious to his health. It is not only that which can be shown to be prejudicial to health which can fairly be the subject of complaint. Nor are experiments upon the quantity of sulphurous acid present in the air of a gas-lighted room, nor the conclusions which may be drawn from the rate of ventilation, and the amount of sulphur burnt, as to the quantity of sulphurous acid which can possibly be present, conclusive as against the complaint that the atmosphere of the room is found to be unpleasant, and that the unpleasant smell is that of sulphurous acid. The only logical conclusion to which a comparison of these data can lead is, that a very small quantity of the gas is unpleasant. My own impression is that where ventilation is imperfect, as it commonly is, and the proportion of sulphur in the gas is rather large, it is possible to distinguish the presence of sulphurous acid. These direct sensations are not very describable to others; a certain sense rather perhaps of taste than smell, which is familiar to travellers by the Metropolitan Railway, and is known to chemists as that which sulphurous acid produces, may be observed in these circumstances, when no fire is alight, and sulphurous acid can proceed from no other source than the combustion of gas.

Really, the question resolves itself into a commercial question, as to what is the value of the impression which exists on this subject. Now, if it were possible that gas could be supplied otherwise than as a monopoly, and that consumers of gas could have the choice, which they would have—gas which cost rather less, say 3s. 9d. per 1,000 cubic feet, and which contained some 35 grains of sulphur in 100 cubic feet, or gas which cost rather more, say 3s. 11d., and which contained less sulphur, say 10 or 12 grains in 100 cubic feet—which would be preferred? I do not know what the general feeling is, but, for myself, considering both the sensible effect on the atmosphere of a room, and the likelihood of injury to articles of furniture from even a slight vitriolic dew, such as undoubtedly is deposited, I would rather pay the extra twopence and have the purer gas.

I pass now to the modes by which the carbon bisulphide in gas, supposing its removal desirable, can be removed. The process generally employed for its removal is the transmission of the gas through lime which has already served for removing sulphuretted hydrogen; and, as far as the immediate object is concerned, it is not possible to have a better agent. If coal gas, or hydrogen which has been charged with bisulphide of carbon, passes through a not excessive quantity of sulphide of calcium—the substance into which the lime is changed by the action of sulphuretted hydrogen—the bisulphide of carbon is wholly removed. I believe this removal can be effected almost as completely by the action of sulphide of calcium as that of carbonic acid, or sulphuretted hydrogen, by the agency of clean lime.

I have here a little apparatus which I contrived a year or two ago for the estimation of sulphur in coal gas. It consists of a small bulb, which is filled with pieces of pumice which have been steeped in solution of platinum, the object being to have in a small space a large surface. Through this bulb the gas passes; it is surrounded with a cylinder of porous clay, and there is a lamp burning with a very small flame beneath it. The gas enters by the tube, passes down to the bottom of the bulb, and then up through the heated material, and so out by the horizontal tube. Thence it passes downwards through a capillary tube into the liquid in this glass. The liquid is a solution of lead in soda, mixed with some syrup or solution of sugar. The lead serves to give a dark colour with the sulphuretted hydrogen. which passes into the solution. The gas, as it enters the apparatus, is free from sulphuretted hydrogen, but the action of the heated surfaces upon it transforms the bisulphide of carbon which it contains, in presence of the hydrogen of the gas, into sulphuretted hydrogen. Thus, the test consists of two parts. First, there is the action of the heated surfaces on the gas, which turns the bisulphide of carbon into sulphuretted hydrogen; and, secondly, there is a test for sulphuretted hydrogen—namely, the lead solution which is coloured by it. In order to make a quantitative estimation, I have by the side of the lead solution another glass, containing a liquid of a colour similar to that which the lead solution will acquire. The solution is not the same, for the solution which is coloured with sulphide of lead is not coloured permanently; by this light it is permanent, but exposed to daylight it quickly fades. All that is necessary is to have a solution, whose colour is fixed, comparable with that of the liquid coloured by the sulphide of lead.

It is necessary also to know what quantity of gas is operated upon. That is ascertained by running the water from the aspirator, which draws the gas through, into this graduated cylinder. Then, on reading off the quantity of water, I know that from a volume of gas, which is equal to this volume of water, has been extracted a quantity of sulphur sufficient, in the form of sulphide of lead, to impart this degree of brownness to this volume of lead solution. Such a comparison constitutes a quantitative test, and by the action of the heating apparatus it is applicable not only to gas containing sulphuretted hydrogen, but also to gas which contains bisulphide of carbon, for the estimation of the quantity of sulphur present in that form.

Besides calcium sulphide, many other substances have been tried for the purification of gas from bisulphide of carbon. It would be very desirable, if it were possible, to use a liquid instead of a solid reagent for this purpose, because it would be much easier, in working with a liquid, to avoid that nuisance which is liable to arise, unless special precautions are taken during the removal of this sulphide of calcium, or, as it is justly called, "foul lime." I have made many experiments on this subject, and the results of a few I have made recently are written upon the board. I have tried with an apparatus which I showed you at my last lecture, and which is an efficient form of washer for laboratory experiments, the action of various liquids upon the coal gas supplied at Oxford. Here are some of my results. I made an examination, first, of the gas supplied to my laboratory, and found it to contain $33\frac{1}{2}$ grains of sulphur in 100 cubic feet. Then I passed gas, at the slow rate at which it travels through the testing apparatus, over a solution of ammonia sulphide—which is one of the liquids that have been recommended—but I found that the amount of sulphur remained practically unaltered. Then I passed the gas over ammonium sulphide in which an extra dose of sulphur had been dissolved—the liquid dissolves sulphur readily, and acquires a bright yellow colour. Again I found that, practically, the sulphur was unaffected. Then I tried a solution which suggested itself to me as being likely to succeed — a mixture of ammonium sulphide, with calcium chloride. When these substances are mixed the lime is not precipitated, but remains in solution. We have, therefore, a solution probably containing ammonium chloride and calcium sulphide, and I thought this might answer as well as the solid calcium sulphide. I have written up the actual numerical results obtained in the different experiments, but they are practically the same. There was no improvement produced by washing the gas with that reagent. Then I tried another substance, which has been recommended—a solution of sodium sulphide. It has been assumed that this solution would answer as well as the solid calcium sulphide itself. But again I found that no effect was produced. I tried a solution of litharge in caustic alkali, and that also had no effect.

The only liquid which produced any improvement in the gas was some of the less volatile part of the petroleum. It seemed likely that the reason why the other substances had no effect was that they were all disolved in water. Bisulphide of carbon does not mix with water, and, consequently, substances which are in aqueous solution are as if they were varnished over and kept from contact with the carbon bisulphide. If we take a liquid which can be mixed with carbon bisulphide, such as alcohol—an alcoholic solution of potash, for instance—then we have an action. I found that the heavy petroleum mixes readily with carbon bisulphide; and I found, using that as a washing liquid, that there was by no means a complete effect, but still a considerable effect, that the quantity of sulphur in the gas was reduced to something like one-half what it had been previously.

Another mode of removing carbon bisulphide from gas, which has suggested itself to various persons—I believe the first who brought it prominently forward was Mr. Bowditch, a good many years ago—is by acting upon the gas with heated surfaces. I use that expression rather than heating the gas; because I believe if it were possible to heat the gas without placing it in contact with heated surfaces, the effect would be little or none. When gas is brought into contact with heated surfaces—it is not necessary that their temperature should be even near that of a red heat—the change which I have already referred to, in explaining the principle of the colour test, takes place, and the hydrogen of the gas and the carbon bisulphide act upon one another, and sulphuretted hydrogen is formed. This, therefore, if used on a large scale, offers the means of removing the sulphur from coal gas; since we can transfer the sulphur from its combination with carbon—in which form we have no more convenient reagent than calcium sulphide for arresting it—into a combination with hydrogen, which we are able to remove by means of oxide of iron.

The experiment of acting upon gas with heated surfaces was tried on a rather large scale, between two and three years ago, at the Horseferry-road Station of the Gaslight and Coke Company. I have here a diagram showing two sections of an apparatus constructed by Dr. Siemens for this experiment.

The apparatus was in action for some time, but, as will happen with experimental apparatus, there were many difficulties in working it. The iron plates which separated the gas from the fire cracked, and were difficult to mend. The gas which escaped ignited, and added to the strength of the fire, and the temperature was liable to become unduly high. Also the material through which the gas passed was in too large pieces, and did not present a sufficient surface.

I have here a record of my experiments, showing that two or three times, for a week or ten days together, when passing gas through the apparatus at the rate of 10,000, or even 20,000 cubic feet an hour, I succeeded in reducing the amount of sulphur from 30 or 40 grains to between 10 and 15 grains per 100 cubic feet of gas. But, after these short periods of successful working, the purifying effect gradually diminished.

I think that probably this disappointing result arose from the difficulty of managing the temperature of the apparatus, and the ill effect of heating it too strongly—viz., a deposition of carbon upon the materials with which it was filled. The amount of this deposition of carbon was not such as to produce any prejudicial effect on the illuminating power of the gas; but it affected the surface of the material which was used to act upon the gas, and rendered it much less efficient for the purpose.

I have made, since that experiment was terminated, a good many more laboratory experiments on the same subject, especially to ascertain what material was most favourable for the purpose, and I find that the quantity of the substance which it is necessary to heat, and also the requisite temperature, may be very much reduced by having a different material, and that in a form more favourable to the action of its surface and the equable distribution of the gas current. I have made recently a number of experiments with a material made into what appears to be the most desirable form—viz., little balls, and consisting of a mixture of clay and oxide of iron, the latter of which is changed, when thus heated in the presence of coal gas, into metallic iron. The particles of iron which are formed, being separated by being mixed with clay, do not fuse and run together, as iron which is heated in gas containing sulphur is apt to do if its particles are contiguous one to another, but are kept apart in a state of fine division, and thus present a large surface. The quantity of gas that can be purified by a very small amount of this material is really very remarkable. I have made quantitative experiments, using only the amount of material which I have in such a bulb as this, containing about 2 cubic inches, or somewhat less. I have passed the gas through this bulb, heating it in the manner shown, measuring the rate at which it passes, collecting it, and then ascertaining how far the sulphur in the gas was reduced.

I tried, first, whether making these balls of clay only would answer the purpose, and I found that for a moderate rate of passage of the gas, clay answered fairly well; but when I forced a larger quantity of gas through the small bulb the effect diminished. I then tried the mixture I have described, of clay and iron, and with this I found that I could purify gas as fast as, with the pressure at my command, I could send it through the bulb. On sending the gas through at the rate of between 9 and 10 cubic feet an hour, which, considering the quantity of material used, is very fast indeed, the purification effected is as great, with that rapidity of passage, as it is with a lower rate.

After streaming through the contents of the bulb, the gas was purified from the sulphuretted hydrogen which is formed, by passing it through a small tube containing oxide of iron. When balls of clay were used, and a small quantity of gas passed through, the amount of sulphur remaining was only 9 or 10 grains; but when a larger quantity was sent through—namely, 6, 7, 9 cubic feet per hour—then gradually the effect diminished and almost disappeared. But with balls of clay and iron, even with this large quantity of gas passing through, the effect was always uniform, and the amount of sulphur, which, as it entered the apparatus, was between 30 and 33 grains per 100 cubic feet, was uniformly reduced in all my experiments to between 9 and 10 grains per 100 cubic feet.

I have, of course, been alive to the danger of this effect being a transient one. Some weeks of continuous heating and passage of gas have not impaired it, and I am now engaged in pushing the trial further. I hope to find that the lower temperature which, with this material, is sufficient for the destruction of carbon bisulphide, may be low enough to cause no deposition of carbon from the gas. Experiments on a large scale are difficult and costly to make; but my belief is that, if I could place in the top of the large experimental apparatus such a material as I now use, it would purify a much larger volume of gas than was actually sent through it. It is easy to calculate, from the experiment on a small scale, what should be the effect of using the same material on a larger scale—that is, how much gas should be purified, if, instead of employing these two cubic inches, I employed, say, a cubic yard. I find, making this calculation, that to purify the winter make of gas of some of the largest London gas-works, such as 5½ million cubic feet a day, it would only be necessary to use one cubic yard of such material—that is to say, a quantity which could most easily have been placed in the top of the apparatus that I had in use.

There is one other point I wish to refer to—namely, the effect of carbonic acid in gas upon the purification of gas from sulphur by the action of calcium sulphide. It was pointed out a few years ago, I believe by more than one person at about the same time, that the main reason why the purification of gas from sulphur by the action of lime showed so great a want of uniformity was, that the calcium sulphide —the chief purifying agent—was liable to be decomposed by the carbonic acid of the gas. What was necessary for effective purification was, that lime should be used in sufficient quantity to remove the carbonic acid wholly in the first purifiers, so that the succeeding purifiers should contain undecomposed calcium sulphide, which would then retain the bisulphide of carbon.

I made, at that time, some experiments upon the effect of carbonic acid on calcium sulphide which had been used to purify gas from sulphur, and the results may still be of interest. I first prepared some calcium sulphide, and used it to purify gas, which it did very effectually, down to 10 or 12 grains per 100 cubic feet for some weeks together, the carbonic acid in the gas being carefully removed before the gas entered the tube filled with calcium sulphide. I then allowed gas containing carbonic acid to pass through, and pushed the experiment further by adding carbonic acid to the gas. The issuing gas then contained a very large quantity of sulphur indeed. The gas freed from carbonic acid showed only some 10½ grains per 100 cubic feet. When I passed through the same material gas to which I had added a little carbonic acid, I found 68½ grains per 100 cubic feet. I pushed the experiment further, adding a larger quantity of carbonic acid, and found 135 grains of sulphur. With still more carbonic acid I got as much as 245 grains of sulphur given off.

Crude coal gas may occasionally contain a considerable quantity of carbonic acid. So there can be no doubt that the cause assigned for the fluctuations in the amount of sulphur, when lime was used unmethodically or in insufficient quantity, is a true cause, and that the very large quantities of sulphur sometimes found in gas result from carbonic acid being allowed to go forward in the lime purifiers, and so to set free the sulphur which has been removed by the lime from a previous quantity of gas.

In the next and concluding lecture I propose to speak of those ingredients of coal gas which are most important for their heating and illuminating properties.

DOMESTIC ECONOMY CONGRESS.

The first annual Congress on this subject was held in Birmingham on Tuesday, Wednesday, and Thursday, the 17th, 18th, and 19th inst., by permission of the Royal Birmingham Society of Artists, at their Rooms, New-street. The Congress was opened by a *conversazione*, at 8 o'clock, on the evening of the 17th, and the following were present, amongst others:—

The Mayor of Birmingham in the chair, Genl. F. C. Cotton, C.S.I. (Chairman of the Council), Mr. E. Chadwick, C.B., Sir Henry Cole, K.C.B., Mr. R. Rawlinson, C.B., Mr. Danby Seymour, Mr. E. C. Tufnell, Mr. J. A. Youl (Members of the Council), Mr. G. C. T. Bartley, Prof. Huxley, Mr. Alan Cole, Mr. P. Le Neve Foster (Secretary), Mr. H. T. Wood (Assistant Secretary), Mr. Charles Critchett (Educational Officer).

Mrs. W. Kenrick, Miss Chamberlain, Miss Kenrick, Lady Cole and daughters, Mrs. Matthews, Mrs. Wiggen, Miss Cobden, Mrs. Tonk, Mrs. Le Neve Foster, Miss Chessar, Miss Rose Adams, Mr. Pope, Alderman Heaton, Councillors White, R. F. Martineau, Mathews, Barker, M. J. Hart, F. Wright, and Shammon; the Revds. Canon Bowlby, A. R. Vardy, E. F. M. MacCarthy, Brooke Lambert, T. W. Peart, H. W. Crosskey, C. Clarke, E. Templeman, H. Watson, A. J. Smith, and Newton Price; Colonel Ratcliff, Colonel Phelps; Drs. Heslop, A. Hill, Welch, Lloyd, Foster, Pope, Carter, Wynne Thomas, and J. A. Langford; Messrs. J. D. Goodman, G. W. Hastings, H. Wiggin, J. T. Chance, J. H. Chance, F. Osler, W. Bragg (Sheffield), R. Peyton, E. Tonks, J. A. Cooper, J. T. Collins, T. Kekewich, C. Davies, W. S. Harding, L. Parker, J. Derrington, Allen E. Everitt, T. Beston, E. O. Smith, D. Baker, J. C. Lord, G. Glossop, D. S. Hasluck, J. Creese, G. H. St. Clair, A. W. Dale, R. H. Vertegans, E. W. Tyrer, T. Griffiths, Marigold, Yeoville Thomason, Ross Jordan, H. A. Barnard, F. Rawlings, H Edmunds, C. J. Bracey, E. Edwards, Mander (Wolverhampton), H. Harris.

At half-past eight o'clock **Sir H. Cole** stated that, in the absence of Lord Leigh, the Mayor of Birmingham (Alderman G. Baker) had consented to preside.

The Mayor, on taking the chair, said he was very sorry to have to inform them that Lord Leigh was prevented from being there through an accident which had occurred to his son. As Mayor of the town, he was happy to see such a large company on that interesting occasion, and he hoped that the meeting was an augury of the success of the Congress to be held during the next two days.

The Rev. E. F. M. MacCarthy then read the following letter from Lord Leigh:—

"Stoneleigh Abbey, Tuesday Afternoon,
17th July, 1877.

"My Dear Sir,—Since receiving your telegraph message this morning, I regret extremely to say that my second son (Dudley) has met with a serious fall riding, accompanied by a slight concussion of the brain, and although I am glad to say that he is going on favourably, I do not like to leave him for the next few hours; consequently, I trust that you will kindly excuse my attending the *conversazione* this evening, and explain the cause of my absence to the meeting. I should very much like to have had the pleasure of attending it, as I have always felt the great importance of introducing industrial occupations into our parochial and Board schools, and I should like to have shown by my personal attendance there the interest I take in the subject.

"I was reading the other day, with great interest, some remarks made by Mr. Leveson Gower (chairman of the Kensington School of Cookery), who has taken great interest for some time past in the important subject of domestic economy, and chiefly as regards cookery. In speaking on this subject, he remarked that most of the large towns in England and Scotland had now schools for cookery, but that those schools were chiefly attended by the wives of shopkeepers, whereas there was a great difficulty in getting the wives of the labouring classes, who are so much interested in the question, to attend; and he thought (and I think justly so) that the only way to reach this class is to teach children cookery in our schools.

"I am aware that there may be some difficulty in instructing children in this art in day schools, where children do not board or lodge; but papers will be read at the Congress by persons of experience in these matters (and amongst others I see the name of my old friend Mr. Browne Clayton, who for many years has taken a great and practical interest in the subject), and I hope they may be able to point out how the difficulty I have suggested may be overcome.

"Again regretting my unavoidable absence, believe me to be, yours very truly, "Leigh."

Mr. P. Le Neve Foster, M.A., Secretary of the Society of Arts, then read the following

INTRODUCTORY STATEMENT.

1. Soon after the holding of the Exhibition of the Works of Industry of all Nations, in 1851, which was originated by the Society of Arts. the Society, in 1854, at the suggestion of Mr. Harry Chester, one of its most active members, held an exhibition of all kinds of works and appliances used in elementary education, which Dr. Whewell and many of the foremost promoters of education actively assisted.

2. This work led to the formation of the educational branch of the South Kensington Museum, and a section of it was devoted to objects of domestic economy, especially promoted by Mr. Thomas Twining.

3. The Society followed up this action by establishing examinations and giving prizes throughout the country, which have had a great influence on the Committee of Council on Education in organising the details in the Code for Elementary Education, and the work of the Department of Science and Art; both following the course first carried out in many ways by the Society of Arts.

4. During the last two years the Society has instituted examinations, with prizes, for papers on housekeeping and thrift, cookery, clothing and its materials, &c., health. The result of these examinations will be spoken of in another paper.

5. Finding several subjects of domestic economy adopted by the State and Parliament in the Code for Elementary Education, but no regulations, or suggestions, officially laid down for giving effect to this truly wise proceeding, the Society offered prizes of £30, £20, and £10 for the best syllabus on the subject. The syllabuses sent in competition for these prizes are now under the consideration of the judges.

6. It has appeared to the Council that the time has arrived when public attention should be systematically and seriously drawn to the subjects

of domestic economy of the greatest national importance, and the means for teaching it, and the Council therefore announced its intention of holding a Congress yearly in some great centre of population. Looking to the advanced state of public interest in Birmingham on most of the subjects embraced in domestic economy, the Council felt that no place seemed so appropriate as Birmingham for the first Congress, and the result has proved the correctness of this view.

7. The Council propose that the second Congress shall be held in 1878, in connection with various educational institutions, in Lancashire.

The Rev. E. F. M. MacCarthy stated that letters of apology had been received from the following:—The Right Hon. Lord Sandon (Vice-President of the Committee of Council on Education), who wrote: "Lord Sandon wishes to express his regret that his official and Parliamentary duties will not permit him to have the pleasure of attending the *conversazione* and the meetings of the Congress; but he hopes that the interest which he feels in the subject will be known by his action in his official capacity, and by the expressions he has used in reference to domestic economy in the House of Commons." Sir John Lubbock, M.P., "fully recognised the importance of the movement." Mr. P. H. Muntz, M.P., wrote: "For years it has been my opinion, founded on observation in this and foreign countries, that cleanliness and domestic economy should form part of our educational system. The first promotes self-respect, so essential to our well-doing; and cooking, sewing, &c., enable the poorer classes to enjoy many comforts which their present ignorance of good management puts beyond their power. I, therefore, cordially wish you that success which the important subject of the Congress merits." The Lord Bishop of Worcester, in his letter, said: "The subjects proposed for discussion at the Domestic Economy Congress are of very great importance for the happiness and welfare of the people. I rejoice at the opportunity given by the Congress for the full discussion of them, and I wish all success to the meeting." The Earl of Harrowby wrote: "If the Congress can give a practical impulse to the wise consideration of the various subjects of their discussion, as no doubt they will, they will have made no small contribution to that effort for improving the habits and condition of the people on which the nation and Parliament are so earnestly bent." The Earl of Lichfield wrote: "I attach so much importance to the advantages to be derived from the deliberation of the Congress that I will make a point of attending if possible." Mr. Alexander Brogden, M.P., wrote: "I look upon the Congress as the inauguration of an effort of great importance to benefit the whole community, for there can be nothing upon which the comforts and happiness, and consequent sobriety and culture, of the population are more dependent than a knowledge of domestic economy." Rev. Dr. Cowie, Dean of Manchester, wrote: "I shall be much interested in reading the account of your proceedings, and hope that social progress may be the result." Lord Hampton wrote: "I hoped at one time I should have been able to attend, and to express in person my approbation of the objects of the Conference and my good wishes for its success. It seems to me that an attempt to increase and improve the knowledge of the public in the various branches of domestic economy is a natural, if not a necessary consequence of the recent efforts to extend elementary education, and I trust the approaching discussion at Birmingham may lay the foundation of much and permanent public good." Mr. C. Minton Campbell, M.P., wrote: "I regret my non-attendance, the more because domestic economy is now of paramount importance, and I believe that the study and appreciation of the subject enumerated would tend much to secure happy homes, and do more, in my opinion, to stem the tide of intemperance than any legislative enactment." The Duke of Sutherland wrote that he felt "greatly interested in this subject, and did not doubt that much good will arise from the meeting and discussion of the subjects proposed in the various sections." The Marquis of Hertford wrote: "The object is excellent and must do practical good; and I wish it all success." Lord Wrottesley wrote: "You will permit me to assure you that I wish much success to the work of the committee in their endeavour to direct general attention to subjects which must be of so much practical utility in the common affairs of each one's daily life." Letters of apology had also been received from the Right Hon. John Bright, M.P., the Right Hon. W. Forster, M.P.; Mr. R. W. Hanbury, M.P., the Rev. J. Montague Seaton, and the Hon. F. Leveson Gower.

The Rev. E. F. M. MacCarthy next stated the arrangements made for the transaction of the business of the Congress.

Professor Huxley, at the request of the Chairman, then delivered an address. He said he was very glad on that occasion to have the opportunity of saying a few words upon the objects of the Congress and the expediency of arousing public feeling in regard to the importance of the objects which it had in view, because that particular subject of domestic economy was one which had always possessed a very great amount of interest for him, and it happened to be one upon which in former years he had expressed very decided opinions. In fact, he thought he could go back as far as the year 1868, when it was his business to address a working men's college upon the subject of what constituted a liberal education; and although he was excedingly loth to quote himself, yet if they would allow him, as he could say nothing better, he would trouble them with just a paragraph or two. What he said upon that occasion was, "if any one is interested in the laws of health it is the poor workman, whose strength is wasted by ill-prepared food, whose health is sapped by bad ventilation and bad drainage, and half whose children are massacred by disorders which might be prevented. Not only does our present primary education carefully abstain from hinting to the workman that some of his greatest evils are traceable to mere physical agencies, which can be removed by knowledge, patience, and frugality, but it does worse. It renders him, so far as it can, deaf to those who would help him, and drives him to substitute an Oriental submission to what is falsely declared to be the will of God for his natural tendency to strive after a better condition." He believed that those words remained as true now as he thought he might venture to say they were ten years ago; and although it was perfectly true that since that time the Education Act had been passed, which, whatever any of them might think about its details or about the extent of the ground which it covered, must nevertheless be admitted by all to have been a step of the first magnitude—yet that primary Education Act had not in reality touched any of the points which were referred to here. He did not quarrel with those who passed that great Act, but the inculcation of the solid substance of knowledge was altogether forgotten in it. He thought there might have been very great reasons for legislation in that direction at the time that that legislation was carried out. But happily, in consequence of the Education Act principally, and also in consequence of the immense stir which had been given to thought upon this subject by the elections, which had been held in every town in which a School Board had been instituted, public opinion had been very largely educated, and was now competent to deal very much better than it could formerly have dealt with this question of education; and he thought it had come to be seen that what was the obvious, and plain, and common sense view of the matter must be adopted. He meant that people would know what they were taught. It was really almost an axiom—it did not require much reflection—if they were taught reading, writing, and arithmetic, they would know reading, writing, and arithmetic; but however well they might know their reading, writing, and arithmetic, that was no guarantee that they would understand one syllable of their social duties, or of those conditions upon which their health and their welfare depended, or indeed any one of those matters which it was important to them as social individuals to know. And he thought it was that conviction impressed on the public mind which had led to the formation of Congresses such as this. If he might say so with respect, he believed it was supposed to be one of the advantages of the Government of this country that it lagged a little behind the people, and it had become, after going through a long series of change, a purely representative Government. It was more or less governed by row. He meant to say that nothing was done until there had been a very considerable row about it—what they called discussion and talk, and endless or often confused talk of all kinds, out of which, however, in the course of time something definite emerged; and that definite thing presented itself to the Government as something that had a vote at the back of it, and therefore must be listened to. So in this case of introducing a number of new elements into education, if it were, as he believed it to be, true that the conviction that something of this kind must be done had laid hold of the minds of the most intelligent persons who were conversant with the wants of the working classes particularly, then there was only one course to obtain what they wanted. They must have a Congress; they must talk; they must follow the precept of the Scripture, and look upon the Legislature as occupying the place of the unjust judge, who did not give his decision in virtue of justice, but simply on account of the frequent importunity of the widow. The association must put itself in that position, and year by year, by operating on the political forces of the country, it would doubtless, sooner or later, get what it wanted. That, he supposed, was in plain words the meaning of that Congress. If he had erred in interpreting the riddle, he trusted that some one would put him straight.

General Cotton proposed a vote of thanks to the Mayor for presiding, and remarked that he was sure they could not have found a city in England more able and ready to help forward the object which the promoters of the Congress had in view.

Mr. J. D. Goodman seconded the motion, and it was carried with acclamation.

The Mayor acknowledged the vote, and expressed his sympathy with the objects of the Congress, and his gratification at Birmingham having been selected as the first place of the meeting.

The Sections met on the 18th and 19th. The following is the full list of papers brought before the Congress:—

WEDNESDAY, JULY 18TH.—MORNING SITTING, 10.30 TO 1.30.

SECTION A.

1. *Needlework—Clothing and its Materials*, 10.30 *to* 11.25.

"Results obtained in some Elementary Schools," Miss Kenrick; "Needlework," Miss Mary Willis; "Clothing and its Materials," Mr. Joseph Pope, Staff Surgeon (retired), late Royal Artillery.

2. *Cleanliness—Washing*, 11.25 *to* 12.30.

"Head to Foot Washing," Mr. Edwin Chadwick, C.B.; "Baths and Swimming for Children," Miss Chessar; "Washing," Rev. Harry Jones; "The Methods of Training Young Servants in habits of Cleanliness," Mrs. Watson.

SECTION B.

1. *Health*—12.30 *to* 1.30.

"Elementary Instruction to Children in Physiology," Professor Huxley, F.R.S.; "Substitution of Scientific Subjects for Fancy Work in Girls' Education," Mrs. Frances Elizabeth Hoggan, M.D.

AFTERNOON SITTING, 2 TO 5.

SECTION C.

1. *Methods of Teaching Domestic Economy—Text-books*, 2 *to* 3.10.

(*a.*) "The Practical Development of Elementary Education through Domestic Economy," Sir Henry Cole, K.C.B.

(*b.*) "Text-books," Rev. J. P. Faunthorpe, Principal of Whitelands Training College; "Text-books on Domestic Economy, their Objects, Scope, Preparation, and Circulation," Rev. Edward T. Stevens, M.A.

2. *Inspection—Government Grant—Female Inspectors—Working of the Society of Arts Examinations*, 3.10 *to* 4.10.

"Mode of Inspection and Administration of Government Grant," Rev. E. F. M. MacCarthy, M.A.; "Importance of Female Inspectors," Miss Synnot, assistant to the late Mrs. Nassau Senior; "Working of the Examinations of the Society of Arts in Domestic Economy," Mr. Charles Critchett, B.A., Educational Officer of the Society of Arts.

3. *Thrift—Savings Banks*, 4.10 *to* 5.

"School Savings Banks," Mr. G. C. T. Bartley, Manager of the National Penny Bank; "A Birmingham Board School Bank," J. A. Langford, LL.D.; "The Influence of Order, Method, and Cleanliness in Factories and Workshops, upon the Home Life of Industrial Populations of large Towns," Mr. S. Wall Richards.

THURSDAY, JULY 19.—MORNING SITTING, 10.30 TO 1.30.

SECTION B.—CONTINUED.

1. *Sickness*, 10.30 *to* 12.

"Nursing," Mrs. W. E. Gladstone; "Nursing in connection with Education," Miss Helen Taylor; "Provident Dispensaries—a means of providing for Sickness," Mr. Lawson Tait, F.R.C.S.; "Ladies' Sanitary Association," Miss Rose Adams; "Sanitation, &c.," Mr. E. Chadwick, C.B.

2. *The Dwelling—Warming and Ventilation*, 12 *to* 1.30.

"Buildings for Working Men" Mr. R. Rawlinson, C.B.; "House Drains in their relation to Health," Dr. Alfred Hill, Medical Officer of Health and Borough Analyst, Birmingham; "The Appointments and Appearance of the Workman's Home," Mr. Frank Curzon, Organising Secretary of the Yorkshire Union of Mechanics' Institutions; "Warming and Ventilation," Captain Galton, C.B., F.R.S.

AFTERNOON SITTING, 2 TO 5.30.

SECTION A.—CONTINUED.

Food and Cookery.

(*a.*) "The National Training School for Cookery," Mrs. Charles Clarke; "The Art of Preparing Food; its Place in General Education," Miss Guthrie Wright, Hon. Sec. of the Edinburgh School of Cookery; "Teaching of Domestic Economy in Conjunction with Cookery in Elementary and Secondary Schools," Mrs. Fenwick;" "Combination of Practice with Theory in Cooking Lessons for Public Elementary Schools," Mrs. Rowland Williams.

(*b.*) "Cookery in Public Elementary Schools," Rev. Newton Price; "Several Years' Experience of Cookery taught in various Schools," Mr. R. Browne Clayton; "The Practical Use of the Food Collection of the Science and Art Department," Mr. W. Stephen Mitchell, M.A.; "Errors in Diet," Dr. Wilson, Medical Officer of Health.

NEEDLEWORK.

By Mary W. Willis.

1. Needlework, as we know, is one of the most ancient of the arts, and the results achieved, and the ingenuity in it, appear to have been highly prized in the earliest ages. In the song of Deborah, for example, the glories of the victors' "spoils of needlework" are celebrated; and we read in the 45th Psalm of the "raiment of needlework" of the bride. Needles made of the bones of fishes and other animals are among the earliest relics we have of antiquity, and we still admire and wonder at such works as the Bayeux tapestry and various church vestments, which must have been produced with the rudest implements.

2. In these days, when every mechanical appliance in the shape of perfect needles, sewing threads and silks, to say nothing of the wonderful sewing-machine, combine to facilitate and lighten work, it is to be regretted that the standard of excellence so commonly falls short of that attained in former times, with far inferior materials.

3. In the reign of Mary Tudor, there was only one needle-maker in England, a Spanish Negro slave, and the needles he made must have been inferior to those still used in some outlying districts of the Continent, which bend at every stitch, though they have the one advantage of not breaking. When women lived much shut up, and books were few or none, the best and most cultivated of our sex found solace and delight in the art which, in this nineteenth century, has afforded to women like Harriet Martineau and Mary Somerville rest and relaxation from their severe mental labours.

4. It would be easy to fill a longer paper than this is intended to be with an account of needlework as a decorative art; but it is our present object to view it from the severely practical side—skill in plain needlework, meaning, as it does to thousands, personal decency, comfortable homes, and tidy children, in whose minds may be planted by its means the first seeds of love of order, cleanliness and respectability.

5. Much has been said of the superiority of French needlework, but a Woodstock glove is a sufficient proof that in England high mechanical excellence is attainable in needlework as well as in other handicrafts, such as cabinet-making, metal-work, &c., in which the English mechanic is unsurpassed. In mentioning the beauty of the stitching of the glove-makers, however, I am reminded of a melancholy fact attendant upon restricted mechanical skill, viz., that in the villages where gloves are made to perfection, it was not long ago impossible to get a sheet or table napkin tolerably hemmed, much less a shirt made. This shows the necessity of avoiding as much as possible too great monotony in the kind of needlework taught in schools. I believe that attention is now being paid to improving the teaching of this important branch of female education, which, indeed, is much needed, for how few servant girls, fresh from school, can be trusted with even the ordinary mending required in a household. An exhibition of school needlework was held last year in the theatre of the Albert-hall, under the presidency of the Princess Louise. It is true that this can hardly be accepted as a sufficient test, as it was difficult to get together an adequate number of exhibitors on short notice, but it is instructive to mark that the work on the whole was not of high quality; the patterns were very inferior, which is largely to be accounted for by the fact that the school-mistresses complain that they cannot spare the time required to teach needlework properly, in order to reach the standard required by the inspectors in other valuable but, I really believe, less practically useful studies.

6. Occupation which encourages the use of the hands has, besides, a valuable moral influence upon children, but is not half enough considered in our schools for boys as well as girls. It is not found that Scotch children are behind ours in book-learning, though the shepherd lads knit their own stockings, and much of the fine cambric embroidery used for trimmings is, in Scotland, made by boys.

7. After the first rudimentary instruction in plain needlework, it will be found that cutting out and shaping garments, requiring as it does more thought and ingenuity, is generally neglected; but every possible means should be taken to enable children to apply the knowledge they have acquired, to the making up and cutting out of their own frocks and pinafores. And here we would strongly urge the taking some thought for prettiness and taste, in colour and design. The delight of quite young children in working the Kindergarten pricked patterns, in bright coloured wools or cotton, shows that a love of bright colour is instinctive in human nature, and is even beneficial when wisely directed. A reaction towards vulgar and extravagant finery is ever found strongest in those girls who have passed their youth in the colourless and ugly uniform of a charitable institution. Mr. Ruskin's Quaker student at the Working Men's College, we may remember, effected some useful improvements in the manufacture of certain colours, none of which could be found at a cheap rate pure and bright enough to satisfy eyes weary of gray and drab.

8. In most parishes there are Dorcas societies, where ladies who are above—and sometimes, I fear, incapable of—making their own clothes, expend their benevolent and kindly feelings for their poorer neighbours in constructing fearfully and wonderfully shaped garments. It has been our experience to see really beautiful needlework wasted on clothes, the inappropriate materials and radical errors in the cutting out of which must prevent either comfort or durability in wear — ill-fitting necks, arm-holes either too large for shapeless sleeves, or too small for the arms of the wearer, causing tearing out in a part where mending is most difficult and unsightly. There is another useful institution, common in most places, "The Needlework Society," which provides women with plain needlework cut out and prepared by the subscribers to the society. The few shillings a week to be thus earned are much sought after by wives and mothers, who thereby add to the scantier winter earnings of the men, whilst they have the advantage offered them that they can, at their option, purchase the garments they have made at the mere cost of the materials. Of the work of these poor women I say nothing; it is sad to see mothers of families who ought to have been taught the use of their needles at school, painfully overcoming this

deficiency of their early training, as some (though alas but few), do later in life, and expressing their warm gratitude to the ladies who have helped them to surmount the difficulty.

9. It is not impossible, as it was some time ago, for ladies who wish to make, or at least cut out, their own dresses and under-clothing to procure excellent paper patterns, but these are costly, and for the most part unsuitable to the requirements of working people. It has to be remembered that the shirt for a gardener, blacksmith, or day-labourer, requires to be of a much ampler and totally different cut from that which would be suitable and comfortable for a clerk, or the man who does not use his arms in laborious work; and the shift for a working woman, which alas! has often to serve the purpose of nightgown as well, must be of thicker material and more voluminous cut than the corresponding garment of the lady of the present day, which, reduced to a minimum, threatens, as in the time of the first French Empire, to disappear altogether.

10. The question of patterns and cutting out seems to me a highly important one; why should not the Society of Arts undertake to publish good proved patterns, which might be registered, each garment in three sizes, pasted on cotton cloth, with clear instructions as to making up, the quantities required, &c.? These might be supplied at a low price to schools and work societies, and could be lent out, and used in teaching the children the art of cutting out and planning.

11. In the Society of Arts Examination of this year for needlework, I was again greatly struck by the want of the most elementary knowledge of pattern-making displayed by nearly all the candidates, most of whom passed well in the other branches of the subject.

12. In these days of progress, when materials unsurpassed in beauty and cheapness (let the admirers of "the good old times" say what they will) are ready to our hand, we hope to see a reaction against that foolish notion of gentility, which looks upon skill in the humbler branches of one of the most delightful, as it is the most useful, of handicrafts, as vulgar and degrading. The sad lamentations over "nothing to do" are not heard, and the actual vice which springs from idleness among women of all classes is not found, among those who have been in youth trained to delight in industry and order, with their resulting love of beauty and fitness in all things.

13. I will conclude with a quotation from that great author who has done so much to further a reverence and love for work, and who raised his voice in his 80th year to protest against the spirit of "all slimness and imperfection in handicraft," which he feared in this nineteenth century was gaining ground in England. "Work is the mission of mankind on this earth. A day is ever struggling forward, a day will arrive, in some approximate degree, when he who has no work to do, by whatever name he may be named, will not find it good to show himself in our quarter of the solar system; but may go and look out elsewhere, if there be any idle planet discoverable. Let all honest workers rejoice that such law, the first of nature, has been made good on them."

The remaining papers will be printed in succeeding numbers of the *Journal.*

MISCELLANEOUS.

THE TELEPHONE.

Few of the recent applications of science have attracted so much popular curiosity, and few, perhaps, have been the subject of such extravagant and erroneous statements, as the telephone. It has been said that the sound of a speaker's voice has been recognised after travelling through 500 miles of wire, that an orchestra can play to a dozen audiences a hundred miles apart, and so on. These are, indeed, only American reports, and perhaps it would be uncharitable to say that that accounts for their character. Yet the invention is indeed a most startling one—two remarkable, indeed, to be discredited by any amount of exaggeration.

That musical sounds should be transmitted by telegraph is, in fact, less remarkable than it first appears. To see this we have only to consider the conditions of the problem. Sound is, of course, only the result of air vibrations. If it is possible to produce at any place an exactly similar series of vibrations to that occurring at any other place, the same sounds will be heard at both spots. The vibrations must obviously be precisely similar—of the same rapidity, to give the tone or pitch; of the same amplitude, to give the intensity or volume of sound; and, more difficult to explain, they must also be such as to give the quality, which Helmholtz has shown to depend on the "harmonics" accompanying the primary tone. The first two conditions several telephones fulfil; the third is as yet unattained, and is perhaps unattainable.

It is not difficult to see that the vibrations of a tuning-fork, making and breaking an electrical circuit, will produce pulsations in the current which can, by their action on a magnet, alternately magnetised and demagnetised at each interruption and formation of the circuit, produce exactly similar vibrations in another tuning-fork, no matter how long the circuit and how distant the forks. This idea suggested itself to Philip Reuss in 1861, and resulted in the construction of the first telephone. In this the sending instrument consisted chiefly of a membrane stretched over a box in such a way that the membrane was put in vibration by the voice of any one speaking into the box. On the membrane was a piece of platinum, which, as it moved to and fro, formed and broke the electrical connexion in a properly arranged line of wire. By this line the electrical pulsations were transmitted to a coil of wire surrounding an iron bar, this having on the bar the curious effect of causing it slightly to expand and contract at each pulsation. These slight alterations in length, rapidly succeeding each other, produced a musical note, which corresponded in the number of vibrations with that sounded in the box, and was, therefore, identical with it. But though the note is the same, it is not of the same quality. The instrument cannot reproduce that; it merely, as has been said, sings with its own voice, which has been compared to a penny trumpet. The idea once started, inventors were not wanting to take it up and develop it. In America, Mr. E. Gray and Mr. Graham Bell have been most successful, and in this country, Mr. Cromwell Varley. It has already been announced in the *Times* that the telephone of the last-named gentlemen is shortly to make its appearance at the Queen's Theatre, and on the 12th inst., a private trial was made of the instrument before submitting it to the public. To describe the instrument minutely would be impossible without the aid of drawings, and without entering into technicalities uninteresting and indeed unintelligible to any but practical electricians. Still, perhaps, some account of its general action may be worth giving, inasmuch as it is certainly the first by which musical sounds have been conveyed by telegraph in this country.

Like all telegraphic apparatus, this telephone consists of two instruments, a sender and a receiver. On Thursday both these were at the Queen's Theatre, so that both could be examined, and the wire was laid across to the Canterbury-hall and back, a distance in all of some three miles. In the public performances, of course, the sending instrument will be at one place and the receiver at the other. Let us consider the receiver first, for it is in it that the greatest novelty of the instrument consists. The only thing visible to the audience is a large drumhead, or tambourine, inside which is stretched what appears to be a sheet of tissue paper. Nor is there very much more. Mr. Varley discovered the curious fact that if a pulsating electric current of "high tension" be sent into a "condenser," an arrangement of thin plates alternately of conducting and non-conducting materials, the plates will vibrate, and, if large enough and of proper construction, they will produce a musical note. The note thus formed is greatly magnified by the drumhead and can be made to sound quite as loud as the ordinary note, say of a hautboy, which, indeed, it much resembles. It is understood that this condenser has some special features of construction, but to all appearances it differs little from the ordinary condensers of tinfoil and paraffined paper which are used in electrical operations. No satisfactory explanation of this curious phenomenon has yet been given' but of its existence there can be no doubt.

The sending instrument is much more complicated. A number of tuning-forks, sufficient to enable a simple tune to be played by their means, are employed. Each of these has, mounted near its end, a small electro-magnet, worked by a battery, by which it is kept in constant vibration, precisely, to take a familiar instance, as the striker of an electric bell is kept going when the button is pressed down. The vibrations of the fork are then caused to make and break a second separate electric circuit passing through an "induction coil," by which the "low tension" electricity of the battery is transformed into the "high tension" electricity required to produce the vibrations of the condenser. All these forks are then kept vibrating simultaneously, producing, of course, a rather discordant hum; but the current from none of them passes into the condenser until, by the depression of a key, the circuit is completed between one of the forks and the condenser, when the note belonging to that fork is instantly sounded. A number of keys, one for each fork, are mounted on a key-board, and they are manipulated just like pianoforte keys. The instrument at the Queen's has a compass of an octave and a half, from C below the staff to G above it, and there are consequently 12 forks with their attendant apparatus.

Of the music produced it is impossible to speak in very high terms. Some of the notes were good enough, but others were quite false, and the impression it gave was that the instrument was not properly adjusted and tuned. It was stated that its action is somewhat uncertain, and that it depends partly on atmospheric conditions. This is doubtless to be attributed to the use of high tension electricity, which, as is well known, is difficult to manage over long distances. It did not appear quite evident why a single coil placed near the condenser would have not acted equally well; but there are doubtless considerations of adjustment and the like which cannot be appreciated on a mere cursory inspection.

The whole apparatus has been put up in considerable haste and under considerable difficulties. The Post-office refused to lend a wire, and so it became necessary to erect a private one. This, involving as it did the getting the permission from the proprietors of houses in the route, was a troublesome undertaking; but it was successfully accomplished by the Gutta Percha and Telegraph Works Company, of Cannon-street, who undertook the work. The span of a quarter of a mile across the Thames is an unusually long one, and seemed to present the greatest obstacle, but this was eventually crossed, and the line completed.

Should the present instrument prove all that is expected we are promised a speaking telephone; and it must be confessed that such an instrument would be of far greater utility, as well as of greter interest, than a telephonic organ such as that of Mr. Varley. The weak point of the American speaking telephone of Bell is the extreme lowness of its sounds. This is certainly not the case with Mr. Varley's apparatus. We shall look with interest for a combination of the two, for some apparatus in which the vibrations received by Bell's stretched membrane shall be given out by Varley's condenser. Such an arrangement, if the instruments can be cheaply worked and easily kept in order, would soon replace all the "A B C" instruments used for short distances and on private wires, even if it did not come into use for all our telegraphic communications. The instrument at present shown cannot transmit the sound of the voice, nor can it take up and reproduce the music played by an orchestra or even a single musical instrument. All it can do is to produce in its own voice whatever tune is played on it. That it should do so at a distance of several miles is strange enough, but more than this is expected from the perfect telephone, and more than this will certainly be accomplished before very long.—*Times.*

SULPHUR IN ICELAND.

The *Journal of Applied Science* gives the following account of the sulphur deposits of Iceland:—

Large deposits of sulphur exist in some districts, which at different times have been the object of commercial speculation. The sulphur mines at Krusavik in the south are at present worked for foreign account, but owing to their partial inaccessibility and difficulty of transport, without much success. The right of working at Myoatu, in the northern portion of the island, has recently been conceded by the Danish Government to an Englishman on a fifty years' lease. They were worked some years ago for a Copenhagen house, but were abandoned in 1851, since which time they have remained closed. Many causes contributed to this result, the chief of which, doubtless, were ignorance of the proper method of gaining the sulphur, the cost of transport on horseback to the seaboard, and the want of remunerative demand. Since then those conditions have changed, and there exists no reason why these mines should not be worked profitably. They extend over a large tract of country, and their position is most advantageous in the middle of a flat district, within an easy distance of Husavik, a convenient shipping port, and during the many years they have been closed the deposits must have very greatly accumulated, and should yield abundantly; indeed, so strong was this conviction in the minds of the natives, that they long opposed the leasing, except on very onerous terms, although quite unable themselves to work them. As these mines are now likely to remain in English hands for many years, a short account of their former history may be read with some interest. They are situated between 65° 20″ north latitude and the Arctic Sea, or, more definitely speaking, lying in the tract between Myoatu (Great Lake) on the east, and Iokulsa (Glacier River) on the west. The right of working them was bought from private owners by the Danish king, Frederick the Second, in 1563, and this right has ever since been in the possession of the Danish Crown. During the reign of this king considerable quantity of sulphur was extracted, amounting to as much as 400 tons annually. In the reign of his son and successor, Christian the Fourth, the produce appears to have fallen off, and his Majesty was unsuccessful in his endeavours to lease them to foreigners. To the falling off of their supply of sulphur in this reign, and the consequent scarcity of gunpowder, the Danes attributed their defeat by the Swedes in Holstein, in 1644. In 1665, we are informed that the Crown granted a concession for "digging sulphur" to a foreigner, who is stated to have exported large quantities up to the year 1676; since which date no special mention appears to have been made of them until the early part of the 18th century, when two foreigners, apparently Germans, acquired in 1724 the right of exporting sulphur form Iceland, of which they also shipped considerable quantities during the succeeding five years, when the death of the lessees put a stop to this commerce. After this date, and up to the present century, the Danish Government worked the mines on their own account, at times, it appears, with considerable profit, until 1806, when they were again leased to a foreigner, and subsequently they have at times been worked by private speculators up to 1851, since which date, as already mentioned, they have remained untouched. In 1840 they were visited by some scientific travellers, who calculated that these northern mines might easily yield an annual net profit of £1,000 or £1,200, but ten years later they were specially examined by a Danish mineralogist, who discredited this statement, and reported them to be less valuable, but in speaking of the Krusavik mines in the south, he says, these might easily be made to yield 200 tons annually, and yet they have always been considered inferior to the northern mines. A French geologist, Eugene Robert, who visited Iceland in 1835, and afterwards published a treatise on its geology, calls the attention of the Danes to the value of the Myoatu mines, and advises them not to lease them to the Englishmen (who were then applying for them) as the property might become of great consequence in the event of the sulphur mines of Sicily falling off, of which, he affirmed, symptoms had shown themselves. It will thus be seen that opinions are divided as to the productiveness and present richness of these mines, but so much is certain that they have for several centuries been worked at intervals with varying results, at times with considerable profit, and the history of the country and the experience of so many years points to the conclusion that, if properly worked, they would become a valuable property.

CORRESPONDENCE.

MR. DAVIS'S SODA PROCESS.

Owing to absence from England, I have only just seen Mr. Davis's letter in the *Journal* of June 15. One or two points in it call for some remark from me.

1. Mr. Davis is wholly unauthorised in writing: "Residue as valued by Mr. Weldon, £1 7s. 6d." I certainly pointed out at the meeting that even "on the supposition that the SO_2 and the residue together"—which is something very different from the residue alone,—"were of the same practical value as the quantity of pyrites containing the same quantity of sulphur, they would be worth only 27s, 6d.;" but I also stated that, for my part, I "could not regard the SO_2 as having any real value at all," that I believed, that "one might as well try to utilise the SO_2 in ordinary coal smoke," that the SO_2 would thus "count for nothing but a source of atmospheric pollution," and that "as for the solid residue it would be 'waste' and nothing else," and that its utilisation was, to my mind, "outside the pale of serious discussion." Yet Mr. Davis writes down £1 7s. 6d. for "the residue," and then claims to have accepted "Mr. Weldon's value for it." My value for it is a minus quantity.

2. At the meeting, I mentioned that calculation from a published analysis by Mr. Davis himself of a lime mud obtained in the ordinary process of manufacturing caustic soda showed that there remained with that lime mud 11·9 per cent. of the total soda produced. I expressed my astonishment at such a result, but accepted it, for the moment, on Mr. Davis's authority. At the meeting, Mr. Davis explained that the mud which was the subject of the analysis in question was not a fair example, having been produced in a work "which was working badly;" but in his letter he "challenges" me to show from his published figures "any such loss" as 11·9 per cent., and says that those figures give "at the highest, 1·906 per cent. of sodium hydrate in the mud," and that "two per cent. soda in the mud is only 4 per cent. loss," wherefore 1·906 per cent. soda in the mud would be only 3·812 per cent. loss. He forgets that, in the column of figures—it is given on page 124 of Mr. Kingzett's "The Alkali Trade"—in which "Sodium hydrate, 1·906," occurs, "Soda, 1·832," occurs also, lower down. The 1·906 being expressly stated to be sodium hydrate, while a different designation is given to the 1·832, I take the latter to be Na_2O, equal to 2·3639 of NaHO. We thus get, in all, soda equal to $1·906 + 2·3639 = 4·2699$ NaHO. We have, at the same time, 40·17 of calcium carbonate, not more than 95 per cent. of which can have been due to the reaction of lime upon sodium carbonate. Taking the caustic soda and the sodium carbonate in the vat liquor employed to have been to each other as 17 to 83, the 40·17 of calcium carbonate thus represent 36·799 of total Na HO, upon which quantity the 4·2699 remaining with the lime mud are 11·6 per cent.

3. Mr. Davis writes, in his curious paragraph on the price of phosphate of alumina: "In quoting from a price-current list, Mr. Weldon admits the inference that this article is at present being sold as a marketable commodity." Not at all! The offer of a thing for sale at a certain price by no means proves that it "is at present being sold;" most of us, and not least the holders of Redonda phosphate, will heartily wish that it did; and whether a thing is "marketable" or not surely depends upon whether you can sell it, not merely upon your offering it for sale. Mr. Davis goes on to say that I am "evidently unaware when the last sale of any importance was made, and of the thousands of tons now in this country which have remained practically unsaleable for some years;" but these are the very grounds on which I based my contention that in putting the price of phosphate of alumina at £3 3s. per ton he puts it at a price at which a continuous supply of it could not be had. Thousands of tons of it are lying in this country, imported some years ago for processes which have failed. For a long time now, not a ton has been sold except for purposes of experiment. So far from being "a marketable commodity," the large stock lying in this country has "remained practically unsaleable for some years." It is "eating its head of," but the holders can't get rid of it. Nobody will buy it. It is obvious what effect this state of things must have on the price at which it is offered, and the latest published offer of it is at "£3 to £3 10s.," according no doubt to the percentage of P_2O_5—say £3 5s. for 35 per cent. Because he can get it at £3 5s. now, when there is a large stock on hand and absolutely no demand for it, Mr. Davis argues that if a demand were to arise for it he could get it at less than £3 5s. I hold, on the contrary, that the price at which it is at present offered is due to there being a very large stock on the market with nobody to buy it, and that any appreciable demand for it would cause its price to go up, and not down.

4. Mr. Davis insists that he knows of salt-cake being sold just now at 50s. 6d., 51s., and 52s. 6d. No doubt; but he must know perfectly well that the average price at which salt-cake is being sold is very much higher than the highest of the figures. And for such a comparison as he institutes to be reasonably fair, he is bound to take salt-cake at its average price at the time being, and not at the price of a few exceptional parcels.

5. After asserting that his precipitated phosphate of lime would be worth "infinitely" more than "an un-

ground mineral of phosphate," Mr. Davis quotes various authorities for fixing its value at the finite amount of 1s. 10d. per unit. It is true he afterwards says that "its value is 1s. 9d.," but he charges it on the credit side of his balance-sheet at 1s. 10d., all the same. What is more, he credits himself with one and a half tons of it at 76 per cent.; but to get that quantity he must get a nearly theoretically perfect yield, and we all know that such yields are not got in chemical works. In the carefully conducted experimental operation, the results of which are given in his paper, he got a result equal only to 1·5 tons phosphate of lime at 71 per cent., per quantity of materials on which the balance-sheet in his letter is based; and as he admitted that he "stood over the men" during that experiment, a yield equivalent to 1·5 tons at 70 per cent. is surely as much as would be obtained in ordinary operations in which he did not stand over the men. That his product would have the value of a ton and a half of ordinary precipitated phosphate at 70 per cent., I do not myself believe, for reasons which I gave at the meeting; but I take it at that because, in so doing, I am obviously more than fair to Mr. Davis, while the present absolute matter-of-fact market value of precipitated phosphate of 70 per cent. admits of no discussion, but can be stated with the same certainty as the price of consols. It is not a question of how much Dr. Voelcker considers such a phosphate to be worth to the farmer; it is simply a question of how much it can be sold for in the market; and in Berger Spence and Company's "Circular" of July 7, "precipitated phosphate of lime at 70 per cent." is offered to all the world at £5 15s. per ton. On what I believe, then, to be an excessive, but what no one can allege to be an illiberal, estimate of the quantity of phosphate of lime which Mr. Davis could obtain from 1·5 tons of Redonda phosphate, its value is, not £10 10s., as he puts it in the balance-sheet in his letter, but £8 12s. 6d.

6. Mr. Davis writes: "Mr. Weldon's statement that I could only, even theoretically, get three-fifths of the salt-cake as sodic phosphate, is completely erroneous. He ignores the fact that it is only the alumina which causes a loss of soda." In his very next sentence Mr. Davis admits that "the fact" which he had just said I ignored is not a fact at all, for he goes on to speak of a further loss as double sulphide of sodium and iron. He says that further loss is only small, and gives what he supposes to be a proof that it is only small; but if he had been as familiar with double sulphides of iron and sodium as I have had occasion to become his remarks on these points would never have been written. Without going into the reasons why the $Fe_2P_2O_8$ in Redonda phosphate is fully as wasteful of salt-cake as the silica and alumina in Mr. Davis's mixture, I will merely point out that Mr. Davis admits, by the balance-sheet given in his letter, that he can utilise only three-fifths of his salt-cake. If my statement to that effect is "completely erroneous," why does he prescribe proportions of materials in exact accordance with it?

7. To conclude, Mr. Davis says that the question between him and myself is "a question of prices." It is not solely such. I certainly hold that the profit he shows on paper is got by underestimating the cost of his raw materials and over-estimating the value of his product. He values his phosphate of lime at £10 10s., and I have shown that £8 12s. 6d. is the present selling price of the utmost quantity thereof that it is reasonable to expect that he could produce. He estimates the cost of his salt-cake at about 10s. per ton less than its present average value to those who make it. He estimates the cost of his Redonda phosphate at 2s. per ton less than the lowest price he has paid himself for portions of the present "practically unsaleable" stock of that commodity; and he "accepts Mr. Weldon's value" for "the residue," but puts that value at £1 7s. 6d., whereas I really value that residue at a good deal less than nothing at all. But it is not merely that he thus makes out, on paper, a profit of £31 1s., where it is obvious there would be a serious loss. If his process were otherwise really capable of yielding a profit, it would be impracticable by reason of the SO_2 produced in it. Mr. Davis says that he could employ that SO_2 to make salt-cake by Hargreaves' process. So he could; but the cost would be prohibitive. My friend Mr. Hasenclever, of Stolberg, at present gets all his sulphur for less than nothing. He is paid by the neighbouring zinc manufacturers to burn off the sulphur from their blende. But he is about to change to the use of pyrites, finding it cheaper to buy sulphur as pyrites than to be paid for taking it as blende. Mr. Davis's SO_2 would be still more dilute than Mr. Hasenclever's. Nothing practical could, therefore be done with it; it would all have to go into the air. But what would the Noxious Vapours' Commission, now sitting, say to that? At present, great as is the nuisance occasioned by the alkali manufacture, only a small fraction of the sulphur employed therein goes into the atmosphere. Mr. Davis's process would require, per ton of soda, 66 per cent. more sulphur than is required at present—would require, that is, 100 parts for every 60 parts used now—and all this sulphur would have to go into the atmosphere as SO_2, except that proportion of it which Mr. Davis believes he would obtain as copperas, but which I believe would find its way, as a poisonous solution, into the water courses. Even if it were otherwise commercially practicable, Mr. Davis's process, instead of diminishing the nuisance arising from the alkali manufacture, would thus enormously increase it. Here, so far as I am concerned, this discussion must close.

WALTER WELDON.

Abbey-lodge, Merton, Surrey,
July 11th.

GENERAL NOTES.

Patent-office.—The Commissioners of Patents have determined to continue their publication of official abridgments from the year 1866 onwards. Most of the series referring to different classes of inventions have now been brought down to that date, and it was originally intended that the work should stop here, the place of these abridgments being taken by the abstracts which, since 1866, the applicants for Letters Patent have been required to send in. As it was found that these abstracts were of little real use, they were stopped about a year ago. The new issue of classified abridgments will contain the inventions of the last ten years, 1867 to 1876 inclusive. Several volumes are already in preparation, but it will be some time before any of them can be published. The Patent-office sale-room has been transferred from Southampton-buildings to Cursitor-street, and considerably increased facilities have been given for the purchase of the official publications. In connection with this alteration, the arrangements for storing the specifications, &c., have been revised, and a new system adopted which enables any required specification to be found with less delay than formerly.

NOTICES.

MEETINGS FOR THE ENSUING WEEK.

THUR....Zoological, Society's Gardens, Regent's-park, N.W., 5 p.m. (Davis Lectures.) Prof. Garrod, "The Ornithorhyncus."

FRI.......Quekett, University College, Gower-street, W.C., 8 p.m. Annual Meeting.

SAT.......Royal Botanic, Inner Circle, Regent's-park, N.W., 3.45 p.m.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,288. Vol. XXV.

FRIDAY, JULY 27, 1877.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

THE CHEMISTRY OF GAS MANUFACTURE.

By A. Vernon Harcourt, Esq., M.A., F.R.S.,

Lee's Reader in Chemistry at Christ Church, Oxford, and one of the Metropolitan Gas Referees.

Lecture IV.—Monday, March 26.

In the preceding lectures, I have dealt with those products of the destructive distillation of coal which are mainly eliminated in the course of the manufacture of coal gas, and I have to speak to-night of those substances which are the ingredients of purified coal gas. In the table on my right there are given the results of the analyses of various samples of coal gas, made some years ago by Dr. Frankland. The figures show that the principal constituents are two—hydrogen and marsh gas. The relative proportions of hydrogen and marsh gas vary to some extent, but, as a rule, that of hydrogen is the larger, so that an average sample of coal gas contains nearly 50 per cent. of hydrogen, and about 36 per cent. of marsh gas. The proportion of the gas next in amount, namely, carbonic oxide, is much smaller, generally about 8 per cent. Next comes a group of constituents—comparatively small in quantity, but chief in importance—olefiant gas and its homologues, which may be regarded as condensed forms of olefiant gas, and of these the proportion is about 5 per cent.

I have here some bottles filled with these principal ingredients of coal gas—hydrogen, marsh gas, carbonic oxide, and olefiant gas. They are all as colourless and transparent as air. I will endeavour, in the first place, to show you some of the differences in their properties, and, in the next, to effect the synthesis of coal gas, by mixing them in the proportions in which they are found to coexist. I pour hydrogen from this bottle upwards, through the water of the pneumatic trough, into a bell jar, which is fitted with a bat's-wing burner on the top, so that I may be able to burn the gases in succession, and you may be able to judge of the difference in their illuminating power. I will pass up sufficient of each to show you the kind of flame which the gas produces; and, as I shall burn them all under the same pressure, and with the same burner, you will be able to make a very fair comparison of their illuminating power. I have now some hydrogen in a jar, and by depressing the jar into the water of the pneumatic trough, I have put it under pressure, and on lighting it you see the kind of flame with which hydrogen burns—a flame of very high heating power, but by itself of very small illuminating power. You see how colourless and non-luminous it is, but also to what intense brightness it ignites a coil of platinum wire which I hold in it.

Now I will repeat the experiment with marsh gas. Here you see I have, as compared with hydrogen, a gas burning with considerable illuminating power; and although the gas, which has been prepared in the ordinary way, by heating together soda-lime and sodium acetate, is probably not perfectly pure, and the illuminating power may be somewhat greater than it would be with pure marsh gas, yet I have never seen a sample of marsh gas which had not some illuminating power; and I think, therefore, the statement frequently made, that marsh gas is to be regarded, like hydrogen and carbonic oxide, simply as a diluent of coal gas, combustible but not luminiferous, must be accepted with some reserve.

Next, I will take the carbonic oxide. There you have the characteristic blue colour, and a scarcely luminous flame. In this case, as in the case of hydrogen, I may show you that this non-luminous flame has an exceedingly high heating power, by holding in it the spiral of platinum wire.

I have still one other of these principal ingredients to examine—namely, olefiant gas; but while that is being brought into the bell-jar, I may pass on to the consideration of the heat which is produced by the combustion of these gases. I have a table here, which Dr. Frankland has kindly lent me, showing some of the different effects of burning marsh gas, carbonic oxide, and hydrogen. There is a difference, though not an important one for any practical purpose, between the quantities of oxygen which are consumed by the three, marsh gas consuming four times as much oxygen as is consumed by either carbonic oxide or hydrogen, the two latter consuming it to the same amount. As to the carbonic acid generated, marsh gas and carbonic oxide both produce their own volume of carbonic acid, while hydrogen, of course, produces none. There is a difference also in the amount of heat that is generated by the combustion of equal volumes of these three gases. One cubic foot of marsh gas, measured under standard conditions—that is, at a temperature of 60° Fahr., and under a pressure of 30 inches of mercury—will heat by its combustion 6 lbs. of water from freezing-point to boiling-point. One cubic foot of carbonic oxide would heat 2 lbs. of water through the same range of temperature—that is, it produces only one-third the amount of heat which is produced by the combustion of an equal volume of marsh gas. Lastly, the heating power of hydrogen is very nearly the same as that of carbonic oxide, comparing, of course, volume with volume, not weight with weight.

Now I will return to the experiment with the olefiant gas, and you see that I have here a gas which really is too powerfully illuminating to be burnt in such a burner; that is to say, it gives a brilliant light, but burns with a smoky flame, and the full illuminating value of it is not developed. Although I think marsh gas should not be regarded as being, like hydrogen and carbonic oxide, merely a combustible diluent, yet no doubt the principal source of the illuminating power of coal gas is the relatively small proportion of olefiant gas which it contains.

Now I will make from the residues of these gases, which remain in the bottles, a mixture to represent coal gas. I mix, first, those three having least illuminating power—the hydrogen, the marsh gas, and the carbonic oxide; and I will show you what amount of light is obtained by burning a mixture of these three gases by themselves. Then I will add the proper dose of olefiant gas, 5 per cent. or so, which coal gas ordinarily contains, and show the difference in the illuminating power thus produced. I have now about one-half the bell-jar full of hydrogen; next, I put in marsh gas to about one-third of its capacity, and then about one-tenth of carbonic oxide. I cannot allow them much time for diffusion, but in a vessel of this diameter gases mix very rapidly; and I will now burn a little of the mixture as it is, this being in fact coal gas, *minus* olefiant gas. You see that we have a gas of very poor illuminating power. The illuminating power is not *nil*, but it is exceedingly small. I have here a cylinder on which I have measured off a volume which is one-nineteenth of the volume of this bell-jar, measured down to the point to which it is now filled with the mixture of gases, so that if I pass up into the bell-jar the olefiant gas which this cylinder contains, I shall have added 5 per cent. of olefiant gas to the mixture, whose illuminating power you have already seen. I must allow it a few moments for diffusion, and in this case I cannot freely stir the gases together by agitating the water beneath them, because olefiant gas is sensibly soluble in water. I now expel the mixture through the burner and light it, and you see that I have a gas which has about the ordinary illuminating power of coal gas.

I propose now to make a few observations upon the nature of flames. I have arranged here an experiment in order to illustrate this fact, that what we speak of as flame is a phenomenon occurring at the common surface of two gases capable of acting chemically one upon another, with the production of a temperature of incandescence, that incandescence being either the incandescence of a solid or of a gaseous substance. Thus we may either have coal gas or any other so-called combustible gas burning in the air, or we may have the gas which I have now succeeded in lighting, namely air, burning in coal gas.

I have fitted up a large lamp-chimney with a cork at each end. Two glass tubes pass through the lower cork; one, of a quarter of an inch in diameter, and five inches in length, is central, and rises one inch within the chimney; the other, by its side, passes just through the cork, and is connected with the gas supply. A third tube passes through the cork in the top of the chimney, and serves as outlet. I am sending through the chimney a slow stream of coal gas, which is now burning at the top of the apparatus. The coal gas within the chimney, being lighter than air, produces a small diminution of pressure towards the bottom, and therefore a slow current of air enters the chimney by the open tube. The jet of air thus produced, having been lighted at the end of the tube within the chimney, and being in an atmosphere of a gas with which it can combine, produces a flame in which air is the inside gas, and coal gas is the outside gas. Burning above is a flame differing from that below only in this respect, that common air is the outside gas, and the coal gas is inside; so that here we see two phenomena which are perfectly similar, although one is much more familiar than the other. You see the degree of resemblance between the two flames. There can be no doubt that if our constitution were such that we were capable of living in an atmosphere of coal gas, and if we were able to make from any material which would then correspond to coal, a gas having the nature of atmospheric air, we could lay it on and light our streets and houses with air as we now do with coal gas.

Now, the nature of flame being of this kind, there is a further question, and a very important question, as to the nature of luminous flames, and as to what is the common property to which different flames own their luminosity. In the case of what may be described as hydrocarbon flames, such as the flame of coal gas, the theory of Sir Humphry Davy is, I believe, the true theory, —namely, that their luminosity is due to the presence of solid carbon in the flame. It has been pointed out that there are examples of highly luminous flames in which there is no solid matter. If we burn a substance of which I spoke in my last lecture—carbon bisulphide—in an atmosphere of oxygen, we have an intensely luminous flame, although the substances produced—carbonic acid and sulphurous acid—are both at the ordinary temperature gases. Even in the case of one of the most brilliant of flames, that produced by the combustion of phosphorus, the oxide of phosphorus at the high temperature at which it is formed is also gaseous; and there are some other highly luminous flames in which nothing solid is present. But there are also plenty of examples of flames, otherwise non-luminous, which are rendered luminous by the introduction into them of a solid substance.

In the case of the flame of a candle or of coal gas, a finely-divided solid substance is formed in the flame. At the high temperature which is produced by the burning of carbon and hydrogen in the outer zone of the flame, the gas which is still within this zone, and has not yet emerged into the air, or into the presence of a sufficiency of oxygen for its combustion, is decomposed and deposits its carbon; and it is to the ignition and incandescence of this carbon that the luminosity of the flame is due. In a word, what we see in the flame of coal gas or of a candle is soot heated to whiteness. I will try to illustrate this to you by a very simple experiment. I have here a Bunsen burner, burning with its well-known non-luminous flame, and I have placed round it a tray formed of a piece of stiff paper, on which there is a layer of lampblack. On shaking this paper, particles of the lampblack rise in fine dust, and pass through the opening for air at the bottom of the burner, and so rise in a fine carbonaceous cloud into the flame. You see that as long as the paper is shaken the flame is luminous, but as soon as the agitation ceases the flame burns as usual, in a non-luminous manner.

There is another experiment I need hardly make, it is so familiar. If we dip any cold substance into a luminous flame of coal gas or of a candle, a black carbonaceous coating is deposited upon it.

No doubt that is not conclusive as to the presence of carbon in the flame. It might be the case that that which otherwise, at the high temperature of the flame, is gaseous, becomes solid when it is brought into contact with the solid substance upon which it is deposited. Moreover, the deposit which is thus formed does not consist of pure carbon, but contains a certain amount of hydrogen. That, however, is also true of coke and charcoal, and of every portion of carbon which is produced by the ignition of a substance in which hydrogen was once united with carbon, however high the temperature applied may have been. When coal gas or any gaseous hydrocarbon is heated to redness in a glass tube, more condensed hydrocarbons—or what are called, with convenient vagueness, tarry matters—are formed and deposited. And if these tarry matters are strongly ignited, air being excluded, a solid residue always remains. These conditions exist in the interior of a gas-flame, and, apart from the evidence furnished by the deposition of soot on a cold object placed in the flame, it seems certain that a solid non-volatile hydrocarbon must locally and transiently be formed.

Now as to the conditions which render a flame of this kind more or less luminous. I have arranged here an experiment, for which I am indebted to Professor Heumann, which illustrates well the effect of a more or of a less rapid and intense combustion upon the flame of coal gas. I have a bottle of oxygen fixed in an inverted position, and I will burn a small jet of coal gas in the oxygen; and while it is burning, I will describe to you what I conceive to be the nature of the changes which occur. The first thing I wish you to observe is that the gas, which was burning in the air with a fairly long and luminous flame, when placed within the oxygen, gives a brighter point of flame, but so much smaller that on the whole the light emitted is less than it was before. But that light will continually increase—it is already greater than it was when the jet was first placed within the bottle. The flame grows in size, diminishing a little in whiteness and brightness, but increasing in the total amount of light which is given out, up to a certain point; and after that point has been reached and passed, then the flame continues to increase in size, but the total production of light again diminishes. Some interesting observations have been made upon this series of changes. In the first place, it seems that the amount of light which is given by a coal-gas flame burning in air depends simply upon the degree of dilution of the oxygen with an indifferent gas, and that it is immaterial whether that gas is nitrogen, as it actually is in the case of air, or whether it is some other gas, such as carbonic acid. In any case the luminosity reaches its maximum when the proportion of the diluent gas is about that which it is in our own atmosphere—that is, about four parts of diluent to one of oxygen. You observe now that the flame, burning in a mixture of oxygen and carbonic acid, has very much the same appearance as it had when burning outside in the air. At this point, I believe, if an analysis of the gas were made, we should find that one-fifth of the gas remaining in the bottle was oxygen, and that four-fifths were carbonic acid or steam. But as the dilution of the gas advances, the quantity of oxygen remaining in the bottle being progressively diluted with the products of combustion, the luminosity continually diminishes whilst the size of the flame increases, and we have at last a large flame wholly non-luminous.

There are, however, several other conditions upon which the degree of luminosity of a flame depends. One of these, which has been carefully investigated by Dr. Frankland, is the density of the atmosphere in which the gas burns. His experiments began with some observations which he made upon the combustion of candles at different heights. The same candles were burnt first at Chamounix, and then at the top of Mont Blanc, and it was found that the rate of combustion was unaffected by the considerable difference of barometric pressure at these two different elevations; but it was observed that the luminosity of the candles was much less at the higher than it had been at the lower level. The observations were afterwards carried further, by burning a jet of gas in an apparatus in which the atmospheric pressure could be varied at will. The general result, expressing by 100 the illuminating power observed at the ordinary pressure of 30 inches of mercury, was that, down to a pressure of 14 inches, each diminution of one inch of barometric pressure produced a decrease in illuminating power of 5·1. Hence it follows that the ordinary variations of atmospheric pressure, amounting to two inches or more, must produce very appreciable differences in the illuminating power of the same sample of gas. Or again, the same sample of gas burning in two towns at different levels, and thus, being under a different atmospheric pressure, will exhibit different illuminating powers.

Another condition is the temperature of the flame. Other things being equal, the illuminating power appears to be greater in proportion as the temperature of the flame is higher. An interesting experiment has recently been made by substituting for the brass tube with which Bunsen burners are ordinarily furnished, a platinum tube, which can be heated to redness without giving off any substance which will colour the flame or render it luminous; when the gas is lighted, and the tube through which it is passing is heated with a strong horizontal jet of flame from a blowpipe, the non-luminous flame becomes, to some extent, luminous. The explanation given is that a mixture of gas with so much air as to render it non-luminous at its normal temperature of combustion becomes luminous when the temperature of the flame is raised by a previous heating of the mixture. An alternative explanation, which naturally suggests itself, is that the change in the luminosity of the flame may depend, not upon the alteration in the temperature, but upon some change produced in the composition of the mixed gas and air by its being locally exposed to a high temperature previously to combustion. But it is said that if the gas, which, when it is burned immediately after it has been heated, gives a luminous flame, is conducted through a certain length of tube—so that it may have lost the high temperature without any further change in circumstances—and then is burnt, the flame is non-luminous as before. It is said also that in the tubes through which the gas is led no deposit is observable, as would be the case if the changes were due to the production and condensation of some tarry matter by the action of the high temperature on the mixture of gas and air.

There are a number of interesting questions connected with the relation between temperature and luminosity, such as the cause of the interval seen to be interposed between the burner and the flame, that interval probably depending on the cooling influence of the metal tube of the burner. A similar effect is observable if any conducting material, such as a piece of metal, is placed within the flame. In this case a non-luminous interval may be seen, where there seems to be no flame at all, between the cold substance which is thrust in and the body of the flame. The cause appears to be that the contact with such a substance lowers locally the temperature of the burning gas below the point at which combustion takes place. A fact that we often have occasion to observe in a chemical laboratory is this, that if we depress a large vessel containing water into a Bunsen flame, there is a smell of unburnt gas, or partly-burnt gas. No doubt the introduction of a large cold surface into the flame cools the gas so much, that a considerable portion of it no longer reaches the temperature required for combustion, and although part of the gas is burning, part of it escapes unburnt or incompletely burnt.

Another condition which greatly affects the brightness of a flame is the manner of contact between the gas and the air. Indeed, in the construction of burners, the point of greatest importance is to bring the two together in such a manner as that the production of finely divided carbon, in the first place, and a strong ignition of the finely divided carbon in the second place, may be promoted as far as possible. I will show you a very simple experiment, which illustrates the great importance of the manner of bringing together the coal gas and the air. I have a small gasholder here, charged with coal gas; I am able, with the column of water at the top, to obtain a stronger pressure than that at which gas is supplied. Here is an ordinary bat's-wing burner. By supplying the gas at the rate at which the burner is designed to consume it, I have the ordinary flame; but now, on turning on this tap, so as to get a more rapid flow of gas, you observe the effect. First, I have an increase in the size of the flame, and, probably some increase in the total amount of light; as I open the tap more widely, the quantity of gas that is burned continually increases, but, instead of the illuminating power being improved, it is almost destroyed. That is the effect of having gas brought into the air at a high pressure. You see that, although I am consuming much more gas, the burner yields very much less light than it does with quite a small flame. The reason is that gas rushing thus into the air produces a rapid admixture of itself with the air.

In this experiment the distance of the flame from the burner depends upon the relation between the rate of issue of the gas and the rate at which the combustion of the mixture of air and gas travels towards the point from which the gas issues. Bunsen has made experiments upon the rate at which combustion is propagated, by charging a tube with a mixture of oxygen and hydrogen, in the proportions in which they combine, and observing at what rate the combustion of this explosive mixture travels from one end of the tube to the other. When gas is burning, there is always a race in opposite directions, the gas issuing from the burner at a certain rate, and the combustion propagating itself from the outer part of the flame inwards towards the burner at another rate. The *locus* of the inner edge of the flame depends partly upon the absorption of heat by the burner, partly upon the relation between these two rates. In the case of the roaring, non-luminous flame, which I showed you just now, the flame was a long way from the burner, the reason being that the velocity of the gas at the point of issue greatly exceeded the rate of propagation of its combustion, and only was made equal to it by the resistance of the air operating through a considerable space. We are all familiar with the principle of the steam-jet, in which a current of air is produced by sending a jet of steam under strong pressure through a tube to which the air is admitted. Its action resembles that of a current of gas issuing under pressure into a still atmosphere. The jet of steam carries on, by mixing with itself, the air in contact with it; and in the same way gas issuing under pressure carries along and mixes with itself the atmosphere around it. Thus by burning gas under a high pressure exactly the same state of things is brought about as in the Bunsen burner; that is to say, the gas becomes mixed with so large a proportion of air that there is no part of the flame where carbon is deposited and becomes incandescent, and consequently the flame is non-luminous.

I may illustrate this point in another way. I have here two exactly similar Argand burners, which I will adjust so that their flames may be equal, and now I am going to substitute for the chimney of one of them a much longer chimney. You will see, on comparing these two flames, that the difference between them is something like the difference between the appearance of the jet of coal gas burning in the bottle of oxygen, and that of the same jet burning in the air. The burner with a longer chimney has a whiter flame, and, considering only the unit of area, a brighter flame, but on the whole the photometer would show that it is giving less light than the other. For we must remember that the total luminosity of a flame is the product of two factors—of the brightness of the unit of area and of the total number of such units. In other words, flames differ one from another both in brilliancy and in size, and the quantity of light emitted by a flame depends upon its brilliancy and also upon its size. In this case, the effect of putting on the longer chimney is that there is a much stronger draught, and more air is drawn through than is needed for the most advantageous combustion of the coal gas; and, consequently, although the actual flame is brighter, the total amount of light got out of the same volume of gas is less than it is in the other case.

I have here a drawing of one of these Argand burners, made to show you some of the points of importance in their construction. One I have already called attention to—namely, the proportion between the quantity of gas that is burnt and the size of the chimney. Is is of great importance that the chimney, and also the openings for the admission of air below, should be of the right dimensions for the quantity and quality of gas that is burnt; and these are matters of very fine adjustment, so that one ought properly to have a different chimney for the same rate of burning for each quality of gas, or for the same quality of gas burning at different rates. The manner in which the air reaches the gas is also of importance. This sectional drawing shows a cone, the object of which is to cause the current of air to impinge on the flame of the gas. In an Argand burner there is an admission of air through the centre, and so the flame burns in a ring, the air having access to it both within and without. Another essential point, which the experiment I have just shown illustrates, is, that the gas should issue into the air very gently. If it enters with a rush, it mixes itself with the air, and there is a loss of light. Consequently, in well-made Argand burners the holes in the steatite chamber, from which the gas burns, are made very large relatively to the quantity of gas which is to pass through them.

I pass now to the measurement of the illuminating power of gas, and I will illustrate to you the manner in which the estimation of the illuminating power of gas is commonly made, by taking this candle as the unit of comparison, and this burner, which is one of the standard burners that are employed in photometry, for the burner at which the gas is consumed. I have here also one of the discs which are used in photometry. It consists of three paper discs of the same size, the outer ones being of thin paper, and the inner one of stouter paper, with a star cut out in the centre. Either such a disc as this, or one with a round grease-spot in the centre, will serve the purpose. If I place this disc midway between the candle and the lamp, it receives the light of the candle on one side and the light of the lamp on the other, and since the light of the gas-lamp is very much greater than the light of the candle, you see on the side on which the candle is, a dark star on a white ground. But if I bring the disc near to the candle until the light which reaches it from the candle is greater than that which reaches it from the lamp, then the conditions are reversed, and you see a bright star upon a dark ground. If I move it between the two until the light which reaches each side of it is equal, the star disappears. Therefore, the disappearance of the star serves as an indication that the disc is so placed between the candle and the gas-flame as to receive equal light from each. Now we know that the light which comes from any source of light varies inversely with the square of the distance of the object illuminated from that source. We, therefore, can compare the amount of light proceeding from the gas-flame and from the candle, by simply measuring the distance between each of them and the disc. If I were to measure the distances between the candle and the disc, and the lamp and the disc, when the disc is in the position of equal illumination, I should find probably that the distances were very nearly as four to one, the distance from the candle to the disc being about one-quarter of the distance between the disc and the gas-lamp. This would be the case if my standard candle were consuming sperm at the proper rate, and if the gas were burning at the standard rate of five feet an hour, and had the illuminating power of 16 candles. Or, to argue from the observed intervals to the illuminating power; since the amount of light varies inversely with the square of the distance from the source of light, and the ratio of the two intervals is as four to one, the illuminating power of the gas, compared with the illuminating power of the candle, is as sixteen to one. It is in this way that the luminous power of a sample of gas is estimated.

It is, however, necessary that the gas should be burnt under certain fixed conditions. The rate at which the gas is to be burnt has been fixed at five cubic feet an hour, and the burner at which the gas is to be burnt has also been fixed. During the past year the standard burner has been defined by an exact measurement of all its principal parts, the height of the cone and of the steatite chamber above the gallery on which the chimney stands, the size of the holes from which the gas issues, and the internal and external diameter of the steatite chamber. This burner was constructed by Mr. Sugg, and is a most excellent burner, although I believe he has improved upon it since. The fixing of the burner by Act of Parliament was a very important step, and one quite in the right direction, in order to establish a fixed measure of the illuminating power of the gas which the gas companies undertake to produce.

Besides a fixed manner of burning the gas, it is also necessary that there should be a standard of illuminating power; and that which is used in this country for the standard is a sperm candle, one of six to the pound, and burning 120 grains an hour. The ordinary way in which the testings are made is by using two such candles fixed side by side, and comparing their light, by means of the disc in the manner I have described, with that yielded by the gas burning at the rate of five cubic feet an hour at a standard burner. There are certain corrections which need to be made in using the candles. Although they are intended to burn at the rate of 120 grains per hour, sometimes, as one would expect, they burn more, and sometimes less, than that amount. It is assumed, although the assumption is only an approximation to the truth, that the light given by the candles will vary directly with the weight of the sperm consumed; and, accordingly, the candles employed are weighed before and after each testing, and a proportional correction of the result is made, if more or less than the proper quantity of sperm has been consumed. Candles are certainly a very imperfect standard of comparison. The amount of light that the candle gives varies, not only with the rate at which the grease is being consumed, but with a number of other conditions, with the curvature of the wick, with the surrounding temperature, and with the way in which the candle is burning from minute to minute, a different amount of light being produced by a candle when the cup is full of grease, and when it has been drained dry by guttering or the capillarity of the wick. These differences are by no means inconsiderable, and, consequently, photometric observations are always uncertain, however carefully they have been made, since the standard used for comparison is itself variable. I have been endeavouring for some time to obtain a substitute which should be more satisfactory than the candles, and I wish, in concluding this lecture, to bring before you a form of standard light which I have recently devised.

What are the points in a candle which are unsatisfactory, and in what is a change needed in order to obtain a more satisfactory standard? First, there is the uncertainty as to the composition of the candles. I believe that they are not made of pure sperm, which is too brittle, and that the manufacturer needs to mix from 5 to 10 per cent. of white wax, or a small quantity of paraffin, with the sperm, to make a serviceable candle. Next, the number of strands in the wick, which is the burner of the candle, may be varied, and the size and formation of the wick have a considerable effect upon the illuminating power. Also, as has been pointed out, the mode of burning and light of the same candle fluctuates greatly from time to time.

In order to have a material which should be more definite, I propose to employ an "air gas," a mixture of light petroleum with air. Such a gas may be readily obtained of any desired illuminating power. The light petroleum may be procured in large quantities at a moderate price, and by three or four rectifications between 50° and 60° C., a product is obtained which volatilises into the air readily and wholly at a low temperature. The gas which I am here burning was made by passing air through the water which is contained in this Woulfe's bottle, having previously placed upon the surface of the water a measure of light petroleum. The whole operation of making the gas consists in charging a pipette with light petroleum, placing the point of the pipette within the Woulfe's bottle, and allowing the volatile liquid to flow down upon the surface of the water, quickly replacing the corks and connecting the outlet tube of the bottle with a gas-holder, increasing the weight of the counterpoise, and opening the tap. The air then bubbles up through the water, and through the layer of petroleum which floats upon the water; the petroleum volatilises, and mixes with the air. In order that the gas may have a definite illuminating power, it is necessary to take known amounts of air and petroleum, and such a quantity of air, and petroleum so volatile and in such quantity, that the whole of the petroleum employed may volatilise into the air. The reason for having water in the bottle is, that for the volatilisation to proceed regularly, there should be a level surface, which the water provides, and also that a quantity of heat should be supplied to the petroleum, for it becomes very cold by its own evaporation, and that heat the water furnishes.

Next, it is requisite to have a very definite burner. That it should be a good burner is not at all necessary; but it is essential that it should be thoroughly definable. The burner I have here is a very simple one; it is a brass tube, four inches long and one inch in diameter, the upper part being closed by a plug, half an inch in thickness, with a cylindrical hole in it, the diameter of which is a quarter of an inch. The gas, therefore, issues practically at no pressure at all and passes out freely into the air. A pair of such burners are fixed side by side, like the candles in the holder of the photometer. In each tube I have packed a little asbestos, in order to have the means of equalising the proportion in which the gas divides itself between the two. That, however, has no influence at all upon the way in which the gas-flame burns; the upper part is clear, and the gas streams out freely into the air.

The first step towards obtaining a standard gas was to ascertain experimentally, with various proportions of air and petroleum, which proportion gave with this burner the most constant flame, and at what rate each sample needed to burn to give from each gas-burner the light of one candle. I find I can make the gas such that the rate of burning is a convenient round number. The gas is now passing through the meter at the rate of one cubic foot an hour; and the two flames are now giving, but much more regularly, the same light as the standard candles burning beside them.

I have made many experiments, comparing in a photometer the light of such gas-flames with the light of the candles, and altering slightly the proportion of petroleum until I have got this equality. I think that this gas-flame will have, as a unit of light, the advantage over the candles of greater definiteness of substance, and far greater definiteness in the conditions of burning. I find also that the flame is very much steadier in the photometer than the candle-flame. The whole experiment lies in the hands of the operator; he has not to depend on the maker of the candles, for he makes the standard combustible himself. The burner is perfectly definite, and the gas itself is very readily and quickly prepared. The rectification of the petroleum is an easy operation on a scale which yields enough light petroleum for the preparation of from 10 to 20 samples of standard gas.

This question of the unit to be employed in the measurement of the illuminating power of coal gas, which I have thus attempted to solve, is the last topic on my list, and concludes the course of lectures which your Council have done me the honour to ask me to undertake.

DOMESTIC ECONOMY CONGRESS.

The following papers were among those brought before the Congress at Birmingham:—

NEEDLEWORK.—RESULTS OBTAINED IN SOME ELEMENTARY SCHOOLS.

By Miss Kenrick.

Needlework is not so well taught now as it was forty or fifty years ago, or it would, perhaps, be more correct to say that girls now leaving our elementary schools do not sew as well as their mothers and grandmothers did.

It is not difficult to explain the causes that have brought about this result. At that time it was considered very doubtful how much reading and writing it was wise to teach girls, but there was no doubt on the advisability of making them good needlewomen, and they were taught much younger than it is now usual to begin. It was not an uncommon thing for girls of seven to have made a shirt, and I know of one instance of a girl who, before she was six, had entirely made one, the front of which was elaborately frilled and pleated, as was then the fashion. It would be wearisome to quote from the old manuals on the subject in support of these remarks, many of which were, however, more exacting than Schedule 3 of the Code of 1877, the publication of which created in March last such feelings of dismay in the minds of teachers and managers of elementary schools.

Such feelings were not surprising, for, for many years, the Educational Department had contented itself with insisting that needlework should be taught, but no rules were laid down as to how it should be taught, nor was any standard of proficiency fixed; at the same time the standard in other subjects was being slowly but constantly raised; more must be taught in the schools; the pupil teachers were expected to learn more. The same process was going on in the training colleges. The evil reached its height when payment by results for other subjects became the order of the day.

It is well known that the average attendance in girls' is lower than it is in boys' schools. If a child is wanted to help at home it is always a girl who is kept; but if a mistress was to earn the same amount of grant that a master did she must teach the same subjects and in less time; if, in addition, three or four hours a week were devoted to sewing, the difficulty was increased, and unless the inspector of the district was particular, or the school managers made a point of its being thoroughly taught, the temptation to shirk the subject was great. To remedy this, the Department was asked to make needlework one of the subjects for passes in which a grant could be earned. This was done, but as it was left to each inspector to fix the standard for his district, the standards varied greatly in different parts of the country.

There is still another difficulty that teachers have to contend with; the method of teaching is defective. The plan that answered for a few scholars utterly fails when tried with a number. Our large schools would utterly break down if the teaching were what it was fifty years ago. Reading is now taught collectively instead of individually, and the same change must be made with needlework before we can hope for satisfactory results.

The London School Board, more than three years ago, laid down a well-considered scheme of needlework, in which the different stitches were arranged progressively and apportioned to the six standards.

This scheme has worked admirably, and wherever it has been honestly tried, in connection with position drill and simultaneous teaching, has produced results little short of marvellous, especially in infant schools. Children of four can be taught to turn their own hems without assistance, to their great pride and pleasure. At the same age they may be seen threading needles, No. 7, egg-eyed. Both these exercises are good training for eye and hand, and are not any more difficult than some of the kinder-garten lessons, and are equally useful. Long before they are seven, these little maidens will be able to make a plain pinafore, and the mothers are not a little proud of their attainments, the demand for garments made in infant schools far exceeding the supply. The head mistress of an infant school expressed her astonishment at the interest and intelligence shown by the children, who discussed with her how the work should be done. In another school, which had only been opened two months, pinafores were being made; in a third, the children were unexpectedly called on to fix, sew, and fell seams before her Majesty's Inspector, which they did well and correctly in 25 minutes. There were 500 children in average attendance, and garments were being well made by children of four and five. In a fourth school, twenty-six infants, just going to be transferred to the girls' department, all showed one or more garments besides knitting, one five and another seven well made garments as her year's work. In a very poor part of Lambeth infants under six make pinafores entirely without assistance, and have done so for two years. At another school, infants fix their own work, including pleating, and in many schools gathering is done by children under seven. At St. Clement's School, Bristol, the most intelligent of the infants were taught marking by their late mistress. Besides their sewing, all these children were taught knitting. The experience of many teachers is, that the little ones "so love knitting;" and many infant schools can show muffatees—four needles—and socks made by children under seven. In one, at least, the boys are also taught knitting, and all this is the result of only three hours teaching per week. Let us now pass to the girls. In one school opened in August, 1875, on 23rd of October, 1876, 360 were seen, each one diligently at work on a garment, and almost every one was fixing her own work. In another school were 300 girls, nearly all from the streets, in three months from the time of opening, all were seen at work on garments. Again, where the average attendance was 136, and the staff considered of a head mistress, one assistant, and one candidate, in the first thirteen months 110 garments were sold, and 100 were in hand, besides knitting. At another all the first class—girls of 12—cut out, and a half-timer cut out entirely alone, and tacked together a child's frock body. Placing and cutting out are most important parts of needlework, and as long as they are untaught a mistress fails as much in this subject, as she would in arithmetic, if she were satisfied with teaching her pupils to work their sums after herself writing them on their slates. Undoubtedly compulsion presses hardly on the mothers, and the efficient teaching of sewing may, therefore, be advocated as a matter of good policy, for if a girl learns at school to make and mend the family's clothes, she will be such a help to her mother as will go far to reconcile her to the additional work that has been thrown on her by her daughter's attendance at school.

Appended is a list of the needlework shown in connection with this paper:—

Needlework (Girls).

Plain print pinafore, made in 3 hours 25 minutes; age of maker, 8 years.

Chemise (unbleached calico), by girl who had not been in infant school; age of maker, 8 years.

Holland pinafore, with fulled body, and skirt put into band. I. Standard.

Print pinafore; sides fixed and hemmed, and part of bottom fixed in 2 hours. II. Standard. Age of maker, 9. 12 months after this school was opened every girl fixed her own work.

Boy's shirt (white calico); neck, wristbands, and neck gussets stitched; button-holes well made. School only opened two years. Schedule 3 in full operation.

Boy's shirt, with tucked front. Mixed school.

Chemise (full size), white calico, gathered into band at neck; entirely fixed and made by girl aged 11 years.

Boy's shirt (white calico); stitching of neck and wristband very fine; button-holes excellently made; age of maker, 11 years.

Child's print frock, with full body, set into band at neck and waist; skirt tucked; entirely fixed and made by girl aged 11. All the class, taught by pupil-teacher in three years, doing the same. Premises inconvenient, and in poor part of Lambeth. Patching on print; pattern joined; patches triangular and on the cross. IV. and V. Standards.

Stocking web darning; 4 specimens. Standard VI.

Table-cloth darned at back; 4 specimens.

Knitting.

Dish-cloth, or duster, made of squares of plain and purl knitting, with plain darning and grafting. Mixed school.

Bath towel made of strips of garter knitting.

Infant's Work.

Hem turned down by child aged three years ten months.

Strips (calico) hemmed and seamed together by child aged four years eight months.

Ditto, by child aged five years seven months.

Ditto, by child aged six years eight months.

Strips hemmed and seamed together, made into duster; patchwork, scraps of holland with border of hemmed calico (economy combined with difficult practice); plain print pinafore (three yards of hemming made in 2½ hours) by child aged seven years.

Holland pinafore seamed on shoulder by child aged seven years.

Shaped holland pinafore put into band at waist by child aged seven years.

Plain print pinafore seamed on shoulder, the result of teaching of child aged under seven years.

Shaped holland pinafore pleated into band by child aged under six years.

Patch, white calico, excellently seamed and hemmed by child aged seven years.

Baby's shirt entirely fixed and hemmed by child aged seven years.

Child's chemise gathered into band, entirely fixed and made by child aged seven years.

Plain print pinafore made in three weeks nine hours, by child aged five years six months.

Holland pinafore with gussets to armhole and string sewn on, entirely made by child three years ten months.

Knitting.

Bath towel made of strips (cotton), knitted by boy aged seven.

Strip knitted by girl aged seven.

Muffatees, wool, plain and purl, two needles, by girl aged six years eight months.

Ditto, by girl aged six years eight months.

Leg of sock, plain and purl at top, four needles, by girl aged six years eight months.

Ditto, by girl aged six years five months.

Ditto, by girl aged five years nine months.

CLOTHING AND ITS MATERIALS.

By Joseph J. Pope,

Staff-Surgeon, Army (retired).

It is only possible, in the allotted time, for me to offer you a few short notes on this important subject; yet I trust they may receive at your hands some further consideration. I shall avoid troubling you with any historical or commercial facts, or descriptive accounts of the sources or manufacture of the varied articles of modern clothing, preferring to draw your attention to some points which I think of interest and importance, as affecting our individual hygienic and domestic economy.

Clothing, a distinguishing characteristic of man, is essentially a result of civilisation, and has borne a relation to its advancement or decline, in quantity, character, and variety. Man, as a wild animal, could doubtless exist with little or no clothing, but such a state would demand continued energy and incessant activity, a condition of life not natural to the human race. And we find, therefore, that as man has become civilised, associated with commerce and society, he has provided himself with sheltering arrangements and put on clothing.

The principal use of clothing is the maintenance of animal heat, whilst its secondary uses will combine protection from external heat, defence from the bite of insects, prevention of the accumulation of dirt, and removal of undue pressure on certain parts, as we see in the use of sandals and shoes. It is fit, however, that the marked distinction between the maintenance and production of warmth should be recollected. Clothing cannot create animal heat. Food, and food alone, is the legitimate source, and clothing merely supplementary. "The best fuel in winter is a well-filled stomach." Sir John Ross truly said, "that starvation from cold follows too soon starvation from food." Being an adjunct to food, it follows that, in colder climates, the warmer we are clad the less necessity for increased fuel, and so we find furs and flannels for our Arctic travellers, whilst we hear from Captain Speke, that the wardrobe of a native African chief frequently consists of an iron bracelet and collar.

Man has adapted substances from both animal and vegetable kingdoms, to make into clothing. Those of animal origin—furs, hair, wool, silk, and leather, being all worse conductors of heat, and so warmer, than the vegetable fibres of cotton, flax, hemp, and jute. The raw material should be light, porous, and durable, and a bad conductor of heat. For all these qualities wool certainly claims the first place. Cotton, which is a species of vegetable wool, has, however, but a small share of these properties, for it is exceedingly hard, does not absorb water, nor shrink in washing, and its conducting power is much more rapid than in wool itself. Linen is the coolest and smoothest of all materials used as clothing. It is the presence of air in a substance that makes it a bad conductor of heat, and this you may realise at once by the different sensation experienced on touching wood and iron.

The wool and hair of animals, and the fibres of plants, contain air in their structure, and in direct proportion to its amount, so they vary in their warmth-maintaining power. Dr. Hammond's experiments are very decisive on this point. He found that a vessel of water, temperature 150° Fahr., cooled down to 140° Fahr., if left uncovered, in 5 min. 11 sec. If, however, the vessel were covered with linen shirting, it lost the 10 degrees of heat in 7 min. 24 sec., with cotton shirting in 9 min. 42 sec., with white flannel in 12 min. 35 sec., and with woollen cloth (dark blue), in 14 min. 5 sec.

If we desire to use clothing as a protection from direct solar heat, we have but to attend to colour. Texture has nothing whatever to do with it. In the shade colour has no result, and we obtain our effect from mere thickness of material and conducting power. As far as colour is concerned, white reflects direct heat and light (some of the latter rays being converted into heat rays), and at the same time it radiates much less than black or darker colours. Grey, yellow, pink, blue, and black, follow in order.

It is curious how we have, in our colour of dress, gone directly opposite to nature. Everywhere around us we see white associated with cold, and yet it is in the hottest season that we employ it as a covering for ourselves. May it not be worthy a thought that the radiating power of black and darker colours offers a facility for rapidly throwing off heat generated within. And, again, white clothing would really form the warmest in winter, due regard being paid to power of conduction and thickness of material. The old coachman was correct when he stuck to his white duffel coat as the proper thing for winter and summer.

There can be no doubt but that the wearing of dark clothes has arisen simply from principles of economy—the expense of soap and water—and not comfort or use. We must mind our economy does not harm us; dark clothes get as dirty as light ones, and the fact that we do not notice this, may cause suffering and disease that could be easily avoided.

Woollen articles of clothing have a more vitally important character, they absorb water freely, not only into the fibres (hygroscopic water), but between and amongst the fibres, in the interstices of the material (water of interposition). It is this power that renders wool so superior to cotton and linen.

Professor Parkes has proved that, in comparison to either cotton or linen, the absorbing power of wool, according to relative weight, is double, and according to surface, quadruple.

In condensing the watery vapour constantly given off from the skin of the healthy human body, woollen material restores the latent heat to the system, and is thus always warm. I maintain that its free use is imperative in our alternating and fickle climate. Chills are most fatal conditions, and if they are to be avoided, and a healthy standard of warmth maintained, wool must be worn next the skin. There is but one disadvantage in the use of woollen clothing. It shrinks in washing, and the fibres become smaller, harder, and lose a proportion of their absorbent power. Our manfacturers would do well to battle further with this evil, and by mixtures of wool, or various combinations of silk, cotton, or other material, to produce an article free from the objection, and yet possessed of water-absorbing power. Wool will bear a mixture of 40 to 50 per cent. of cotton, and yet act satisfactorily as a chill-preventing agent.

To the minds of some, the mere mention of woollen garments suggests an overheated and irritable condition. I would impress upon them the fact that wool can be, and is, woven into material of an almost gossamer-like character, as well as into thick mufflers and heavy blankets, and its use can be adapted to all times and seasons.

But it is at night time that the protective influence of flannel is so valuable. During sleep, the nervous system quiescent, the circulation slow, the senses numbed and at rest, the body is less able to resist changes of temperature, chills, and other evils. Then, flannel clothing is the best guardian of our health and comfort. Further, let me add a word on behalf of babies and young children, who are also unable to resist the external influences of cold. They should always be more warmly clad than adults. The notion that is still held of the possibility of "hardening children," by exposure and cold bathing, cannot too soon be abandoned. It is cruel, wrong, and often fatal. The younger the animal, the less power has it of resisting cold. John Hunter's rules should be written in every nursery. For rearing children healthily, he says, there must be "Plenty of sleep, plenty of milk, and plenty of flannel."

May I also hint that low dresses are dangerous luxuries. It is a fact that, within the past few weeks, the powers at the Admiralty have issued orders for the flannels of our seamen "to be cut square across the breast, and close up to the neck, so as to afford more protection to the chest."

How strangely this contrasts with the stringent order for "low dresses" at all her Majesty's drawing-rooms and receptions. It suggests either a sad want of consideration, a disregard of individual health, or the foolish conclusion that ladies are in this respect hardier and more capable of enduring exposure than the weather-beaten tars of the British Navy.

There may be some who look upon my earnest support of woollen clothing with favour, but who regret its extra pecuniary cost. To such I would point out that in common paper—white, brown, or even newspaper—we have an almost equally warmth-sustaining material to wool. For the poor it is invaluable, and can be employed as a lining to a coat or waistcoat, as a blanket or quilt, or even as a petticoat. Ordinary brown paper was our grandmother's "Allcock's Plaister," and right good service it did. Wadding or wool, quilted between two sheets of paper, forms the best and lightest chest protector, and I need not say the cheapest.

An Irishman, talking of his experiences as a sailor in the Arctic Expedition, said, "'Deed, indeed, yer honor, cowld was'nt the name for it. If it hadn't been for my paper blanket, I believe, sir, I'd have died every blessed noight of my life."

One point with reference to the water-absorbing power of articles of clothing requires attention. I rarely see now the large "clothes-horse" in front of the kitchen fire on a Saturday night. As a boy, to have put on clean linen without it had been "well aired," would have been treated as a suicidal act, and been met with prompt punishment. All clothes should be aired. An ordinary shirt, exposed to no unusual circumstances, contains $\frac{3}{4}$ of an ounce of water, a pair of trousers an ounce, a coat two ounces, and a waistcoat $\frac{1}{4}$ ounce, and so on in proportion. This necessarily is evaporated by the loss of heat from the body, which is thus more or less reduced. With sick, feeble, or aged persons, with infants and young children, this becomes an important consideration, and should receive attention at your hands.

I cannot now offer any remarks upon the style of modern clothing. I would only say that having selected the material with a due regard to its properties, it should be worn with more respect to comfort than custom, with more deference to the laws of health, than those of fashion.

The great points are avoidance of undue compression, while the vital parts are protected and the healthy temperature carefully sustained. Chimney-pot hats, stiff collars, corsets, false and heavy head-dresses, trailing skirts, high heels, and low cut dresses fail in all these requirements.

When our clothing shall be placed more effectually under the rule of reason and science, and freed from the fatal incubus of fashion, we may hope to see it occupy its proper position in our domestic economy.

THE IMPORTANCE OF TRAINING YOUNG SERVANTS IN HABITS OF CLEANLINESS.

By Mrs. Watson.

I am invited to communicate to the meeting a paper on "Cleanliness." Under this designation I shall include everything that is meant by order and neatness, whether in person or in household matters, and not the absence of dirt.

That cleanliness is next to godliness, is a household proverb so firmly established among us, that many people can with difficulty be persuaded that it is not to be found in the Bible. But, though a household proverb, it is far from being an established household principle of action.

True, indeed, the reputation of England for cleanliness stands high among the nations; but when we come to absolute and not merely comparative merit, we have indeed many shortcomings to deplore. Where, then, does the responsibility rest? To what quarter are we to look for improvement in our standard of domestic cleanliness? My answer is, emphatically, to the wives and mothers of England; to those who have the direction and superintendence of households, whether large or small, and who are entrusted with the care and management of domestic servants, both male and female.

The work must be a work of time. It will take a generation or more to carry it out; and it can only be effected by rousing those who have the management of households and the ordering of servants, to a sense of the responsibility they are under in properly training those servants. Every mistress of a household, whether she has one or a dozen servants, should regard them, and especially the female servants, as the master of a trade regards his apprentices, as people entrusted to her care, not only to work for her, but to be taught by her; not only to do tasks assigned to them, and to be scolded, or perhaps dismissed, when the work is badly done, but to be taught, and guided gently and firmly; to have their faults pointed out, and to be encouraged to overcome them. Then these girls, when in time they marry, and become mothers, will hand down to their children the habits of order and cleanliness they have themselves acquired. For it needs only that the habit should be formed, to render cleanliness and order as easy and natural as dirt and disorder. The means of ensuring it are so cheap and simple as to be within the reach of the humblest peasant family.

Now, it will require, as I have said, a generation, if not longer, to bring about such a state of things as this. Because it can only be done effectually by imparting the love of cleanliness and order to the wives and mothers of our poorer classes. At present they are sadly deficient in this respect, and they can only be improved by the influence of those above them. The best and most effectual way in which they can exert this influence is in their dealings with them as servants in their families.

The majority of the female children of our peasants and artisans go to service on leaving school at thirteen and fourteen, and continue at service for something like ten years on an average. It is exactly in these ten years that the training they so much require should be imparted to them. They cannot get it to any purpose while at school—no sufficient time can be spared for it. They must learn while at school, if they ever are to learn, the rudiments of their very simple education, reading, writing, and arithmetic, with the extremely important item of needlework. Neither do I anticipate any very marked results from resort to a training school, for the express purpose of learning domestic work after leaving the national school. At the most, but a very small proportion of the whole number could afford the time for this additional instruction, even if the money were forthcoming. A few months' actual work under the superintendence of a conscientious and able mistress would be more valuable than as many years' theoretical instruction in a training school. It would necessarily be theoretical, for each day would have its regularly appointed routine, and the countless interruptions and unforeseen hindrances which have to be encountered in even the best conducted households, could not be provided for. Indeed, I have, of my own experience, known cases (and, for the reasons I have just referred to, I can easily believe that they might frequently occur) in which a course of instruction in a training school has proved a hindrance rather than an advantage to the pupil. I knew a scullery-maid in a large family, who had been brought up in an admirably-conducted training school, and she actually thought it an insupportable grievance to be called upon to prepare the plates for dinner on Sunday, because in her training school she had never been accustomed to Sunday work.

The real training schools for the daughters of our poorer classes should be the families in which they are employed as domestic servants, and the training mistresses should be the ladies presiding over these families, and the servants under them, each in their several degrees. Their work will be generally slow, and frequently disheartening; they will have to battle with many defects of character and intelligence, with obstinacy, timidity, irritability, and stupidity, and, worst of all, with that impatience of control which will often induce a girl to throw up a good place, where she has received careful, conscientious instruction. This is a great drawback, but it is unavoidable, for, though unfitted to be their own mistresses, the position of servants when earning their own living makes them, however young, independent even of their parents, and gives them the power of throwing up a place for the merest whim. Still, the mistress should always remember that some good has been done. The girl is certain to carry away with her some fruits of the care and pains bestowed upon her.

It is, indeed, sad to see how terribly ladies who have the charge of servants neglect their duties to them; not only those ladies who devote themselves chiefly to enjoyment, but those who are conscientiously endeavouring to make themselves useful in their generation. They occupy themselves abroad, and forget the vast field for their labours which lies neglected at home. They are busy teaching in schools, or attending public meetings, perhaps in distributing tracts, and in all this work they forget the claims upon their attention of the poor servant girls, who are entirely dependent upon them for that supervision and instruction which is necessary to make them more careful in their walk through life.

In such a paper as the present it would be impossible to enter into all the details of the domestic management of a household. But no house, however small, ought to be without a set of rules committed to writing, and accessible to all whom they may concern. At first sight, and to a superficial glance, such a code of rules might appear as needlessly minute, vexatious, and intricate as the receipts in a cookery-book, but a little attention would prove how easy it would be for every one to follow them, and how compliance with them would make the work of the day a pleasure rather than a burden. By implanting a feeling of responsibility for the education of their servants in the minds of mistresses, and by a little judicious management on their part, the trivial round and common task of household duties would no longer be a dull and irksome routine, but would be transformed into bright and holy work. Mistresses would feel that in themselves and their servants they were making their daily labour and their religion one. They would impart to those under them a practical, and not a mere pedantic, notion of the dignity of work. They would make them feel that even the humble tasks of sweeping and dusting have a share, as well as our Bible readings and church-goings, in disciplining our souls for God's service. And instead of ladies seeking abroad, as many do, for opportunities for doing good, and meeting with disappointment and failure, they might find their work all ready to their hand—a work at which they might labour with the certainty that their labour would in time, although possibly not in their own time, return a rich harvest.

SCHOOL DRILL.

The annual inspection of School Board boys was held in the Regent's-park, on Thursday, the 19th inst. There were present upwards of 10,000 boys, and an immense number of spectators. A very large square was formed in the open part of the park, the square being kept by the people themselves, a policeman or two, and a few park-keepers. The "saluting point" was shown by the "challenge banner," given by the Society of Arts. At this point were Sir Charles Reed, Sir E. H. Currie, late Deputy-Chairman of the Board, the Rev. John Rodgers, the Hon. Lyulph Stanley, Professor Gladstone, Mr. E. C. Tufnell and Mr. T. R. Tufnell (representing the Council of the Society), and many members of the School Board. The boys were massed in a brigade of column in divisions, according to the quarter of London from which they came, and the boy bands from various training establishments lent their aid. Of the companies who were to drill, the Tower Hamlets division sent 52, mustering in all 2,236; the Southwark division sent 21 companies, with 283; the Chelsea division, combined with Westminster and the City of London, sent 18 companies, with 774—the City and Westminster, which have very few Board schools, sending only one company each in this total; the Lambeth division, 49 companies, mustering 2,097; the Greenwich division, 25 companies, 1,075; Finsbury division, 31 companies, mustering 1,333; the Hackney division, 31 companies, mustering the same number as the Finsbury; and Marylebone, 20 companies, mustering 860. In all there were 247 companies, with as many boy commanders and 494 guides (taking the place of colour-sergeants), and 9,880 boys in the ranks, or a total of 10,621. After all had marched past in companies, a company of Marylebone division boys, from Werrington-street Schools, St. Pancras, another company from Kender-street, Hatcham, in the division of Greenwich (the school which won the banner last year), a company from Olga-street, Bethnal-green, in the division of Hackney, and another, were called upon to march again. After various tests, the banner was awarded to the Hatcham boys.

MISCELLANEOUS.

SCHOOLS OF COOKERY.

The following letter and memorial have been addressed to Lord Sandon:—

[Copy.]

Watford, 21st July, 1877.

My Lord,—At a Conference of persons interested in cookery schools, held at Birmingham yesterday, the enclosed memorial to the Lords of the Committee of Council on Education was adopted.

The subject of "Food and its Preparation" would doubtless require careful definition. It would probably embrace parts of two or three subjects already taken up by the Science and Art Department, and would in this respect resemble the subject last added to the list (Agriculture).

Persons wishing to be teachers of cookery would seek to add the certificate in food to their qualifications in practical cookery, and the teachers of elementary schools in which Domestic Economy is taught would have an opportunity of proving themselves to be qualified in this important branch of their work.

I have, &c.,
Newton Price.

The Rt. Hon. Lord Sandon.

[Copy.]

To the Lords of the Committee of Council on Education.

We, the undersigned, being connected with schools of cookery, are of opinion that it would be advantageous for the promotion of the scientific teaching of cookery, if "Food and its Preparation" were added to the subjects of examinations conducted by the Science and Art Department; and we are further of opinion that this examination would be of special advantage in connection with the requirements of the Education Department in respect of Domestic Economy.

Mary Edmunds, Hon. Sec. Birmingham School of Cookery.
Eleanor E. Smith, School Board for Oxford.
M. Bramston, School of Cookery, Winchester.
Frances Elizabeth Lupton, Hon. Sec. Yorkshire Training School of Cookery.
Ellen Rowland Williams, Liverpool.
E. Emily Robinson, Hon. Sec. of the Yorkshire Training School of Cookery.
Elizabeth H. Fenwick, Hon. Sec. of Leeds School of Cookery.
C. E. Guthrie-Wright, Hon. Sec. Edinburgh School of Cookery.
Amy M. Mander, Hon. Sec. Wolverhampton School for Cookery.

Mary Anne Garlick, Treasurer of the Leeds School for Cookery.
Edith Clarke, Lady Superintendent of the National Training School for Cookery.
Newton Price, Watford, Secretary to the Meeting.

King Edward's School, Birmingham, 20th July, 1877.

THE METROPOLITAN FIRE BRIGADE AND WATER SUPPLY.

A close, and it is generally acknowledged an impartial, examination of the evidence by the Select Committee of the House of Commons on the constitution of the Fire Brigade of the metropolis, and the means of preventing fires, conducted under the chairmanship of Sir H. Selwyn Ibbetson, has resulted in what is declared to be a clear and able report, with well sustained conclusions which it is satisfactory to state are in affirmation of the main conclusions arrived at by the Select Committee appointed by the Council of this Society, namely:—That the supply of water should be placed on the constant system, and that all the streets should be hydranted with the least delay; that the water systems of the eight separate water companies should be placed under unity of management on a public footing; and that the Fire Brigade service should be transferred from the Metropolitan Board of Works to the Metropolitan Police service. The evidence collected at the instance of the Society was communicated to the Select Committee of the House of Commons by Mr. Edwin Chadwick. The following are the conclusions of the report of that committee, in respect to which, however, it is felt that for their application further investigation of scientific details, especially as to the distribution of water, and the complete removal of fouled or waste water, will be required for efficient and economical administration, for which purposes and on the subject of improved sources of supply, the special committee of the Society will continue its investigations. A confident expectation is entertained that on further examination it will be found that for the purposes specified no additional rate will be needed, and that the expenses may be defrayed from the economies derivable from unity of the administration of the water supplies, a topic on which the Select Committee of the House of Commons did not enter.

The following are the resolutions of the Parliamentary Committee:—

1. That the statutory arrangements for the extinction of fires in the metropolis, whereby the fire brigade is administered by the Metropolitan Board of Works, two separate police forces exist side by side, and the water supply is sectionally furnished by eight independent companies, are not such as to furnish adequate protection to life and property; and contrast unfavourably with provincial systems, where the fire brigade, water supply, and police, are under a single authority; and that consolidation of management, so far as is practicable, is urgently required.

2. That the fire brigade should be transferred from the Metropolitan Board to the Commissioner of Police for the metropolis, so, however, as to constitute a distinct branch to be placed under the immediate command of a separate assistant-commissioner, and to be authorised to act within the City of London as well as in the metropolis.

3. That the members of the fire brigade should be entitled to superannuation on the same terms as those applying to other constables of the metropolitan police force, liberal provision being made for those now serving in the brigade.

4. That the police-stations and the fixed points should be used as fire brigade stations, or as places where small engines or other appliances should be deposited, and that all police-constables, both of the metropolis and City, should be auxiliary to the fire brigade, but that, as now, each force should be empowered to act only within its own jurisdiction, excepting on a special requisition.

5. That in lieu of the limit of one halfpenny on the consolidated rate, there should be substituted a limit of a penny rate on the metropolitan police district, and that the amount of the Government contribution should be correspondingly increased.

6. That the contribution from the insurance companies should be continued at the present rate, and that a charge should be levied on owners of uninsured property saved from fire.

7. That hydrants should, without delay, be affixed to mains and service pipes wherever there is a constant supply, and should follow the extension of such supply.

8. That the water systems now belonging to the various companies should be consolidated in the hands of a public authority, which, in dealing with the questions of constant supply, pressure, and pipage, should be bound to have regard not only to the convenience of consumers, but also to the requirements for the extinction of fire.

9. That no new theatre, or large music-hall in the metropolis should be finally licensed until certified that, in respect of position and structure, it satisfies all due requirements for the protection against danger from fire, and that the Metropolitan Board should be the certifying authority.

10. That with respect to existing theatres and halls, the Metropolitan Board should have the power to call on the proprietor to remedy such structural defects as appear to the Board to be the cause of special danger, and to admit of being remedied by a moderate expenditure, option being allowed to the proprietor to refer the whole question to arbitration.

11. That with a view to the prevention of danger from fire, the Lord Chamberlain and the Justices should be authorised to make regulations as to the management of theatres and music-halls under their jurisdicton; that for the purpose of ascertaining whether such regulations are complied with, provision should be made for the inspection of these buildings; and that any breach of the regulations should be punishable on summary prosecution.

12. That effect should be given by the Legislature to these recommendations.

MUSICAL PITCH.

The following appeared in last week's *Nature*:—

Koenig's Tuning-forks.

The letter of Herr Koenig inserted in *Nature* (vol. xvi. p. 162) did not come under my notice till July 8. On October 27 last year I counted all the 64 sets of beats in Herr Appunn's tonometer, one through 15, the rest through 20 seconds, with a pocket chronometer which was gaining less than four seconds a day, and found every set of beats perfectly true. The perfection of the consonances, more than 80 of which I tested mechanically, by observing the beats that arose on flattening one of the two consonant notes, seemed to me to eliminate all possible error of irregular counting. The suggestion now is that the beats were perfectly regular and uniform, and that no exception need be taken to my counting, but that Herr Appunn's pendulum was originally incorrect, to such an extent that what appeared to him 80 beats in 20 seconds, were only 79·27, and that my chronometer was not sufficient to detect the error. If this were the case, all the numbers on Herr Appunn's tonometer would have to be reduced by as nearly as possible 9 in 1,000, which would make them agree with Herr Koenig's. I shall, therefore, have to re-test the tonometer with a larger chronometer, and if possible count each set of beats for a longer time. I shall not be able to undertake this examination at present, but I shall not neglect doing so, and will inform you on the result. It is right, however, to say that on July 9th and 10th I received communications from Prof. McLeod showing that his improved instrument for counting vibrations gave results almost exactly agreeing with Herr Koenig's numbers. The marked difference of Herr Appunn's and Herr Koenig's numbers will I hope lead to such an examination of the subject as will result in an accurate determination of pitch that can be generally accepted.

Alexander J. Ellis.

Kensington, July 11th.

P.S.—I have this morning received a letter from Herr

Appunn, in which he tells me that the letter of Prof. Helmholtz, quoted by Herr Koenig, was received eleven or twelve years ago, and that the error of Herr Appunn's pendulum there pointed out was corrected more than ten years ago. He also refers me to pp. 46-7 of Prof. W. Preyer's tract, "Ueber die Grenzen der Tonwahrnehmung," Jena, 1876, in which, by a calculation there detailed, Prof. Preyer shows that the absolute pitch of two of Herr Koenig's forks, which should have been 128 and and 256, were 129·1 and 258·2; and says that "the determination is as exact as possible, so that the first decimal place can be fully trusted." I made another fork to be 258·4, and I know by comparison of several specimens that Koenig's forks do not always agree within more than ·2 vibrations. A. J. E.

July 16.

PHILADELPHIA EXHIBITION REPORTS.*

Ceramic and Glass Wares.

The second report in the volume is by Mr. Soden Smith, on "Ceramic and Glass Wares." The Exhibition as a whole was extensive and complete, as regards the different descriptions of pottery and glass. In porcelain Europe was not strongly represented. No special collection came from Sèvres, and many German and English manufacturers contributed little or did not exhibit at all. In stoneware, faïence, and terra cotta, the Exhibition was stronger. The collections of Oriental pottery were very extensive, especially that from Japan, which Mr. Smith considers the "most important contribution to the ceramic department brought together by any one country." He remarks on the tendency towards deterioration that has been caused by anxiety to supply rapidly a foreign and undiscriminating market. He, however, thinks that the occasion of the Exhibition seemed to have drawn the attention of the Japanese artists to the danger of abandoning the ancient traditions of their country. Amongst the points noticed was the evidence of technical skill shown in some special articles, such as a pair of vases eight feet high, and some large flat slabs as much as six feet across.

The Chinese collection was also very fine, and though there are certain qualities in which the modern artists are inferior to their predecessors, there were yet some examples shown, "such as no makers of hard porcelain in Europe have yet equalled in their technical excellence as specimens of potting." The colours were fine but inferior to those in ancient Chinese work.

In regard to the European collections generally, the reporter says that he noticed a paucity of invention both in respect of new processes and new applications of material, though at the same time he remarks on the readiness with which manufacturers adapt their art to the changing demands of fashion, and on the extended facilities which mineralogy and chemistry have afforded them. Among novelties the following are mentioned:—Red and buff-coloured ware from Copenhagen, Watcombe terra-cotta, Lambeth stoneware, and painted faïence. In the application of pottery to architecture, chiefly in the form of terra-cotta and wall tiles, the Exhibition contained much that was suggestive, and Mr. Smith speaks approvingly of this revival of an ancient practice.

After the introductory remarks, the substance of some of which is given above, the report proceeds to deal in detail with the contributions of the several countries, commencing with the United States. Besides being remarkable for its extent, and for the evidence it afforded of abundant raw material, the United States collection was important "from the direct and formidable challenge it offered to similar wares of European, and especially of British manufacture." The chief seats of the industry are Trenton, in New Jersey, and Greenpoint, New York. It appears that potteries of a superior class were first established in the States about 1760. During the war with Great Britain, 1812-1815, a short lived impulse was given to the American pottery manufacture, but at the end of the war many potteries which had been opened were again closed. Till 1830, no effort was made to enlarge the number of potteries, the country being mainly dependent on its imports for all but the cheaper and bulkier sorts of ware. About that year a porcelain manufactory was started in Philadelphia, but though it produced much work of a tolerably high quality, it was not successful. At Trenton, in 1854, an attempt was made to produce the "white granite" ware, of which large quantities were, and still are, imported into the States. Till 1870, however, this hardly became a commercial success, but now this manufacture is a large and important one. The processes employed are of the most improved kinds, and the potteries are "well arranged, very orderly, and highly commendable." The pottery works of all kinds in the States use a capital of about £2,000,000, and give employment to 12,000 to 15,000 persons. The annual out-turn is about £1,600,000 to £2,000,000 worth of goods.

Great Britain Mr. Smith places first among the countries of Europe in this class, though the names of several well-known firms were absent from the list of competitors. The range of objects shown was very wide. One of the specialities in the British Section was the ornamental stoneware, both in its application to architectural purposes, and in vases, &c. The terra-cotta, also, from this country was superior to that exhibited by any other country, one colossal group, the "America," reproduced from the Albert Memorial, being probably the largest work ever attempted in this material. Terra-cotta is now coming into use in America for building purposes, most of it being exported from England.

Many of the tiles shown were of a high degree of artistic excellence; but it is considered that for floor tiles, which have to endure much traffic, a stronger material, or, rather, one that will resist wear better, is wanted. It is found that such tiles also wear unevenly, one colour yielding more rapidly than another, and thus producing an uneven surface. In the rougher sorts of paving tiles this difficulty is not found; the "terro-metallic" fire-clay tiles are very hard and dense.

The exhibition from France was of considerable extent and variety, yet it was considered not fairly representative. "When some delicate kinds of porcelain had been examined, and the larger but not satisfactory collection of decorative faïence, the reproductions of Palissy and majolica wares, together with some earthenware for household use, the visitor's work was almost done." The collection of decorative faïence was large and various, and a considerable collection of majolica was shown. Some red terra-cotta statuettes by Eugene Blot and his son were "admirable, full of artistic expression, handled with force and freedom, the groups well conceived and ingeniously carried out."

The German collection "presented no features needing to be dwelt upon." That from Italy showed a want of originality and invention. "The general impression of the exhibition was that the potters and artists are too well content to rest upon the reproduction of the thoughts of more artistic days." Of the Japanese and Chinese manufactures a long account is given, and of the former Mr. Smith says that it "was such as to surpass anything that has hitherto been shown by a single country at any previous International Exhibition. The other contributing countries noticed in the report are—Mexico, Peru, Brazil, Argentine Republic, Canada, Austria, Spain, Portugal, Belgium, Holland, Denmark, Russia, Sweden, and Turkey.

The exhibition of glass, though large and important, was not equal to the displays at former International Exhibitions. There was a want of individuality in the exhibits from different countries. The United States collection included nearly all descriptions of glass wares. Manufactories of glass of the coarser kinds were early established in the States, but no great advance was made until the first quarter of the present century, when several flint glass works were founded. At present the manufacture of glass of this sort is large and well established. Not much plate-glass is made, though in several places works have recently been established for its manufacture. "Lime" glass is also made to a large extent. On the whole, it is evident from the present position of the manufacture that before many years have passed America will compete successfully in all the industrial processes of glass making with any country in the world.

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* Continued from page 815.

The collections from Great Britain were good, and indicated an advance in designs and forms, both of ornamental objects and household wares. France was represented only by window plates and mirror glass. The German collection was chiefly of the same character. Bohemian glass was well represented. In this the traditional forms are generally adhered to. The quality of the "metal" has improved, but there is still room for improvement in colour and design. By the adoption of new processes, the cost of production has been lowered, and the consequent use of the glass increased.

An appendix to this report gives a number of analyses of the materials used in the Japanese manufacture of porcelain, with remarks on their chemistry and composition by Prof. H. Wurtz.

Chemical Products.

Professor Odling's report in this important section of the Exhibition is by no means long, for it consists only of half-a-dozen pages. He commences by remarking that the development of the chemical arts was shown at the Exhibition "alike by the superior quality of the products furnished by long-established processes, by the more extended use of processes of recent establishment, and by the introduction of altogether novel processes and products of manufacture." The two classes of chemicals to which Dr. Odling specially refers are the products of the alkali manufacture and the coal-tar products. He gives a brief account of the main processes involved in each case, and then goes on to mention the chief novelties brought before his notice in the Exhibition. In connection with the alkali manufacture were shown specimens produced under Hargreaves' patent, shown by the Runcorn Company (England). The process of Solvay was also illustrated by specimens sent by Messrs. Solvay (Belgium), and other manufacturers, English and German. In this process the carbonate of soda is obtained direct from brine by the use of ammonia gas obtained from gas liquor. Yet another process was illustrated by a Pennsylvanian firm. In this the basis of manufacture is "cryolite," a double fluoride of aluminum and sodium. By treatment with lime an insoluble fluoride of calcium is formed, from which the soluble alumina and soda can be separated. Alum and carbonate of soda are obtained by further treatment.

The principal novelties shown in connection with the coal-tar industry are—a method (Coupier's) of making aniline red without the use of arsenic acid; a method of making the Hofmann's violets without the use of iodine; and a mode of converting the base of these violets into aniline green, also without the use of iodine. Amongst the exhibitors of carbolic acid products the finest display was made by an English firm, F. C. Calvert and Co. Specimens of the more recent salicylic acid were shown by many exhibitors in this class. The development of the manufacture of the anthracene products, and the consequent depreciation of the natural products of the madder, is referred to by Dr. Odling at the conclusion of his report as "the most notable triumph of industrial organic chemistry that has ever yet been achieved."

GENERAL NOTES.

Trade Marks.—The following notice relative to new trade marks has been issued from the Trade Mark Registration-office:—Considerable disappointment and expense being frequently caused by persons applying to register as new trade marks, marks already registered for other persons, it is recommended that, before adopting new marks, engraving blocks, and circulating impressions of such marks among their customers, a search be made at the Trade Marks Registry, with the view of ascertaining whether the proposed mark is already resistered, or whether from its being calculated to deceive by a resemblance to other marks already in use it would be refused registration under the 6th sec. of 38 and 39 Vic., c. 91. The fee for inspecting the register is one shilling. (Signed), H. Reader Lack, registrar.

National Portrait Gallery.—According to the recent report of the trustees of the gallery, the number of visitors to the gallery in 1876 was 108,252, which was a larger number than in any preceding year. The number of visitors on Whitsun Monday in 1876 amounted to 4,409, against 2,322 of 1875, and 1,544 of the year before. On Boxing-day in 1876 the number of visitors was 2,249, against 2,837 of 1875, and 1,128 of the year before. On Easter Monday last, April 2, the number amounted to 4,534, against 4,848 of last year, and 4,139 of the year before. The total number of persons who visited the gallery from its opening in Great George-street in 1859 to the end of last year was 676,336.

The Lavoisier Medal of the Société d'Encouragement pour l'Industrie Nationale—the French Society of Arts—has just been given to an Englishman, Mr. Walter Weldon, F.R.S.E., for his process for the regeneration of manganese employed in the manufacture of chlorine. In presenting the medal at a crowded public meeting, held at the new Hotel of the Society, in the Rue Bonaparte, on June 15th, the president, M. Dumas, congratulated Mr. Weldon upon having cheapened every sheet of paper and every yard of calico made in the world, and upon having effected a more complete industrial revolution than had ever been effected before in the same time. Professor L'Amy stated that whereas, at the date of the introduction of Mr. Weldon's invention, seven or eight years ago, the total quantity of bleaching-powder made in the world was little more than 50,000 tons per annum, it now exceeds 150,000 tons, and that of this vast quantity 90 per cent. is made by the Weldon process. The Lavoisier medal is one of six "great medals," bearing respectively the effiges of Lavoisier, Jean Goujon, Thénard, Ampère, Chaptal, and Prony, the only previous recipients of any of which are Ferdinand de Lesseps, Henri Sainte-Clare Deville, Boussingault, Henri Giffard, Jacques Siegfried, and Sir Charles Wheatstone.

THE LIBRARY.

The following works have been presented to the Library:—

Nieuwe verhandelingen van het Bataafsch genootschap der Proefondervindelijke Wijsbegeerte te Rotterdam.

Lloyd's Register of Shipping, 1877, and the Rules and Regulations. Presented by B. Waymouth.

The Girls' Reading-book; or, Chapters on Home Work and Duties, by Mrs. Henry Sandford.

The Sizing of Cotton Goods, and the Causes and Prevention of Mildew, by Wm. Thomson, F.R.S.

Annual Record of Science and Industry, for 1876, edited by Spencer F. Baird, Smithsonian Institution, Washington, U.S.

Journal of the Royal Geographical Society for 1876.

The following have been purchased for the Library:—

A Systematic Hand-book of Volumetric Analysis, by Francis Sutton, F.C.S.

Chemical Handicraft, by J. J. Griffin.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,289. Vol. XXV.

FRIDAY, AUGUST 3, 1877.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

DOMESTIC ECONOMY CONGRESS.

The following papers were among those brought before the Congress at Birmingham :—

SCHOOL PENNY BANKS.

By George C. T. Bartley,

Manager, National Penny Bank (Limited), 269 and 270, Oxford-street, London.

Thrift is the quality by which small and apparently unimportant atoms are turned to the best account. We measure most things in money, and hence the idea has sprung up that thrift merely means the saving of money. This is, however, not the case. Thrift has a far wider signification. We can be thrifty in the use of time, in the use of dress, in the use of food, in the management of our strength, in the arrangement of our daily duties; and, in short, thrift can, and indeed, should, underlie the whole of our work, if we would really live to the best advantage, and do our utmost to advance the welfare of our fellow-creatures and ourselves.

In considering the subject generally known as domestic economy, it will be found that thrift is, as it were, the groundwork on which all the other branches must necessarily be built. In the selection of food, in cooking, in clothing, in the management of the house, and in the general expenditure, cost of materials, money, and time, thrift enters so largely that without it these various branches of the subject cannot with advantage be studied. It will, however, be convenient to allow the different sections of domestic economy each to treat on the subject of thrift from its own standpoint, and for me, in this paper, to take up the more common and limited idea of thrift, namely, that which more or less confines itself to the saving of small sums of money. With this view I shall inquire, first, whether the inculcation of this habit in schools among children is desirable; and second, if it be desirable, how it can best be promoted.

It would seem to be hardly necessary to argue as to whether the inculcation of thrift among children is desirable, after having shown that it enters, or should enter, so largely into the everyday habits of life. I should not, indeed, propose to do so were it not for some common and popular erroneous notions concerning the subject of thrift among children. Not a few regard thrift and economy as desirable, important, and even essential among grown-up persons, while among children they hesitate to approve of these habits, lest they should degenerate into niggardliness, meanness, and selfishness. No doubt there is some apparent truth in this; but, on investigation, it will be found that the danger of these evil dispositions arises, not from any inherent mischief in the habit of thrift itself, but from enforcing the duty from a wrong and a selfish motive. The act of saving, *per se*, is not meritorious, and even the motive for saving may or may not be commendable. A child saving his pocket-money merely to be able to boast that he has more than his schoolfellow, is doing far worse than another who spends his all in toffee which he shares with his friends. A boy who saves in order to get enough to buy a cricket-bat is doing a good, though a selfish, act, for he foregoes the present pleasure of spending what he has in order to obtain a future and, as he thinks, a greater pleasure. A child who saves even to an extreme in order to help a friend, or to do a kindness or an act of love for a sister or a parent, is acting nobly, and runs little danger of ever becoming niggardly or mean.

The danger of the inculcation of thrift degenerating among children arises from the careless way in which it may be taught, even by those who mean well. The motive for saving and for being careful and thrifty is the most important consideration with all, but especially with young children, who, of course, have not those ties which come later, and which render saving for the wants of the individual and his family a distinct and imperative duty. To tell a child to save and to be careful of his pocket-money in order that he may have a large sum, is wrong. The accumulation by a child of pence, for the purpose of possessing a shilling, is of itself no virtue, and the teacher fails in his duty who cannot point to some higher motive, and who cannot instil a habit of thrift among his pupils based on a far nobler and more unselfish foundation.

The real aim of thrift must always be not only to teach us how to save but how to spend. The miser saves to perfection, but we rightly despise him. The practical use and benefit of inculcating thrift must be to teach children how to husband their resources, in order that they may spend well and to the best advantage, so that by their spending they may do the most good to their own circle and to the community at large. Spending well is far more difficult than simply saving, and the basis of teaching thrift must always bear this in view. If this is done, there will be little danger of thrift degenerating into niggardliness, meanness, or selfishness.

Considering how essential thrifty habits must be to the comfort and happiness of us all in after life, it is strange that an inculcation of these principles has not long since been insisted on by educational and social reformers. We teach a child to read, and, if we can, to write, not only for the moral good it does him, but because of the practical use it will be to him hereafter. We apprentice him to a trade in the same manner, and for the same object; but yet the habit of thrift which enters into his domestic every day life, and may make his home happy and comfortable, and remove daily anxiety from his mind, we expect to come naturally to him as a matter of course. Some may think that in teaching morality and religion thrift will be included, and though it should form part, and no mean part, of such instruction, yet as a matter of practice it rarely does do so. Thus, for one cause or another, the practical lessons of thrift are unattended to or overlooked, and our boys and girls, from one generation to another, grow up with little or no knowledge of the blessings that this habit would be to them. The consequences of this omission are to be met with, not only in the paupers who burden our rates and in the recipients of our so called charities, but in the thousands and tens of thousands of those who all their lives long are struggling with poverty, and hanging, as it were, on the verge of destitution and misery.

The assertion is sometimes made that habits of thrift will come later in life, when the important need of saving for a family is experienced, and that we, therefore, need not worry children with such matters, or trouble them during the bright and gay period of life with anything so unpalatable as an idea of saving for the wants of the future. Is this, however, really true? Do young men and women, never accustomed to look a-head beyond the present week and its earnings—except perhaps to forestal their income—as a matter of fact, gradually in later life grow thrifty? Do they not almost invariably continue when in middle-age as they begin life in youth or childhood? Further, even if it were the case that they do thus change, and grow careful and thrifty when the needs of a family force them to do so, would they not have to be taught, by the hard and bitter experience of the consequences of a want of thrift—at a time, perhaps, of sickness either to themselves, their wives, or children—lessons which, if inculcated in childhood, would have prevented many of such misfortunes from ever occurring to them.

Seeing, then, that thrift, when based on worthy and proper motives, is in itself a good and noble quality; seeing also that it is not—certainly in England at the present time—a natural or usual quality; seeing, further, that its effects are so beneficial, not only to the individual, but to the community at large, I think it is clear that its inculcation in any school should be a matter of course, and that, especially in our elementary schools, time devoted to a consideration of this subject will be wisely and profitably spent.

I now come to consider the best way in which habits of thrift, as regards money especially, may be inculcated in schools among children. First, I may say that, unless a careful and thrifty example is set by the teachers and enforced on the pupils in small matters, and with so-called unimportant little things, such as paper, slate-pencils, slates, books, &c., a great deal of the benefit to be derived from direct lessons and special agents for promoting thrift will be lost. It is, unfortunately, common in schools, and not only in those of an expensive character—where, by-the-bye, it is equally mischievous—to find a great disregard to the way in which some little things are wasted, and others are not turned to the best account. Look at the books in use; how few of them are fairly worn out, and how many are wantonly or carelessly destroyed. No doubt children are told not to spoil their books, and at times they may even be punished for so doing; practically, however, but too little attention is given to such matters. The same with slates, pencils, desks, forms, and almost all the properties of school life. Inattention to these considerations is so much practical instruction in carelessness, waste, and recklessness, qualities altogether as incompatible to the growth of thrift as rank weeds and briars are to the springing up of good seed. It is, indeed, true that even earlier in life these undesirable habits are allowed to flourish, from the way in which little children are but too often permitted wantonly to destroy or misuse their toys. Of course, most toys cannot be very long-lived, and broken playthings often afford as much amusement and pleasure as new ones, but the natural wear and tear of the nursery articles is altogether a different thing to the wanton destruction which is but too often allowed, and even encouraged, among the young.

The first step, then, towards inculcating a habit of thrift among children, both at home and at school, must be by a careful attention to the proper use of the things they handle, both by example and precept, discouraging waste of any kind in those materials and objects with which they have to deal.

The second mode of practically inculcating thrift is by a careful economy of time. At all ages there is great waste in time. I do not now refer to that waste caused by indolence, but that brought about by a careless or thoughtless arrangement of the day's work. In school this is often especially the case. Time is lost in getting to work, in changing lessons, and even in getting to play. Much practical good will result from a careful saving of time throughout the day, and the teacher should set the example of this important branch in practice, as well as impress the theory by precept on the pupils. Again, by the thorough use of time thrift may be inculcated. The listless half-attention, half-playing, half-reading, whether for lessons or recreation, is all so much time partly wasted. If by thorough attention a work may be mastered in an hour which is dawdled over for two, an hour is wasted, and a worse effect is produced by far than if the work were done in an hour, and the whole class slept during the remainder of the time. It will be idle to lay great stress on thrift in pence when time is wasted by the hour. Children are very quick and more logical than is often supposed.

I will now say a few words on the direct means of inculcating habits of thrift among children, by the establishment of penny banks in schools. It will be convenient to consider, first, what we mean by a penny bank in a school; secondly, how such a penny bank may practically be managed; thirdly, the advantages of such a penny bank being established and carried on.

1st. A penny bank in a school is an arrangement by which, at some fixed hour or hours each week, provision is made for receiving and paying out such sums of money as the pupils may wish voluntarily to pay in or draw out. The voluntary element is essential, for where all the pupils are required to place their money in a teacher's hands and to ask him for it as they want it—a plan adopted in some schools—the main uses and good derivable from a voluntary penny bank are lost. It is also important that, not only should money be taken in without question, but also that it should be allowed to be withdrawn without inquiry. It is a mistake to suppose that any check should be put upon withdrawals. True, a child may save up a good deal and then draw it out for some unwise or even mischievous object, but the penny bank should have nothing to do with this. If a child is not allowed to have his or her money out of the bank without giving a satisfactory reason for wanting it, or even if much moral pressure is used to prevent the withdrawal, the only consequence will be that the money will not be put in. Children, fearing the questions to which they may be liable if they want some money from the penny bank, will keep their pocket money themselves, and conceal it, if necessary, so as to retain their control over it. Of course, if money in a school is spent wastefully or mischievously, the fault will be corrected as a fault, but even this should give no pretext for an intimation, or threat, of in any way limiting or controlling the power of perfect free action as regards withdrawing from the penny bank. One of the best and surest modes of preventing waste, or foolish expenditure, is the possession by each child of a penny bank account, and one of the most effectual ways of preventing them from opening accounts is to allow any dread, or suspicion even, of awkward questions being asked as to the purpose for which withdrawals are required.

2nd. How a penny bank may be practically carried on in a school.

a. By being established in connection with the Post-office.

b. By being established in connection with such an institution as the National Penny Bank.

a. By being established in connection with the Post-office.

This plan is the only one available for villages and small towns, where no other organisation exists. All that is necessary is for two or three persons—the school managers should take the lead—to consent to act as trustees, and for one of the teachers to act as collector. The rules which are settled by the Post-office are very simple, the main one being that no person is to have more than £5 in the penny bank, and that, directly any one's deposits amount to £1, he or she will be encouraged to transfer it to the Post-office Savings Bank in a separate account. The small pass-books (one of which is given to each depositor) are supplied by the Post-office free of charge, and in them the rules, and, if it is wished, the name of the penny bank are printed. The collector each week, at some fixed hour, and in some fixed place in the school, opens the bank. It is best if one of the trustees, or one of a committee formed for that purpose, is also present, but this is at times difficult, or impossible.

The books required are two, the cash-book and the ledger. The cash-book should be ruled with four columns, the first about an inch wide, then a money column, then one of two inches wide, and then another money column, leaving a space for remarks. The first column is for the number of the pass-book, the second is for the amount deposited, the third is for the name of the depositor or withdrawer, and the fourth for the amount withdrawn. The ledger should be a wide book, ruled with two, three, four, or five money columns on the page, each column being divided by a thick line. Each of these columns contains one depositor's account.*

When the bank is being held, the collector should take the cash-book and the committee-man the ledger, and entries in both should be made direct from the depositor's pass-book. The collector should retain a small sum, say 10s. or £1, in hand, so as to be able to repay ordinary withdrawals at once if wanted. All the remainder of his takings should at once be paid into the Post-office, into the account opened in the names of the trustees. When money is wanted out of this account, the notice will have to be signed by one of the trustees. Nothing is simpler than this arrangement, which is described in full detail in Provident Knowledge Papers, Nos. 4 and 5, price one penny.†

If the school be large, and the penny bank is very successful, so that most of the children join, some little difficulty may arise, owing to the tax on the teachers' time. This, however, can be got over by inducing the pupil teachers to assist.

The interest given to depositors is a matter which must be mentioned. Where accounts on reaching £1 are transferred to the post-office, interest is unimportant, and not considering it will save a good deal of trouble. If it be preferred, however, to pay some interest, it should only be given on sums, say, of 10s., left in a complete calendar month, and each child's account—the greater number will not have enough in the bank to get interest under this rule—should be made up, and the interest added, at the end of the year, or when the child wishes to close it.

b. School Penny Banks in connection with such an institution as the National Penny Bank.—The action of the National Penny Bank has hitherto been confined to London, where 25 branch penny banks in schools have been established. The great advantage of schools being enabled to avail themselves of such an organisation is, that the collector is supplied independently of the teachers, and beyond one school manager, teacher, or pupil teacher being present when the bank is open, and keeping the ledger, the whole trouble of the management of the bank, the keeping of the cash and of the books, &c., is undertaken by the paid collector of the National Penny Bank. The detailed way of conducting the bank is the same as that above described. The main difference, beyond that important one just referred to, is that there is no £5 or other limit to the amount of deposits, and consequently it does not form an essential rule that depositors of £1 should transfer their money to the Post-office, though there is no objection to this being done if wished.

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* Suitable books may be obtained, price 15s. the pair, for 500 accounts, from the National Penny Bank, Limited, 269 and 270, Oxford street.

† List of Provident Knowledge Papers, which can be had on application, for stamps or P.O.O., at C. Williams, 112, Brompton-road, London:—

1. Pensions.—How to set about buying them by small payments, weekly or otherwise.
2. Insuring One's Life.—How to set about it by small payments, weekly or otherwise.
3 Easy Tables, showing what a Few Pence a-Week will do towards Insuring one's Life, or buying a Pension.
4. Penny Banks in every Town, Village, and Manufactory.—How to start them.
5. Penny Bank in every Elementary School.—Why they should exist, and how to start them.
6. Money in the Bank.—How every one may have a Banker.
7. Collectors of savings.—How to have a Collector of Weekly Savings where you work, and to have him paid by the Post office.
8. Interest and Security —What these words mean, and the danger of getting too much for one's money
9 Pawnbrokers —How every man may be his own Pawnbroker.
10. Domestic Servants.—How to have a place always to fall back upon.
11. Incomes without Income Tax.—Governesses, Clerks, and all persons who pay no Income Tax What to do instead.
12. A Penny a Week, or who earns enough to put by anything? Or, is a shilling, Sixpence, Threepence, Twopence, or One Penny a-Week, worth putting by?
13. What's the Good of Saving?
12. Provident Dispensaries in Villages, Factories, Workshops, large and small Towns.

In towns either where branches of the National Penny Bank can be formed, or where independent organisations can be established to carry on penny banks, in a similar way to that adopted by the National Penny Banks, the arrangement last described is certainly the best; there is a complete audit, and the collector is checked just as in an ordinary business. In country villages and other places, however, not having these advantages, or until these establishments extend throughout the country the former plan may be made to work very well, only the local interest is maintained.

3rd. *The advantages of Penny Banks in Schools.*—*The Encouragement of Thrift.*—This will be an obvious result of the penny bank, and from what I said in the beginning of my paper, if the right motive for thrift be inculcated, there will be no danger of meanness or miserly habits being promoted.

The Learning of the real Use of Money.—Perhaps few practical lessons in life are acquired with greater difficulty. What many people earn by hard labour, they seem to be altogether ignorant of how to use with advantage. The penny bank will do much practically to teach children the real uses of money, before they have to learn them in a harder experience of life.

The Appreciation of the Importance of Small Things.—This may be said to be thrift, and so it is, but it is important enough to be specially mentioned. It is an old saying, that if we take care of the pence the pounds will take care of themselves; but few practically realise this in its literal sense, and fewer still act upon it. The power of the pence is often theoretically, but not practically, understood. Few qualities could tend to reduce poverty and distress in after-life more than acquiring, through the agency of the school penny bank, an appreciation of the importance of small things.

The habit of Restraining Present Indulgence for Future Advantage.—This habit lies at the bottom of all social improvement. No doubt the national tendency is for most of us to enjoy at once what we have, like that of the child is to spend all his pence immediately in sweets. We learn by experience that this is not only not wise, but that it affords us less real pleasure than a careful and judicious husbanding of our resources. The school penny bank teaches this lesson forcibly, and in a practical way.

The Inculcation of Unselfish Habits.—Besides the last quality, the virtues of unselfishness may be inculcated by the uses of the penny bank. The habit of saving, and the consequent possession of a sum of money—even though it be but small—spared from present indulgence, and available at any time for any emergency, may often enable the holder to do a kind and useful act to a parent, a relation, or a friend. Children frequently, when any misfortune or otherwise happens, wish they could do something, however small, to show their sympathy. They often do much, very tenderly and nicely by acts of kindness, but they frequently regret that they have spent all their pence as they had them, for otherwise they feel they would be able to get such or such an article which would be of use. This is a feeling much to be encouraged, and their little accounts at the school penny bank will be found of great value. Those children who have such accounts will be able to carry out their wishes, and will earn the pleasure of so doing, whilst those who have not joined the bank will see the advantage of so doing at the earliest opportunity.

The Habit of Banking.—The inculcation of the habit of banking must be mentioned—not a few persons have an idea that the way to save is to hoard up money in some place of concealment. The Post-office Savings' Bank has done much to get rid of this notion, but it exists largely still. School penny banks will teach the children that it is wiser, for many reasons, to put our savings in some safe bank out of our possession and the temptation of spending them. Even those who do not join the school penny bank will see the practical good of such institutions, and when they leave school they will the sooner join the Post-office or some other savings bank. Whenever possible, on children leaving school, their money, if they have as much as a shilling, should be paid into the Post-office Savings' Bank, and an account opened in their names. The presentation of a Post-office Savings' Bank-book, or a National Penny Bank-book, on a child leaving a school may form one of the best possible presents or prizes that can be given him.

The Habit of Independence and Self-reliance.—Nothing promotes the feeling of independence and self-reliance more than the knowledge that we possess a resource of our own for any emergency that is likely to occur. The penny bank begins this feeling in a small way at school. If the habit of forming a reserve fund is—as it will be in many, if not in most cases—continued after leaving school, independence and self-reliance will become the characteristic of the child. Instead of that miserable habit of reliance on others, either from charity or from the parish on the first week of illness, or immediately on being out of work, the young man and woman will feel that they have something of their own, to enable them to weather the storm of adversity or trouble. Living from hand to mouth without any such provision is like going to sea in an open boat. The least ripple is alarming, whilst a wave over which we should ride with ease in a suitably provided craft will swamp us altogether, and oblige us to depend for safety on the accident of others being near us and able to assist us. This feeling is altogether incompatible with independence and self-reliance, qualities which must form the backbone of social progress and individual happiness and comfort.

I have now endeavoured to give some of the chief advantages which the establishment of school penny banks may be expected to promote. There are many others which will strike you perhaps, and which may differ in different localities, among different children. I trust, however, that I have said enough to convince you that some systematic and practical instruction in thrift is not only desirable and beneficial, but that it is more. I would rather have it thought to be an essential part of school instruction without which much power for social usefulness will be forfeited, and much domestic comfort throughout life will be lost. I trust also that I have shown how little need be the trouble, compared with the benefit secured, of establishing school penny banks; and, in conclusion, I will only say that I shall be most happy to assist any one, in any part of the kingdom, in promoting this branch of practical domestic economy.

ON ELEMENTARY INSTRUCTION IN PHYSIOLOGY.

By Professor Huxley, LL.D., F.R.S., Ph.D.

The chief ground upon which I venture to recommend that the teaching of elementary physiology should form an essential part of any organised course of instruction in matters pertaining to domestic economy, is, that a knowledge of even the elements of this subject supplies those conceptions of the constitution and mode of action of the living body, and of the nature of health and disease, which prepare the mind to receive instruction from sanitary science.

It is, I think, eminently desirable that the hygienist and the physician should find something in the public mind to which they can appeal; some little stock of universally acknowledged truths, which may serve as a foundation for their warnings, and predispose towards an intelligent obedience to their recommendations.

Listening to ordinary talk about health, disease, and death, one is often led to entertain a doubt whether the speakers believe that the course of natural causation runs as smoothly in the human body as elsewhere. Indications are too often obvious of a strong, though perhaps an unavowed and half unconscious, undercurrent of opinion that the phenomena of life are not only widely different in their superficial characters and in their practical importance from other natural events, but that they do not follow in that definite order which characterises the succession of all other occurrences, and the statement of which we call a law of nature.

Hence, I think, arises the want of heartiness of belief in the value of knowledge respecting the laws of health and disease, and of the foresight and care to which knowledge is the essential preliminary, which is so often noticeable; and a corresponding laxity and carelessness in practice, the results of which are too frequently lamentable.

It is said that among the many religious sects of Russia, there is one which holds that all disease is brought about by the direct and special interference of the Deity, and which, therefore, looks with repugnance upon both preventive and curative measures as alike blasphemous interferences with the will of God. Among ourselves, the "Peculiar People" are, I believe, the only persons who hold the like doctrine in its integrity, and carry it out with logical rigour. But many of us are old enough to recollect that the administration of chloroform in assuagement of the pangs of childbirth was, at its introduction, strenuously resisted upon similar grounds.

I am not sure that the feeling, of which the doctrine to which I have referred is the full expression, does not lie at the bottom of the minds of a great many people who yet would vigorously object to give a verbal assent to the doctrine itself. However this may be, the main point is that sufficient knowledge has now been acquired of vital phenomena, to justify the assertion that the notion that there is anything exceptional about these phenomena receives not a particle of support from any known fact. On the contrary, there is a vast and an increasing mass of evidence that birth and death, health and disease, are as much parts of the ordinary stream of events as the rising and setting of the sun, or the changes of the moon; and that the living body is a mechanism, the proper working of which we term health; its disturbance, disease; its stoppage, death. The activity of this mechanism is dependent upon many and complicated conditions, some of which are hopelessly beyond our control, while others are readily accessible, and are capable of being indefinitely modified by our own actions. The business of the hygienist and of the physician is to know the range of these modifiable conditions, and how to influence them towards the maintenance of health and the prolongation of life; the business of the general public is to give an intelligent assent, and a ready obedience based upon that assent, to the rules laid down for their guidance by such experts. But an intelligent assent is an assent based upon knowledge, and the knowledge which is here in question means an acquaintance with the elements of physiology.

It is not difficult to acquire such knowledge. What is true, to a certain extent, of all the physical sciences, is eminently characteristic of physiology—the difficulty of the subject begins beyond the stage of elementary knowledge, and increases with every stage of progress. While the most highly trained and best furnished intellect may find all its resources insufficient when it strives to reach the heights and penetrate into the depths of the problems of physiology, the elementary and fundamental truths can be made clear to a child.

No one can have any difficulty in comprehending the mechanism of circulation or respiration; or the general mode of operation of the organ of vision; though the unravelling of all the minutiæ of these processes may, for the present, baffle the conjoined attacks of the most accomplished physicists, chemists, and mathematicians. To know the anatomy of the human body, with even an approximation to thoroughness, is the work of a life; but as much as is needed for a sound comprehension of elementary physiological truths, may be learned in a week.

A knowledge of the elements of physiology is not only easy of acquirement, but it may be made a real and practical acquaintance with the facts, as far as it goes. The subject of study is always at hand, in oneself. The principal constituents of the skeleton, and the changes of form of contracting muscles, may be felt through one's own skin. The beating of one's heart, and its connection with the pulse, may be noted; the influence of the valves of one's own veins may be shown; the movements of respiration may be observed; while the wonderful phenomena of sensation afford an endless field for curious and interesting self-study. The prick of a needle will yield, in a drop of one's own blood, material for microscopic observation of phenomena which lie at the foundation of all biological conceptions; and a cold, with its concomitant coughing and sneezing, may prove the sweet uses of adversity by helping one to a clear conception of what is meant by "reflex action."

Of course, there is a limit to this physiological self-examination. But there is so close a solidarity between ourselves and our poor relations of the animal world, that our inaccessible inward parts may be supplemented by theirs. A comparative anatomist knows that a sheep's heart and lungs, or eye, must not be confounded with those of a man; but, so far as the comprehension of the elementary facts of the physiology of circulation and of respiration and of vision goes, the one furnishes the needful anatomical data as well as the other.

Thus, it is quite possible to give instruction in elementary physiology in such a manner as not only to confer knowledge, which, for the reason I have mentioned, is useful in itself; but to serve the purposes of a training in accurate observation, and in the methods of reasoning of physical science. But that is an advantage which I mention only incidentally, as the present Conference does not deal with education in the ordinary sense of the word.

It will not be suspected that I wish to make physiologists of all the world. It would as reasonable to accuse an advocate of the "three R's" of of a desire to make an orator, an author, and a mathematician of everybody. A stumbling reader, a pot-hook writer, and an arithmetician who has not got beyond the rule of three, is not a person of brilliant acquirements; but the difference between such a member of society and one who cannot either read, write, or cipher is almost inexpressible; and no one now-a-days doubts the value of instruction, even if it goes no further.

The saying that a little knowledge is a dangerous thing is, to my mind, a very dangerous adage. If knowledge is real and genuine, I do not believe that it is other than a very valuable possession, however infinitesimal its quantity may be. Indeed, if a little knowledge is dangerous, where is the man who has so much as to be out of danger?

If William Harvey's life-long labours had revealed to him a tenth part of what may be made sound and real knowledge to our boys and girls—he would not only have been what he was, the greatest physiologist of his age, but he would have loomed upon the seventeenth century as a sort of intellectual portent. Our little knowledge would have been to him a great, astounding, unlooked-for vision of scientific truth.

I really see no harm which can come of giving our children a little knowledge of physiology. But then, as I have said, the instruction must be real, based upon observation, eked out by good explanatory diagrams and models, and conveyed by a teacher whose knowledge has been acquired by study of the facts; and not the mere catechismal parrot-work which too often usurps the place of elementary teaching.

It is, I hope, unnecessary for me to give a formal contradiction to the silly fiction, which is assiduously circulated by fanatics who not only ought to know, but do know, that their assertions are untrue, that I have advocated the introduction of that experimental discipline which is absolutely indispensable to the professed physiologist, into elementary teaching.

But while I should object to any experimentation which can justly be called painful, for the purpose of elementary instruction; and, while, as a member of a late Royal Commission I gladly did my best to prevent the infliction of needless pain, for any purpose; I think it is my duty to take this opportunity of expressing my regret at a condition of the law which permits a boy to troll for pike, or set lines with live frog bait, for idle amusement; and, at the same time, lays the teacher of that boy open to the penalty of fine and imprisonment if he uses the same animal for the purpose of exhibiting one of the most beautiful and instructive of physiological spectacles, the circulation in the web of the foot. No one could undertake to affirm that a frog is not inconvenienced by being wrapped up in a wet rag, and having his toes tied out; and it cannot be denied that inconvenience is a sort of pain. But you must not inflict the least pain on a vertebrated animal for scientific purposes (though you may do a good deal in that way for gain or for sport) without due license of the Secretary of State for the Home Department, granted under the authority of the Vivisection Act.

So it comes about, that in this present year of grace 1877, two persons may be charged with cruelty to animals. One has impaled a frog, and suffered the creature to writhe about in that condition for hours; the other has pained the animal no more than one of us would be pained by tying strings round his fingers, and keeping him in the position of a hydropathic patient. The first offender says, "I did it because I find fishing very amusing," and the magistrate bids him depart in peace; nay, probably wishes him good sport. The second pleads, "I wanted to impress a scientific truth, with a distinctness attainable in no other way, on the minds of my scholars," and the magistrate fines him five pounds.

I cannot but think that this is an anomalous and not wholly creditable state of things.

ON NURSING FOR ARTISANS AND COTTAGERS.

By Mrs. W. E. Gladstone.

1. The blessing of education is, happily, more and more considered, and we are all learning to value sound elementary teaching in our national schools. Why, then, is such gross ignorance upon matters of health allowed to prevail among the poor? A cry might well be raised, as we visit cottage after cottage in times of sickness, and find the most simple sanitary facts of sick nursing unknown, without teaching or method, and often without thought. It is true there are methods of training professional nurses, but why are not the elementary principles of nursing added to the subjects already taught in schools, so that they may become part of the regular instruction of young girls? How often is the little daughter or friend of 10 or 12 years old the only attendant the poor father or mother can

have in case of sudden illness, and how much can even a mere child do who has learnt to think and observe, and to understand a few easy rules about a sick room! Men of experience, and great physicians, have advised the matter being taken in hand—why is it so utterly neglected?

2. The reasons are only too plain:—

First. The very ignorance which exists about illness stifles all desire to learn what can be done, and blinds the poor to the crying necessity of the case.

Secondly. People do not know the exceeding interest as well as usefulness of really intelligent nursing, a work they might love if once they understood it. It is true that the beautiful gift of nursing does exist naturally in some, but, even in cases where the natural "turn" for it is strong, it needs guiding and development.

3. Whilst waiting and hoping for some scheme that shall bring about such a development, I venture in this short paper to try and spur, if I may so express it, in the right direction, my hearers, members of School Boards, teachers throughout the country, and the Education Department in particular. I attempt to show that something can be done to save time and even lives before a more perfect plan can be organised. Life is so holy a thing, shall we not see and think how to preserve it best? Cottage-nursing being my special point, I go at once to the subject. Now, as I have said before, a mere child may be so taught to nurse as to give her what is really a high and holy aim. She may learn thoughtful, cleanly, gentle, sensible ways, and thus become a treasure in her home at a time of sickness.

4. Let me draw a little picture of the cottage where ignorance prevails. The heavy hand of sickness has been laid on the dwelling—the mother is laid low. What happens? Poor little Polly has leave to stay away from school. She does her best. She knows nothing about the poison of bad air and of fresh air being all-important—her one object is warmth, and warmth too often means foul air. She draws the bed-curtains close, stuffs up the chimney, and shuts every window and door. Neighbours assemble round the sick bed talking, gossiping, wondering, almost killing with well-intended kindness, and all helping to exhaust the air and disturb the patient, fuss prevails, and every one has a piece of ignorant advice to give; but where is common sense and presence of mind?

5. Let us now look at another picture, and see the contrast. Here we have little Jenny, no older than Polly, but Jenny has had a few sensible rules put into her head. She has learnt that four good things are first of all to be secured in a sick room, namely, fresh air, cleanliness, quiet, and comfort; these Jenny can see to before a doctor arrives. Before helping her mother to bed, she thinks of what is needed to make the bed tidy and comfortable. Whatever is likely to be wanted she puts neatly upon a table, which is cleared of other matters, so that medicine, a feeding cup, clean glasses, spoons, &c., are always at hand. If there is, as we must hope, a chimney in the room, she takes care that nothing may block it up, no stuffing of boards or paper to exclude air; she knows the chimney will carry off the impure air, she manages to have some window open, if possible at the top, so as to gain fresh air and avoid a draught. We can see how in these little ways a child can practice presence of mind, and gain that confidence which in itself soothes and comforts the patient.

6. Let us go a little further, and try and show how that confidence and simple wisdom can be practised. I only give in this paper a few simple facts which can be found elsewhere far better expressed and drawn out.

7. *As to Fresh Air and Ventilation.*—Ventilation is absolutely necessary for the preservation of health, because the very air we breathe purifies the blood, and supports life. If this be so important in health, what must it be in sickness, when the blood is disordered? Let the little nurse then be taught to look about and see how best to procure pure air. If the room is so small and inconvenient that it is impossible to keep the window constantly open without exposing the patient to draughts, the next best thing is to change the air from time to time, by opening the window for a few minutes. It is easy, when airing the room, to cover up the patient for two or three minutes, to avoid chills. Bad air is poisoned air to the lungs. The air we breathe should, if possible, be as pure as the external air, and that need not mean cold air. The mischief which bad air causes is not always felt at once, just as there are slow poisons which do not at once discover themselves, but, sooner or later, the poison does its work. Do not allow unnecessary people to go in or out, or to stay in the room; each person consumes so much air, just as candles or gas will do, and the usually small space in a cottage calls for special thought on this matter.

8. *Light.*—The light of heaven is good in an invalid's room; when the body is sick and the whole heart is faint, warm and cheerful rays should enter a sick room. It is always easy, when the eyes are weak or the head aches, to arrange a little blind as a temporary guard, and the patient's own wishes should be consulted, but sunshine brings joy and gladness, and is in itself life-giving.

9. *The Bed.*—As to mattresses and bedding, feather beds are unwholesome from the excessive heat they produce, and the difficulty of thoroughly airing and purifying them. Curtains drawn round make the bed into a trap for foul air; none should be allowed excepting perhaps at the bed head.

10. *Cleanliness.*—Keep the sick room scrupulously clean, the less carpet the better; give attention to the floor under the bed and in corners; do not allow anyone but the patient to eat meals there. Do not conceal utensils under the bed or elsewhere; a lid is useful, but nothing unpleasant should be left for any time in the sick room, and all articles used should be very carefully rinsed afterwards.

11. *Cookery.*—We might naturally now turn to the subject of cookery, but so large a subject cannot be treated of here; suffice it to say, that food for a sick person should be of a finer kind than for a person in health; a defect in cookery will speak for itself, while judicious good cooking will save the digestion half its work. Thus we trust our young friends will lose no opportunity of studying this branch of cooking. Proper diet is of greater consequence than medicine.

12. *Quiet and Watchfulness.*—I will now add a few hints which I have myself found useful to

bear in mind in a sick room. One of the first lessons is to be quiet, calm, and cheerful. Avoid giving unnecessary trouble by talking or fidgeting. Sit by the invalid and watch with all your might. You will by observation soon learn his wishes, and this very watchfulness it is which gives experience. It will often be more valuable than rules, though these should by no means be disregarded. Observation will, for instance, better than any rule, teach us how to regulate the patient's food. It is a very common error to think that a person may die because he takes little or no food. Now in this matter, nature is often speaking and doing the restorative work in the best way by bidding the stomach rest; but on the other hand there are cases when it is needful to give food in small quantities often, even every hour or half hour. A nurse must learn when to turn to the doctor to help her judgment in these important points, but she must strive to improve her own judgment by ceaseless watchfulness. Save your patient anxiety, waiting, fear of surprise, emotion; lead him gently but firmly, without driving. Again, manage thoughtfully about leaving him. Tell him when you will return; keep to your time; uncertainty is trying to all patients.

13. *Sleep.*—A nurse must also learn the great blessing of sleep in illness, that beautiful provision of nature, often to be encouraged even to the neglect of the stated hour for food or medicine. Sleep is all-important in bringing respite from pain or weakness, and in refreshing the exhausted powers.

14. *State of the Skin and the Circulation.*—Much good often may be done by attention to the state of the patient's skin. A warm bath, or a hot drink at bed-time, encourages perspiration, which often removes chills and carries off the cold which has come from checking the action of the skin. Examine feet and hands, to judge of the circulation, and to guard against effects of vital heat diminishing; hot bottles or hot flannels help to restore heat to the body. In the early morning exhaustion is more likely to come on, as the vital power is lower.

15. Upon all the last-enumerated matters, however, which manifestly demand the more mature powers, the little nurse at home should learn to be guided entirely by the doctor's directions.

16. Pages might be written, but I have not attempted to do more than suggest small measures and very humble beginnings in the loving work of tending the sick. Only let us not go on in ignorance and apathy, content to see the poor, and those we love, suffering from illness, and lacking the help that their own children might learn to afford. In this very elementary paper, I urge a step being taken to teach the young, so as to put people upon the right road. Let no one be discouraged; it is true the work in itself is of a very delicate nature, needing much patience, but then, it should be a labour of love. "God's precious gift of life is often literally placed in our hands." This has been strikingly said. Shall we not persevere, then? Simple lessons of thoughtfulness and care, and constant watching, will sow seeds that will bring forth much fruit; and how great will be the blessing if from these small beginnings villages should come to possess nurses of the spirit of Florence Nightingale!

17. Even in the infant school the children might be asked simple questions upon the health of their parents and themselves, and gradually be led to think on the subject. In the classes for older children, both boys and girls, the questions might be continued; and I hope to see prepared a small manual on health, which shall be the means of suggesting, rather than presenting, actual questions to teachers. I am not in favour of teaching by questions and answers, which generates too much rote knowledge, and saves the mental labour of the teacher at the cost of the child.

18. Let us conclude with the most important thought of all, which should underlie all our efforts—the thought of the wonder and beauty of our Creator's work in these frail bodies of ours, and how much love and care we should bestow upon the frames He has so loved and cared for.

MISCELLANEOUS.

LOANS TO FREE LIBRARIES AND MUSEUMS.

An important deputation, representing over sixty municipal Corporations, waited on the Trustees of the British Museum, on Saturday, 28th July, for the purpose of submitting to that body that it had now become necessary that the collections contained in that and other national institutions, and which were to a large extent provided and supported by public grants, should, as far as possible, be rendered available for the benefit of museums under the charge of provincial Corporations. The deputation, which was headed by Mr Joseph Chamberlain, M.P., included Alderman Samuelson (Liverpool), Alderman Bragge (Sheffield), Councillor Chamberlain (Birmingham), Councillor Lund (Blackburn); the Mayors of Leicester, Wolverhampton, and Cardiff; the ex-Mayor of Bristol, &c. Letters of apology for non-attendance, expressing sympathy with the objects which the deputation had in view, were received from the leading municipal authorities of Manchester, Bradford, and other large provincial towns. The trustees present at the Museum to receive the deputation included the Duke of Somerset, who presided; Lord Walsingham, Viscount Eversley, Lord Acton, Sir Philip de Malpas Grey Egerton, M.P., the Right Hon. Spencer Walpole, M.P., the Right Hon. R. Lowe, M.P., the Very Rev. the Dean of Windsor, and the Rev. Francis Hanbury Annesley.

Mr Chamberlain, in explaining the views of the deputation, called attention to its character and importance, and pointed out that it represented sixty of the municipal Corporations of the United Kingdom, or all, in fact, who had established free libraries and museums of their own. He stated that the provinces had now, though somewhat tardily, awakened to the importance and the necessity of these institutions as the means of promoting progress in the various branches of art and science. They had at the same time become conscious of the apparent unfairness of conferring all grants for such purposes solely on metropolitan institutions. He emphatically protested against the idea that there was any jealousy of their national reference collections, and stated that at the present no suggestions had been made that the contributions granted in support of them should be in any way reduced. The deputation, however, considered that some greater assistance should be given to the local collections. He had also to point out that, as regarded the number of persons who attended such institutions, and also as regarded the number of those who were specially interested in the several branches of which they were composed, the returns of the provincial museums would compare most favourably with the London institutions, the attendance at a few of their number being larger than the whole of the attendance at all similar collections in London; while, as each town was the seat of some special industry, the exhibition of works illustrative of the industry in the locality would be of more value than a similar exhibition in London, where it could be seen only by a few of those concerned. Referring to a communication made to the Government by the trustees of the British Museum in 1871, respecting duplicates in the Museum collection, and from which it appeared that there were only a few duplicates in the possession of the Museum at that time, Mr. Chamberlain said that although this was technically an answer to the arguments of the deputation, yet he and other members of the deputation contended that there were large collections illustrative of every period of art, which, although the several examples were not actually duplicates the one of the other, yet were so similar in their teaching that some assistance should be rendered to provincial institutions in the shape of the reproduction of articles of unique and special value, and by the selection of originals in the case of the general collections.

The Duke of Somerset, in reply to the deputation, pointed out that, in order to enable the trustees to lend any of the objects in the various collections of the Museum, special legislation would be necessary. He promised, however, after inquiring particularly as to the class of objects which the deputation desired to have circulated, that the matter, which he considered a very important one, should receive the careful consideration of the trustees.

The deputation then withdrew.—*Birmingham Daily Post.*

REPORT ON THE PROGRESS AND CONDITION OF THE ROYAL GARDENS AT KEW.

The annual "Report on the Progress and Condition of the Royal Gardens at Kew, during the year 1876," which, though bearing date January 1 of the present year, has only just been issued, is more than usually bulky, and contains a very large amount of valuable information on plants of economic interest, many of which have received some attention before in the columns of this *Journal*, notably with regard to india-rubber producing plants. Sir Joseph Hooker reports the receipt at Kew, in June of last year, of no less than 70,000 seeds of the Para rubber (*Hevea brasiliensis*), furnishing the best commercial kind. These seeds were obtained on the Rio Tapajos, and in consequence of their retaining their vitality but a short period, they were all sown the day after arrival, and, though closely packed together, covered a space of over 300 square feet, About 33·4 per cent. of these seeds germinated, some as early as the fourth day after sowing, and many in a few days reached the height of 18 inches. In August, 38 Wardian cases, containing over 1,900 plants, were transmitted to Ceylon; 90 per cent. of the plants reached their destination in good order, and for the present will remain in Ceylon, under an arrangement with the Indian and Colonial offices, "that the young plants which could not thrive in the climate of Calcutta, or any of the more accessible gardens of Continental India, should be nursed and established in Ceylon, for subsequent transmission through the Indian gardens to Assam, Burmah, and other hot, damp provinces of India proper." It is satisfactory to know that the plants are thriving in Ceylon, and that a supplementary tropical garden has been established at a lower elevation than that at Peradeniya, for the more rapid propagation of india-rubber, chocolate, and other economic plants requiring great heat and moisture. In addition to the large consignment to Ceylon, smaller quantities of *Hevea* plants have been sent to the West Coast of Africa, Dominica, Jamaica, Trinidad, Burmah, Java, and Queensland. Over and above this large stock of rubber plants raised from seed at Kew, a further consignment of about a thousand young plants were received at the gardens in November last, from South America, and retained there till a favourable opportunity should occur of sending them to India. Of the Central American rubber (*Castilloa elastica*), the plants have been propagated at Kew as rapidly as possible, and sent to the West Coast of Africa, Ceylon, and Java; the bulk of those sent to Ceylon are reported upon as thriving vigorously. Along with the *Hevea* plants received in November, Sir Joseph Hooker reports the occurrence of "seeds and plants of an undescribed rubber tree which furnishes the 'ceará scrap' of the English market." The export of this has been reckoned at 1,000 tons annually. The botanical nature of the plant is at present uncertain; but it may possibly prove identical with *Manihot Glaziovii.* "It is, at any rate, perfectly different from *Hevea* and *Castilloa* in character, habit, and habitat. It grows in a climate with a marked dry season, amongst a scrubby vegetation, and has stout short branches, and deciduous leaves. Forty-one of the imported stems have grown, and as many young plants have been obtained from these by cuttings. The seeds were raised with difficulty during the winter owing to the seedlings damping off soon after germination—a characteristic of plants of similar habit from similar climates; 14 plants, however, are growing from this source."

With regard to the cultivation of the cocoa or chocolate tree (*Theobroma cacao*) in Ceylon, it is said that it is now being rapidly improved, and will unquestionably soon become an important article of trade with that island. In the matter of the new or Liberian coffee, which was first grown in this country at Kew in 1872, it seems that the demands for plants and seeds were made by coffee planters in all parts of the world. The report says, "Now that the function of this establishment in introducing the plant into the coffee-growing districts of India and our colonies is amply fulfilled, and both the seed and plants are to be had from Mr. Bull, of Chelsea, and Messrs. James Irvine and Co., of Liverpool, as well as other firms, no further supply will be kept in Kew than suffices for exchange with other botanical gardens and correspondents." During the year this new coffee was sent out from Kew to the following places: Bombay, Madras, Burmah, Dominica, Trinidad, Montserrat, New Granada, Rio de Janeiro, Cape of Good Hope, Java, and Queensland. Many favourable accounts of the plant have been received at Kew from different countries; of these Sir Joseph Hooker gives extracts of letters from correspondents in Ceylon and Dominica, to both of which plants have been sent. From Ceylon, Dr. Thwaites of the Botanic Garden, Peradeniya, writes:—

"Some of the first plants of Liberian coffee you sent me have become large bushes, and are producing berries. These latter are of a large size, but they ripen very slowly, evidently from the want of a higher temperature, so I am distributing some plants in the low country and near the sea." From Dominica, Dr. Imray writes:—"I am thoroughly convinced that the Liberian coffee will, in time, take the place of our native coffee, if I may so call it. I think you would be pleased were you to see my Liberian trees, with their healthy, vigorous branches, and large, dark green, bright, shining leaves. Many of the trees have blossomed, and are still flowering, and a small crop of berries is coming on. The plant must evidently be very prolific. I count as many as 15 or 20 berries, even more, in the axils of the two opposite leaves. . . . It appears to me that the new species of coffee is peculiarly adapted to this island. So far as the temperature and rainfall are concerned, the climate approximates very closely to that of Liberia, from whence the plant comes. If the cultivation of Liberian coffee is generally taken up in Dominica, as I think it will be, there is a future for this little country. There are thousands of acres of splendid coffee-land that might be cultivated in this island, with no fear of the 'white fly' before the eyes of the planter, for the Liberian tree bids defiance to its attacks. Indeed, there is a very eligible field for settlers here with a little money in their pockets, who wish to cultivate coffee. It might be pleasanter and more profitable, in the long run, to set their faces towards the West, instead of the 'far East.'" The decline in the cultivation of coffee in the island of Dominica, through the prevalence of disease in the plants, has been so fully explained at p. 958, vol. XXIII., and p. 248, vol. XXIV., of the *Journal of the Society of Arts*, that this highly favourable opinion of the re-establishment of the coffee culture in the island will be read with much satisfaction. On the other hand, it seems that the Liberian coffee plants are not disease-proof in Ceylon, some of the plants having become affected with the leaf disease (*Hemileia vastatrix*), though they appear not to suffer so severely as the ordinary coffee. In the Malabar district of South India, also, it has suffered from the attacks of the above disease, but it is thought and hoped that its more vigorous habit of growth may enable it to bear without succumbing to its ravages. On this and other coffee diseases, the Kew report treats very fully and minutely; and, as this is a subject affecting so deeply coffee-planters in general, as well as many readers of this *Journal*, it is here given in its entirety. Sir Joseph Hooker reports as follows:—

"In my last report I stated that Dr. Thwaites, the director of the Botanic Gardens, Peradeniya, Ceylon, had drawn up a series of questions on this subject which have been addressed to the various coffee-growing countries and colonies. All the replies and information that are likely to be received in answer to this inquiry having now come to hand, I have thought it would be most useful to summarise the results in the present report as likely to give them the widest circulation.

"According to the replies no disease, or, at any rate none with the characteristic peculiarities of the *Hemileia* occurs in any of the following seats of coffee cultivation:—Angola, Bahia, Bermuda, Carthagena, Cayenne, Costa Rica, Grenada, Gold Coast, Guiana (British), Jamaica, Java, Madeira, Mauritius, Nicaragua, Reunion, St. Helena, Sierra Leone, Trinidad.

"In the following places from which replies have been sent coffee is not grown:—Barbados, Buenos Ayres, Honduras (British), Leeward Islands (except Dominica), St. Vincent, Surinam, Zanzibar. With respect to the remainder, the information received may be conveniently summed up under the following heads:—

"1. *Hemileia vastatrix* ('leaf blight') of Ceylon and Southern India and associated diseases.

"2. *Cemiostoma coffeellum* ('coffee fly') of the Antilles and Brazil and associated diseases.

"3. 'Borer.'

"4. 'Coffee bug.'

"5. 'Canker' and other vague diseases, attributable to climatic causes.

"The reports received bearing on these several heads are perhaps not as complete in information as might have been both expected and desired. In the light, however, of knowledge derived from other sources, they have proved to possess considerable interest. In some cases the statements have been of a very hypothetical nature, as, to give one instance, where a South American reporter expresses the opinion that the Ceylon disease—the vegetable origin of which is unequivocally known—is 'propagated by myriads of diminutive insects.'

"I cannot refrain from calling particular attention to the fact that whereas in British Guiana coffee was once largely cultivated, especially in the county of Berbice, it is now 'imported.'

"1. *Hemileia vastatrix.*—The 'Leaf disease' is a source of quite recent origin. In May, 1869, a few coffee plants were noticed in Ceylon to be attacked by a fungus upon the leaves. In July following, two or three acres of coffee plant were found to show it. After this its progress was quite extraordinary, and in 1872 it was to be found in nearly all, if not all, the estates in the island. It also soon spread to Southern India, and though Java is at present free from it, I learn, while this report is in operation, that it has made its appearance in Sumatra. I have, however, found no satisfactory evidence of its existence in other parts of the world than the islands and countries contiguous to the Indian Ocean. I conclude, therefore, that it is at present a local or endemic parasite, which, however, unless measures are taken to prevent the introduction of coffee plants from infected countries into others at present free from it, may be expected to spread eventually wherever coffee is cultivated. The fungus, which is allied to the moulds, was first described by our distinguished English fungologist, the Rev. M. J. Berkeley, in the *Gardeners' Chronicle* for 1869 (p. 1157, with a woodcut), and subsequently in the *Journal* of the Linnean Society (Botany, vol xiv., p. 93, pl. 3, fig. 10). A short account also appeared in the *Quarterly Journal of Microscopical Science* (1873, pp. 79-81). It is probably indigenous to Ceylon, and has only assumed the proportions of a scourge because it has found the constitution of the coffee plant suited to it.

"The conditions under which economic plants are grown in large areas are of course extremely favourable for the rapid extension and development of parasitic plants and insects. When these have only native plants in small quantities to prey upon they pass unnoticed, and their appearance on a large scale is one of the penalties which man must expect to pay, for such an enormous disturbance of natural conditions as is implied in replacing a tropical forest, of the most varied and mixed vegetation, by a plantation of some single economic plant. In temperate countries exactly similar phenomena are exhibited, by the rapid spread of the potato fungus, the vine louse (*Phylloxera*), and the potato beetle from the western side of America, first to the eastern, and then, at any rate in the case of the two former, and no doubt eventually in the case of the latter, to the Old World.

"Mr. Berkeley's examination of the *Hemileia* was made from dried coffee leaves transmitted to this country. A first essential is a more adequate study of the fungus than such specimens could afford, especially in all the details of its life history, from germination to fructification. Some progress in this latter task has been made by Dr. Thwaites, with the co-operation of the Rev. R. Abbay, Fellow of Wadham College, Oxford, who was attached to the Eclipse Expedition, and remained some time afterwards in Ceylon for the benefit of his health. Mr. Abbay's observations, though imperfect, are a first step towards a more accurate knowledge of the subject, and will, I hope, shortly be published.

"The *mycelium*, or vegetative part of the *Hemileia* penetrates the tissues of the leaves of the coffee plant, where it is out of the reach of any agent such as sulphur (whether applied in powder, as is so successfully done with hop mildew, or—as suggested by Mr. George Wall—by fumigation). Moreover, the detailed treatment of the trees in a large plantation by any remedy of the kind would be practically impossible. I fear that the 'leaf disease' is a trouble with which the planters for the future will have always to reckon. As with our own potato disease, they must rest their hopes on the likelihood of its proving intermittent, and bear, as best they may, the constant loss of a certain per-centage in every year, with occasionally the loss of an entire crop. At the same time, every precaution should be made to destroy all the infected leaves by burning, and even, when more certain knowledge is arrived at, to boldly sacrifice the foliage of trees on the first symptoms of the malady, so as to prevent the fungus ripening a fresh crop of spores.

"In Mysore another disease appears also to be rather prevalent, which is produced by a fungus distinct from the *Hemileia*. This is known as the "leaf-rot," or Kole-roga. It has been described by Dr. M. C. Cooke under the name of *Pellicularia koleroga* (*Gardeners'*

Chronicle, 1876, Feb. 12, p. 246; March 4, p. 308; Grevillea, 1876, vol. iv., pp. 116, 134-135). From a report by Dr. Cooke, issued by the India-office, it appears that the *Pellicularia* 'makes its appearance about July, when the leaves of the trees affected by it get covered with a slimy gelatinous matter, and turning black drop off, the berries likewise rot and fall in clusters.' It is estimated that nearly one quarter of the crop each year is lost by this plague. The collection and burning of the dead leaves will in this case also have to be persevered with. As suggested by Dr. Cooke, the fungus being external in its growth, is likely to be materially checked by the application of sulphur.

"A somewhat similar disease to the *Pellicularia*, but described in too vague a manner to speak definitely upon, seems to have occurred in 1864 in Jamaica, the leaves of the coffee plants being covered with 'a white substance of a glutinous nature.'

"As I have stated in an earlier portion of this report, the Liberian coffee has not proved exempt from the attacks of the *Hemileia* in India and Ceylon. Mr. G. A. Cruwell, who has visited Liberia, believes that it is affected with the *Hemileia* in its native country. Specimens sent to Kew by him are pronounced by Mr. Berkeley not to be affected by the Ceylon leaf disease, but to owe their discolouration to some other cause.

"2. *Cemiostoma coffeellum.*—A disease has for many years been known to exist in the island of Dominica, and also to a large extent in Brazil. This was characterised by the appearance of large discoloured blotches upon the leaves, leading eventually to their decay and fall, and so seriously impairing the health of the trees. Various theories, mostly of a purely *à priori* character, were started to explain the case, but competent investigation has placed the true explanation beyond a shadow of a doubt. The leaves are destroyed by the larvæ of a minute but very prolific moth. They live between the two surfaces of the leaves, and gradually consume the intermediate cellular tissues. The moth is, in fact, a member of the same genus as that which mines the leaves of the laburnum in our gardens. This insect is said to lessen the coffee crop in Brazil by at least one-fifth. The little pest has been found in the Antilles, island of Martinique, province of Rio Janeiro, and over the whole coffee region of Brazil. According to an enclosure in Mr. Acting Consul Austin's despatch to the Foreign-office, it is of comparatively recent introduction into Brazil:—'In 1854, or soon after, the Imperial Government, desirous of introducing several species of coffee amongst us, advantageously cultivated in other parts of the world, committed the error of importing plants instead of seeds, and thus we had here coffee trees grown in Ceylon, Martinique, Bourbon, &c., it being quite possible that in this manner the germ of the coffee disease was imported.' This is also the opinion of Mr. B. Pickman Mann, who has reported in the most admirable manner upon the whole subject to the Brazilian Government, see *American Naturalist*, 1876, June and July. I may also call attention to a similar transference, from the Old to the New World, of the moth which injures the sugar cane, and which is referred to below. Those interested in the matter should procure and study Mr. Mann's report. The only plan of radically dealing with this pest is to destroy the injured leaves while the coffee-fly is still in the larval state. Mr. Mann remarks:—'If the leaves were picked at such a time as to take the greatest number of larvæ when they were about two weeks old, it would not be difficult to select them, as the size of the blotches would make them very noticeable. I find that the expense would be more than met by the next year's crop.'

"Mr. Consul Pauli has sent from Puerto Rico leaves which are affected with the *Cemiostoma* in its most characteristic manner. The disease appears to do little injury in this island, and no particular attention is paid to it.

"In Venezuela a disease occurs which is known by the name of 'Candelillo,' and which is also, according to information supplied by Mr. R. T. C. Middleton, her Majesty's Minister at Caracas, identical with the 'mancha de hierro,' or 'iron-stain,' Dr. Ernst, however, believes them to be different, and attributes the latter to the *Cemiostoma*. The specimens forwarded to this country by Mr. Middleton of the iron-stain are, however, at once distinguishable from the ravages of the *Cemiostoma*. The leaves have been submitted to the Rev. M. J. Berkeley, who reports that they are affected by a minute fungus, a *Depazea*, for which he proposes the specific name of *maculosa*. It has fusiform spores, ·0008 in. long, and containing about seven nuclei. In Venezuela coffee appears to suffer little, comparatively speaking, from maladies of any kind.

"Mr. Bunch, her Majesty's Minister at Bogota, has forwarded some leaves affected with blotches apparently identical with those from Caracas. This is apparently a rare malady. He has accompanied these with the following description, drawn up by Senor Saenz, Professor of Botany in the University of Bogota:—'It consists of circular or elliptical blotches of an ochreish yellow colour, in which are to be observed hard knots in the centre, round which are formed concentric bands. These salient knots are to be easily distinguished on each side of the leaf, but on one side only are to be found small fungi of a yellow colour (orange), formed of a very delicate pedicule, crowned by a small sheaf of fibres, in which are abundance of oval corpuscles of a darker colour, approaching to green, and of ·003 of a millimetre in diameter.'

"3. '*Borer.*'—In all tropical countries trees of all kinds are peculiarly liable to the ravages of various wood-eating beetles. Coffee is no exception, and the reports from various countries mention 'borers,' no doubt different in every case, with which the cultivator has to contend. They are peculiarly met with where the plantations are new clearings, and an important means of extirpating them is the systematic clearance of any decaying or other wood which they can use as a refuge.

"They are mentioned from the West Coast of Africa, Sierra Leone, Liberia, and Gold Coast; they are also occasionally troublesome in Jamaica. It is in S. India, however, that they work harm on the largest scale, and for an account of the *Xylotrechus quadrupes*, which is the 'borer' of that country, I must refer to Dr. Bidie's report on its ravages, published in 1869.

"4. '*Coffee Bug.*'—While 'borers' attack the roots and stems of coffee trees in hot countries, various species of *Coccidæ* suck the juices of the young twigs and leaves. Under the names of 'blight,' 'bug,' and 'scale,' these are mentioned in the reports from Gold Coast, Hawaii, Madeira, and Trinidad. In the latter case they are noted as being accompanied (as is often the case when they attack the orange) by 'sooty-blight,' a fungus (*Capnodium*, sp.) which covers the leaves with a dark incrustation. The coffee bug of Ceylon (*Lecanium coffeæ*) was once a source of considerable injury to the coffee estates of that island. It is described in Emerson Tennent's Natural History of Ceylon, pp. 436-441. As in other countries, in the face of careful cultivation it appears to have ceased to give annoyance.

"5. '*Canker.*'—Coffee, for some imperfectly-understood reason, has apparently failed to hold its ground in Natal. It is subject to a 'bark disease,' which is thus described by Mr. C. T. Saner:—'The first symptom of the disease is the withering of a small tertiary or secondary branch; on further examination it will be found that the bark, under the primary branches, is decayed and blue-mouldy; the blue mould extends downwards gradually over the whole stem, killing the tree in a few months. . . . . . A tree once attacked never recovers. . . . . . All soils and situations seem alike liable to the disease; the trees seem about to begin to suffer when about six years old. The area of land under coffee has been already much reduced, the crop having already proved unremunerative; the sugar-cane is gradually but surely supplanting the coffee tree.'

"Here, of course, the mould is the proximate cause of death, but the ultimate cause is evidently, from the fact of its appearing when the trees are at the age of six years, due to some unfavourable external condition. The opinion of experienced persons in the colony is so entirely at variance as to what these may be, that I am indisposed to express any myself. The collapse of coffee-growing is by some attributed to neglect of cultivation, by others to unsuitability of climate, and, last of all, to want of depth of subsoil, as shown by the small height attained by the native arboreous vegetation.

"In Jamaica, 'canker' is also spoken of as a source of constant loss of about one per cent. per annum of the coffee trees. Its effects increase with age, and are attributed to the roots penetrating to uncongenial soil. Local 'blights' also occur, which are attributed to sudden climatic changes.

"In Java, a fungus attacks the trunks, giving them 'a white appearance,' and produces death in all the parts above."

Several medicinal plants of acknowledged reputation have occupied considerable attention at Kew during the year, notably the Balsam of Copaiba plant, some seeds of the Para kind having been introduced and germinated freely. The product of this tree, which is described as growing to a height of 80 feet before branching, is known as *Copaiba blanca*, and is chiefly exported to France, where it fetches a higher price than any other kind. A single tree, if tapped at the proper season, is said to yield about 84 imperial pints of balsam. The tree is recommended for introduction to India. Unfortunately, but little is known as to its botanical characters; it has however been described as *Copaifera multijuga* of the Balsam of Peru plant (*Myroxylon pereirae*), a tree, not of Peru as its name would indicate, but of Central America. It is satisfactory to know that the plants introduced into Ceylon in 1861 have not only grown well, but have produced seeds in such abundance that quantities have been sent from Ceylon to Kew, from whence they have been distributed to various tropical colonies.

Ipecacuanha (*Cephaelis ipecacuanha*) a valuable medicinal product of the Brazilian forests, used largely as an emetic and in dysentery, has been introduced into India, and while Dr. King, of the Calcutta Botanic Gardens, reports that he fears this drug cannot be grown profitably so far north in India as Bengal, states that the secret of its successful propagation being now perfectly understood, any quantity of seeds can be sent out. The plant seems in India to be of very slow growth, and consequently the animal production of root is small, this however can be met by a greater extension of its cultivation, which is easily effected by ordinary cuttings, dividing the root, or pegging a leaf to the earth. A trial of the dried root of Indian growth has been made in Calcutta, and reported upon as being as efficacious as the best quality ipecacuanha from South America.

Many other plants of economic value have occupied the attention of the Kew authorities during the past year. Notably, the African oil palm (*Elaeis guineensis*) has been proposed to be introduced into the Island of Labuan. The new tanning material, known as the Algarroba of Chili, which is the pods of *Balsamocarpon brevifolium*, said to be much more valuable even than Divi-Divi, has been sent to Adelaide, Brisbane, Melbourne, Bahamas, Barbadoes, Bermuda, Cape of Good Hope, Natal, Lahore, and Gunesh Khind, Bombay.

The castor-oil plant (*Ricinus communis*), which the Governor of the Bahamas states grows in the island as a weed, but is not cultivated, nor the oil expressed, has received so much attention that a supply of seeds of the best kind was obtained from Calcutta and transmitted to the Bahamas. On this Governor Robinson reports as follows:—"The yield of this variety of the castor-oil plant is, we should say, fully three times greater than that commonly found amongst us, the heads and the beans themselves being very much larger than those produced by the native variety. As the East India plant can be cultivated quite as easily and readily as our own, and as it possesses such a marked superiority in the matter of yield, we hope to see it speedily and widely introduced into the colony, so as to supersede the indigenous kind altogether."

Under the head of "Gutta-percha" is discussed a product of very great importance and of large consumption, but about the botanical history of which, we are reminded literally, nothing is known. Many kinds of gutta-percha, each with a distinct trade name, doubtless of native origin, find their way into commerce. The importance of a proper investigation of the gutta-percha producing plants is pointed out, as there is good reason to believe that their geographical distribution is limited, and the wholesale collection of the product and consequent exhaustion and destruction of the trees must follow, no steps being taken to replace them. A better knowledge of the plants, therefore, would lead to their conservation or protection.

The question of new and cheap materials for paper-making is also one of great and increasing importance, more especially as the supply of alfa (*Macrochloa tenacissima*) is increasing in price and decreasing in quantity. Amongst the plants which have been recommended for this purpose are the following:—Bamboo (the young shoots), baobab bark (*Adansonia digitata*), *Fimbristylis spadicea* from Vera Cruz, *Heliconia bihai* from Jamaica and Trinidad, *Lepidosperma gladiatum*, from Australia, *Phragmites communis*, a common British reed, but which has been imported from Majorca, and *Uniola virgata*, a Jamaica grass. The reports on the quality of these for paper-making are varied.

A sugar-cane, known as the "Elephant cane of Cochin China," has created some little interest amongst sugar planters, on account of the great height attained by the plant. In a good soil, in two years, it attains a height of 10 feet, and in five or six years runs up to from 16 to 30 feet. It seems, however, not to be a valuable variety for cultivation, and is grown mostly for chewing. It will be a matter of regret to all to learn that the sugar-canes, both in Demerara and Queensland, are suffering from attacks of disease, the first from the ravages of an insect and the latter apparently from that of a fungus.

The foregoing notes will give a fair idea of the valuable work done at Kew, in benefiting not only our own country, but also our colonies and our great Indian Empire.

PHILADELPHIA EXHIBITION REPORTS.*

Cotton, Linen, and other Fabrics.

Mr. Watts' report on the exhibits included under this heading deals with products comprised in nine different classes, and takes in besides the well-known textile materials, such matters as asbestos fabrics and packing, wire-cloth, and even a fire-proof wire-lath for plastering, grass, rattan, hemp, ramie bark, mattings, and floor-cloths. With regard to textiles generally, the high protective duties of the States had acted as a great check on foreign exhibitors; but the collection shown by native manufacturers was such as to furnish "a striking illustration of the rapid progress which they have made in the various branches of the cotton industry." But if the amounts sent by European manufacturers was small, the quality was very high, and the display was "sufficient to prove to the American manufacturers that their competitors have nothing to fear whenever they can meet on equal terms." The contributions from Great Britain maintained our high reputation in this department. In fact, Mr. Watts speaks quite enthusiastically of their

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* Continued from p. 850.

"surpassing excellence." In linen the American contributions were not extensive. Ireland took the lead, followed closely by Scotland, several other European States also making a considerable display.

The oilcloths and similar manufactures "transcended anything of the kind seen at previous exhibitions," and in this class the American exhibitors had undoubtedly the pre-eminence. The floor-cloths were of great excellence.

Some specimens of raw cotton were specially examined and tested, care being taken that the judges were not informed as to the names of the particular samples. Mr. Watts congratulates himself, as an early advocate of free labour, on the fact that two of the growers of cotton who took prizes under these strict conditions were negroes.

Some of the newer fibres attracted much interest. Chief among these was the Rheea fibre, or *Ramie*, of which Mr. Watts, like former writers on the same subject, speaks in the highest terms.

As regards American competition with English manufacturers, Mr. Watts is of opinion that if the artificial barriers of protective duties were removed, there would be no cause for fear. The very retention of protective duties he puts forward as a proof that Americans are conscious of this. "Were it proper" he says, "to go into the question, it might be shown that neither in the raw material, machinery, skill, or cost of labour, have American manufacturers any special advantages, whilst in some respects they are less favourably situated than their English rivals."

Textile Machinery.

Mr. W. W. Hulse did not find it practicable to frame a report on this subject, because there was no instance of a complete set of working machines being exhibited. The most complete set belonged to the United States, but was not worked. The machines shown by Americans nearly all possessed features of novelty, and, "as regards extent of invention and ingenuity," surpassed all other nations, but "as regards consummateness of invention and arrangement of mechanism" Great Britain was superior.

Wool and Silk Fabrics.

Mr. H. Mitchell's report on wool and silk is, to a great extent, composed of statistics. In his concluding remarks he gives the following summary of his observations:—

1. No country can produce "Lustre" wool like our Yorkshire, Lincolnshire, and Nottinghamshire fleeces.
2. The nearest approach to this class of wool is that grown in Canada.
3. While Saxony, Silesia, and some parts of Russia produce wool adapted for the manufacture of the best woollen cloth, Australia and New Zealand produce a greater variety of medium and fine qualities, and are making greater progress than any other countries.
4. England is still supreme in the cheaper qualities. In medium goods the competition with Germany, Belgium, and Sweden is very keen. Canada is producing woollen of good quality at a slight increase over English prices.
5. In worsted stuffs France maintains her pre-eminence.
6. In mixed fabrics of cotton and wool, and cotton, wool, and silk, Bradford is above all competition.
7. The Americans excel in the manufacture of flannels, blankets, and medium cloths.

Paper, Stationery, Printing, and Book-making.

Sir Sidney Waterlow's report on these subjects is not very long. With regard to paper, he notices the great disadvantage which high import duties inflicted on English manufacturers, and the comparative poverty of the English exhibits. The American collection showed great excellence, and an advance on former exhibitions. It appears that no hand-made paper is now manufactured in America, and the consequence is that great efforts have been made to improve the quality of that made by machinery.

The exhibition of printing machines and presses is characterised as "one of the most remarkable features of the Exhibition." He specially notices the fast newspaper presses. Of these there were five: a "Walter" machine, similar to that upon which the *Times* is printed in London; a "Bullock" machine; two "Hoe" machines, one with a folder attached, the other with an accumulator; and a "Campbell" machine. "It is no exaggeration to say that no such collection of fast web printing machines was ever before brought together. These machines differ materially in their construction, and in the various arrangements for cutting, folding, &c., but they one and all—and certainly the first four—were of such marked excellence as to render them very valuable specimens of machinery, and a most important addition to the power of spreading news all over the world." The machines were carefully examined and tested by the judges, the most crucial test being a demand on each manufacturer to run his machine for one hour continuously. This test was satisfactorily carried out with all except the Campbell machine, and the result proved that the Walter machine could run with less loss of time in changing the rolls of paper and restoring the broken web than either of the others. In the Hoe machines the accumulators and folder "worked with wonderful smoothness and rapidity, besides being valuable accessories to the machine."

There was also a fine collection of machines for bookwork and for illustrated work. In the division including type casting and composing machines, stereotype apparatus, &c., nothing very new was noticed, except a machine for casting type and setting it up. This idea is condemned as unsatisfactory on account of the great waste of metal in re-melting. Two type-writing machines are noticed, one a new one of Russian invention. Some machinery for making envelopes is strongly commended. One machine for this purpose turned out 6,000 per hour; another produced 3,000 in the same time, impressed with the Government stamp.

Hardware used in Construction.

Mr. Bain's report on this division includes locks, hinges, bolts, nails, &c. A difficulty was found in comparing the productions of America and of other countries, since the collections of the latter were small in extent, and of limited variety. It was, however, considered that in beauty of design and artistic finish the manufactures of the States surpassed all the European exhibits. A noteworthy feature was the extensive use of nickel plating. Door knobs, hinges, even stove fronts and door plates, were all coated with nickel. Locks have long been an American speciality, the most noticeable shown at Philadelphia being combination and chronometric locks. The latter are connected with a timepiece in such a manner that the lock can only be opened at certain hours. Thus, if a thief obtains possession of the keys, he cannot use them at night or out of office hours. The locks shown varied in value from 2d. to £200.

The Patent Bill has been definitely withdrawn. Announced in the Queen's Speech, it was introduced at the very commencement of the Session, but yet was never read a second time. It thus has shared the fate of its predecessors in 1875 and 1876.

In a circular letter just issued, it is stated that, in consequence of the course pursued by her Majesty's Government in reference to the late Brussels International Exhibition, the Executive Committee are compelled to ask the members of the General Committee to contribute the remaining expenses connected with the Exhibition, amounting to £691 18s. 6d.

CORRESPONDENCE.

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KOENIG'S TUNING FORKS AND APPUNN'S TONOMETER.

The letter of Herr Koenig, which was copied from *Nature* in o the *Journal of the Society of Arts* (July 6th. p. 800), and my brief reply in *Nature*, require, I think, a little explanation, in view of my paper on "The Measurement and Settlement of Musical Pitch," read before the Society of Arts. The statements of which Herr Koenig complains will be found in the little table at the bottom of p. 674, col. 2, of the *Journal of the Society of Arts* for 25th May, 1877, containing my paper. They are, briefly, as follows:—Forks which were made by Herr Koenig, and stamped as giving

256 320 384 512 640 896 1024 1152 1280

double vibrations in a second, when measured by Herr Appunn's tonometer appeared to give

258·4 323·1 387·6 516·7 646 905 1033·6 1163·3 1292

double vibrations in a second. Both sets of numbers are in the ratio of the smaller numbers

4 5 6 8 10 14 16 18 20

respectively; so that, on either reckoning, they form a series of harmonics, giving perfect intervals. The question ultimately turns upon the point whether the number of vibrations made in one second by the French "diapason normal" is really 435, as was intended, or 439, as shown by Herr Appunn's tonometer. In my paper all my own measurements were (as I have there stated on p. 672, col. 2) made by the help of Herr Appunn's instrument, and, of course, everything turns upon its correctness, or, if erroneous, on its correction.

As yet I have not learned how the French diapason normal was originally tuned; that is, how the number of its vibrations was determined. But it was tuned by that very eminent physicist, M. Lissajous, and, no doubt, the number of its vibrations was determined with all the accuracy possible in 1859, by a most practised experimenter. But until we know the precise method employed, we are unable to determine the probable or possible amount of error. Herr Koenig is also a well-known skilful acoustical experimenter and mechanician, and his tuning forks are extremely beautiful. The series which I measured, as shown in the passage above cited, gave the intervals with all possible correctness, even as read by Appunn's instrument. In forming an opinion on the point in dispute, this accuracy must be borne in mind, because it shows that both Koenig and Appunn agree with practical precision as to the ratios of the numbers of vibrations of the forks. They differ only as to their absolute numbers. It follows, therefore, that whatever affects any number of beats counted by Herr Appunn's instrument must affect every one of the beats in the same ratio, that is, the numbers as given by Appunn, if Koenig's forks are tuned in correct intervals, of which there seems to be no doubt, must be altered by multiplication and division only, or both, and not by addition or subtraction. For example, if every one of Appunn's numbers were multipled by 435, and divided by 439, they would become almost precisely Koenig's. The divergence of the two sets of numbers in the table cited cannot therefore depend on the numbers of the beats recorded, but on the length of the second by which the beats were counted. Let us suppose that Appunn's pendulum were wrong, and Koenig's were right—for this is the assumption made, although of course it is very difficult to establish without comparing the actual instruments. Then, since each vibration of the same tuning fork is of constant duration, we have

439 vib. in 1 of Appunn's seconds
= 435 vib. in 1 of Koenig's seconds.

Hence 1 vib. lasts $\frac{1}{439}$ Appunn's second and $\frac{1}{435}$ Koenig's second.

Whence Appunn's second = $\frac{439}{435}$ Koenig's second
" " " = 1·0091954 Koenig's sec.
and Koenig's second = $\frac{435}{439}$ Appunn's sec.
= ·9908884 Appunn's sec.

It will be seen that these differences are very small, amounting to about 9 in 1,000, or less than one per cent. But as we have to deal with such numbers as 256 and 512, this difference becomes extremely well marked. It would be, however, very difficult to detect when the vibrations, or beats (for one beat corresponds to a difference of one vibration) cannot be counted through a very long time, such as ten minutes. Now I was able to count them through only 20 of my seconds (which were, of course, different from either Appunn's or Koenig's), and I always found 80 beats between two of Appunn's reeds. We should have to suppose that I was always exactly right in my count, and that my watch was wrong precisely to the same amount as Appunn's pendulum. But, we have seen, Appunn's second was longer than Koenig's (supposed to be right), and on the contrary my chronometer was gaining instead of losing, to the amount of three or four seconds a day, and hence its second was too short. The error thus made would be inappreciable in 20 seconds, but such as it is, it would be in precisely the opposite direction, and hence the only hypothesis that can be made if Herr Koenig is right, is that the number of beats in 20 seconds was really 79·271068, but that I uniformly failed to observe this error of ·728932 beats in each of the 64 cases, which were often counted several times over. Of course this is quite possible, but I do not think it quite probable. I think it much more likely that the actual beats in many cases were slightly, and but very slightly, wrong, and that the direction of the error was different, so that the errors practically compensated each other, while they were individually too small for me to discover either by counting or consonance. I find that according to Dr. Preyer's counting (to be mentioned presently), out of the 32 sets of beats on his instrument, only 14 were exactly 4 in a second, 8 were more than 4, to the extent on the whole of 0·47, and 10 were less than 4 to the extent on the whole of 0·77, so that on the whole there were 128 + 0·47 − 0.77 = 127·7 beats instead of 128. As also the octave of the lowest note was 0·1 too sharp, it followed that the lowest note made 127·6 instead of 128 vibrations as was intended. Now in 14 cases the error was less than 0·1, and would possibly have escaped me, but in 4 it was greater than 0·1, which could scarcely have been overlooked. It seems to me impossible that the total error in my own counting could have amounted to so much as 2·4.

Observe, however, that the correction suggested by Herr Koenig, although it would reduce the French "diapason normal" from 439 to 435, which is Lissajous's number, will not reduce Herr Koenig's numbers with perfect correctness. The difference is very small, but it is quite sensible on paper, and there seems to be a reason for it. Supposing the French diapason normal to be 435, and that a fork is tuned $8\frac{1}{3}$ vibrations flatter, having $426\frac{2}{3}$ vibrations, and another fork is tuned by the Lissajous figures to be a major Sixth below it, it will make $\frac{3}{5}$ of $426\frac{2}{3}$ or 256 vibrations in a second. Now, if the French fork really makes 439 vibrations, as measured by Appunn's tonometer, and a fork were tuned $8\frac{1}{3}$ vibrations flat, it would make $430\frac{2}{3}$ vibrations, and a major Sixth below it would be $\frac{3}{5}$ of $430\frac{2}{3}$ or 258·4, which is what Koenig's fork actually measures by Appunn's tonometer. Now observe, these $8\frac{1}{3}$ vibrations flatter than the French diapason normal are supposed to be counted by Koenig's pendulum, and these, on his supposition, would be 8·40996 of Appunn's, which being subtracted from 439, leave 430·59004, and $\frac{3}{5}$ of this is 258·35402, and not 258·4. The former number, however, and not 258·4, would give 256 when multiplied by 435 and divided by 439. It is of course not pretended for a moment that my counting was accurate to ·04. I merely observe that the hypothesis suggested by Koenig is insufficient, and that this insufficiency is exactly accounted for by the supposition of making a fork 8⅓ vibrations flatter than the French diapason normal, and deducing a 256 from this, an operation of which Appunn's tonometer takes no count. If we were to take Koenig's numbers, multiply them by 439 and divide them by 435, we should only nearly, not quite, obtain the measured results.

Again, Dr. Preyer, Professor of Physiology at Jena, had another of Appunn's tonometers with only 33 reeds, in which, therefore, only 32 sets of beats had to be counted. These he counted for a whole minute each, and very often, at long intervals, with a very good watch. He then, to determine the pitch of the reeds, made use of an older pair of Koenig's forks, which formed such an exact octave that not the slightest wave of sound could be heard in a whole minute. By means of adding together the 33 sets of beats, and finding the beats between each fork and the extreme reeds, it was easy for him to calculate the absolute number of vibrations in Koenig's forks. He made them 129·1 and 258·2. He considered that these figures might be relied on with certainty to the first place of decimals. It will be seen that 258·2 differs only by 0·2 from my determination of the pitch of another of Koenig's forks. Are we to suppose that Prof. Preyer's watch was wrong, to precisely the same amount as Herr Appunn's pendulum? Would it not be more likely that the original determination of the pitch of the French diapason normal was erroneous than that three time-measurers, Herr Appunn's, Prof. Preyer's, and my own, should be all exactly wrong to the same amount, and that Herr Koenig's should be exactly right? Till we have a means of judging of the method employed in deriving that pitch, we cannot reasonably assume that it was necessarily correct.

Herr Koenig makes a great point of my not having hesitated to affirm that all his tuning forks, including those of his great tonometer, which I had probably never seen, and had certainly never been able to examine, were necessarily inexact. I said that "possibly the whole of Koenig's tonometer was vitiated by working from 258·4, as if it were 256" (p. 674, vol 2, note). The word "possibly," stated a mere conjecture. I have never seen this tonometer of tuning-forks. It has been, probably, manufactured with care, and Herr Koenig is a splendid workman. Still, I must own that two pairs of his forks, intended to differ by 4 vibrations, differed as well as I could count them by 3·8 and 4·3 vibrations. He has not impugned my counting hitherto, but merely the length of my second. These numbers, however, differ in opposite direction, and could not be reconciled by any theory of an error in the length of the second. These 4 vibrations are, moreover, exactly the intervals by which the forks in his tonometer differ. Anything approaching to such an inaccuracy, as we shall see, would be utterly fatal to a tuning fork tonometer. So far, then, as I have had any means of testing his forks, similar to those in his tonometer, by beating one with the other, quite independent of Appunn's instrument, I have reason to suppose that even in his very fine instrument unperceived errors may exist sufficient to produce 2·4 or more vibrations in 64 cases, if they were all in one direction. In tuning forks, also, the check of perfect consonances cannot be applied as in reeds, and although the Lissajous figures may be used indirectly, and through other forks, to determine the correctness of these consonances, I doubt whether they could be applied to the 80 cases and more which I proved mechanically to exist on Appunn's tonometer, and which seem to me to prove that the ratios of numbers of vibrations are truly expressed, even if the absolute numbers are wrong. At any rate, I am unable for the present to accept Herr Koenig's tonometer, or pendulum, as necessarily more perfect than Herr Appunn's. Mr. Hipkins also informs me that Messrs. Broadwood's sent an order to Herr Koenig to make a fork of 528 vibrations, giving *carte blanche* for expense. The order was never executed. But, as 528 is double 264, that is an exact octave higher than one of the forks on Herr Koenig's great tonometer, there ought to have been no difficulty in making such a fork. The non-execution of this order was always inexplicable to me, on the suppositon that Herr Koenig's great tonometer was in working order. But even without that tonometer it would have been only necessary to make a fork five vibrations sharper than the French normal, supposed to be 435, and determine a perfect minor third above it by Lissajous figures. If, however, Herr Koenig had made such a fork, it ought to have shown 532·8 by Appunn's tonometer.

Now, the question arises, can any tonometer show the absolute pitch correctly? There are limits to the human powers of hearing and counting. In a tonometer of 64 tuning forks, or reeds, there are 64 sets of beats to form correctly, each being 4 in an absolutely correct second of time. Now, 64 is a large multiplier. Supposing each set of 4 beats were in error by ·0375, then 64 of these would be 2·4 in the whole 64, and this is the precise amount by which the sums of the numbers of beats in the whole octave differ in Koenig's and Appunn's reckoning. Can we manage by any means to hear this difference of ·0375 vibrations? If we could count for a minute, the difference would amount to 2·25 vibrations, which would be most certainly detected. In half a minute the difference would be 1·125 vibrations, which might probably be detected. In twenty seconds it would only be ·75, which might possibly be overlooked. But it is more likely that 79·25 beats in twenty seconds should have been always taken as 79 than always as 80, especially is it more likely that they should have been occasionally or more frequently taken for the smaller than the larger number. But unless I can count for thirty seconds, I cannot hope to be quite certain. I have counted the three highest sets of beats for twenty-five seconds, and found 100 in each case, not 99·0625. With careful repetition, this would probably be decisive, as against Herr Koenig's theory. The difficulty of prolonging the time depends on the difficulty of regulating the force of the blast. The arrangement is such that as long as the wind in the reservoir of the bellows is inexhausted, the blast has uniform strength. But, on forcing more wind into the reservoir, I have hitherto always found the beats to become momentarily irregular, quite sufficiently so to destroy the necessary delicacy. If we could count every set for five or ten minutes, which would be quite easy by continuing to blow gently, and at the same time feel sure that the beats were not affected, we might approximate much more closely. Prof. Preyer considers that by blowing very carefully, and keeping the reservoir at nearly the same degree of fulness, no error will result. Hence he always counted for one minute. This method I have yet to try and test. Correctness of consonances excludes the hypothesis of sensibly irregular counting. The error, if it exists, must therefore be sensibly uniform in every collection of four beats. But if the error could not be perceived in sixty-four seconds, or quite sufficiently in one minute, it would be also imperceptible in 64 sets of beats, for the multiplier would in that case be the same as the divisor.

Prof. Mayer's method, described on p. 672 of my paper, offers exceptional facilities of counting the vibrations of a scribing fork. I have sent a pair of forks to Prof. Mayer, which were originally in unison, in order that the beats of the scribing and loaded fork, with the free and unloaded fork, may be counted. Until this is done, the manifest retardation of scribing cannot be duly allowed for. Thus retarded, Prof. Mayer found 256·31 for Koenig's 256 at 64° F. This is larger than Koenig's number, and, if the retardation produced by the scrape were only 2·09, or 0·77 per cent., would bring Koenig's to Appunn's figure.

Prof. McLeod has much improved his method since I described his instrument on p. 673 of my paper. At present he does not load the fork at all, and he holds it steadily, or, at least, apparently so, in a vice. His method is entirely optical, and consists of observing the figure produced by passing black lines vertically before the eye at the same rate as the tuning fork vibrates, which produces a steady figure when viewed by a proper telescope. The number of lines which pass in a certain time is determined by an electrical counter, and the time varies from one to ten minutes, according to circumstances. The number of lines which pass, divided by the number of seconds, gives the number of vibrations. The fork is kept in constant action by continual bowing, and much or little bowing makes no perceptible difference. Although I have a feeling that some sort of error may lurk here, I cannot at all detect where it lies,* and if the results were absolutely the same as Professor Mayer's, there could scarcely be a hesitation in accepting them. The results are remarkably consistent with each other, whatever be the time of counting. I have had an opportunity of examining the instrument and seeing Professor McLeod take an observation. He has since sent me many of his determinations of a 256 tuning fork of Koenig, which certainly seemed in precisely in unison with that which I measured as 258·4, when I tried them together. Professor McLeod's last results differ from 256 by considerably less than 0·1, whereas Professor Mayer's differ by an unknown amount more than 0·3. Both are generally in excess.

It would be very surprising, considering the extreme difficulty of the investigations, if Lissajous had, without a tonometer, obtained a correct result in 1852. But I have grounds for suspecting a possibility of error, pointed out partially in the note (16) on p. 674 of my paper. Messrs. Broadwood sent to the French Commission on Musical Pitch in 1859, three C forks, representing three English pitches. These forks were retained by the Commission, but Messrs. Broadwood preserved careful copies of them, and Mr. Hipkins of Messrs. Broadwood's and myself measured these copies by Appunn's tonometer as C 521·2, 534·9, 542·5. Now if we reduce these numbers by multiplying by 435 and dividing by 439, they become C 516·45, 530·02, 537·55. Calculating an equally tempered A below these, we obtain A 434·28, 445·7, and 452; while a just A below these would give just A 430·365, 441·384, 447·67. On the suggested theory, one or the other should be the pitches assigned by the French Commission. They were, however, really A 434, 452·5, 455·2. These figures agree with neither of the other sets, and though it was evidently an equally tempered A that was intended, and the first pair of numbers (434·28, 434), may be said to agree, the second pair (445·7, 452·5), are widely different in a different direction, and the third pair (447·67, 455·2), though not more than half as far apart, are still very markedly unlike. Mr. Hipkins, under whose directions the forks were prepared, is quite sure of the correspondences intended. These results, therefore, furnish strong grounds for not unhesitatingly accepting the measurements published by the French Commission.

This is the best account I can give of the present state of the question. The errors which Prof. Helmholtz discovered twelve years ago, in an old copy of Herr Appunn's tonometer, by counting 16 sets in 15 minutes, was supposed to amount to one in 80 of the beats. Herr Appunn states that his pendulum was corrected more than ten years ago ("*der Fehler an meinem Pendel wurde sofort beseitigt schon ueber 10 Jahren*," letter from Herr Appunn in answer to my inquiries, dated 13th July, 1877). To reduce Herr Appunn's numbers to the standard of the French diapason normal, we must multiply by 435 and divide by 439, or multiply by 0·990,888,4. To reduce Herr Appunn's numbers to the standard of the Herr Koenig's forks we must multiply by 256 and divide by 258·4, that is, multiply by 0·990,712,0, which is almost imperceptibly less. We may be sure then that Herr Appunn's numbers are certainly not more than nine in 1,000 too large. This would make the multiplier 0·991. Herr Preyer's results from Herr Appunn's tonometer agree sensibly with mine. Prof. McLeod's agree sensibly with Herr Koenig's. Prof. Mayer's lie between the two, but are not yet fully determined. The mode by which the pitch in the French diapason normal was obtained by M. Lissajous is as yet unknown. Herr Koenig has also not stated how he obtained his, but implies that it was obtained from his own tuning fork tonometer, and he does not state how the latter was verified. It is evident that in tuning either forks or reeds to be 4 beats sharper than adjacent forks, and counting the number of beats in each set to 0·0375 in a second, the same difficulties necessarily occur, and that the means of verifying forks are not so direct or easy as those for verifying reeds.

A great number of measurements which I have made with Herr Appunn's tonometer have been published by the Society of Arts. It is, therefore, my duty to that Society, after doubts have been raised as to the accuracy of the instrument I employed, to investigate the matter thoroughly, and, if necessary, make the proper corrections. The foregoing statement of the delicacy of the research, and of the consequent difficulty of arriving at a conclusion which all physicists will accept, together with the necessity under which I lie of doing much other work, will explain the long delay which must inevitably occur before I shall be able to lay any trustworthy result before the Society. As to the expressions used by Herr Koenig to characterise my work with Herr Appunn's instrument, on the sole ground of a defect in an old instrument, remedied as soon as discovered, I may be excused from noticing them further. I did not communicate a single result till I had, by very diligent examination, convinced myself of the correctness of the tonometer. I see now the necessity of further examination, and I shall not fail to undertake it and communicate the result.

Alexander J. Ellis.

25, Argyll-road, Kensington, W.,
23rd July, 1877.

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* As I was correcting the proof of this letter on 1st Aug. I received a letter from Prof. McLeod, in which probable error of the clock, and want of strength in the galvanic battery to affect the electro-magnet with sufficient rapidity, were suggested as possible sources of very minute errors in his results.

NOTES ON BOOKS.

Chemical Handicraft. By J. J. Griffin, F.C.S. London: C. Griffin, 1877.

This book—a stout volume of nearly 500 pages—is simply a list of the chemical apparatus sold by Messrs. Griffin, of Garrick-street, and its extent offers a somewhat remarkable proof of the immense amount of ingenuity that has been expended in this direction by our makers of philosophical apparatus. The present is a new and enlarged edition, the original issue having long been out of print. There is a considerable addition of new matter, especially in the section devoted to gas-burners and furnaces, in which the last few years have seen very great improvements. Most of the apparatus is illustrated as well as being briefly described, and, in some cases, short directions for use are given.

The Sizing of Cotton Goods. By W. Thomson, F.C.S., &c. Manchester: Palmer and Howe, 1877.

Mr. Thomson has elaborated the paper recently read before this Society on the above subject, and published it in a separate form with considerable additions. The book is extensively illustrated.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,290. Vol. XXV.

FRIDAY, AUGUST 10, 1877.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

DOMESTIC ECONOMY CONGRESS.

The following papers were among those brought before the Congress at Birmingham :—

ON THE PRACTICAL DEVELOPMENT OF ELEMENTARY EDUCATION THROUGH DOMESTIC ECONOMY.

By Sir Henry Cole, K C.B.,

Late Secretary of the Science and Art Department.

1. The arts of reading, writing, and arithmetic, are the three principal instruments for educating or drawing forth the faculties which God has given to the child, and are of necessity the basis of any system of public elementary education. When a child can read, write, and cipher well, he is started on the high road, if he possesses any divine power, to become a Prime Minister of this country, like Thomas Cromwell, the son of a blacksmith; or a poet, like Robert Burns, the son of a poor gardener; or a preacher, like John Bunyan, the son of a tinker; or a great mechanical engineer, like George Stephenson, son of an engine-tenter, who first earned 2d. a day in a colliery; or a philosopher, like William Whewell, the son of a wheelwright; or a statesman-soldier, like George Washington, the first President of America, who was taught only these three arts before he took to measuring land.

2. These arts can be taught, but they cannot be properly cultivated or well preserved without constant and intelligent use. What our State machinery has, up to this time, been able to effect in instilling a knowledge of the three arts, is shown by the report of the Committee of Council on Education for 1876-77. I shall avoid statistics as far as possible, but I cannot give an idea of what is done for nearly the two millions expenditure spent yearly, without a few general figures. In 1876 there were nearly three millions of children registered as being under instruction, in reading, writing, and arithmetic, in England and Wales One million two hundred thousand "passed" what is called "a satisfactory examination" in these three arts, and of this number nearly seven hundred thousand, *i.e.*, about one-fourth, "passed" the prescribed test without failure "in any one of the three subjects." But the Duke of Richmond and Gordon, and Lord Sandon report to the Queen, that "they are obliged to repeat the remarks which they used last year, that the results are not satisfactory." And that the "nature of the results attained by many of those examined are meagre." Their Lordships say, "only thirty-eight in every hundred of children above ten years of age were presented in standards appropriate to their age," and not twelve in a hundred presented passed in the Standards IV. to VI.

3. Six standards of examination in reading, writing, and arithmetic are fixed, and, after the first standard, grammar, geography, and history are made compulsory subjects of examination. The returns of the report for 1876 show how the numbers presented for examination decline as the standard rises, beginning with 327·412 in Standard 1, and going down to 20·763 in Standard VI.

4. This result might have been expected if we try to realise what the mental capacity of the three millions of children under instruction is likely to be. They are the offspring of parents mostly earning weekly wages, which start from twelve shillings, and even less, and rise up to, say, forty shillings. The majority live crowded together in small rooms, badly built, badly heated and ventilated, not over clean or neat, often in the midst of debauchery and disease, poorly and foolishly clothed. Many children are not overfed, and with food not well cooked. Is it possible to train the minds of such children, under such bad physical conditions, on any large scholastic system, to a very high standard? Genius will always assert itself without system, and even with bad food; whilst great men and women, or great individual works, never come out of any system, as Dr. Newman, our neighbour, says. But I should call that system successful which gave to three millions the power to read, write, and cypher well, and thus start them on the way to become what their native abilities enable them.

5. Let us look into what the education system proposes to do. The little child of an agricultural labourer, of eight or nine years old, is expected, in Standard II., to read with intelligence, to write a sentence from dictation, to know the four first simple rules in arithmetic, as far as long division. Besides, it is "to point out the nouns, the definitions, the points of the compass, the form and motions of the earth, and the meaning of a map!" The very enumeration of these demands appals me. How many, even of this audience, will come forth and stand this examination? Who will volunteer to be the examiner except one of H.M. Inspectors? but none of these, I am told, can be present here. Shall we send into those parts of this town of Birmingham, which were lately shown to Mr. Cross as condemned to removal, and take at hap-hazard any ten children under 13 years of age, in tatters of finery, dirty, emaciated perhaps, and see what comes actually out of this present system? Shall they stand as illustrative specimens in the exhibition? Do I, then, condemn learning grammar, geography, and history? God forbid. But I gravely doubt if the teaching of them takes its right place in our present system of State education.

6. I believe the three arts—reading, writing, and arithmetic—should be practised, not on the moon and sun, but on objects which come within the daily life and experience of the poor, which would influence the child's well-being and conduct

all through life. The child's reading and writing should be exercised on those subjects of first importance, as laid down in the Code, "habits of punctuality, good manners and language, cleanliness and neatness, cheerful obedience to duty, consideration and respect for others, honour and truthfulness in word and act;" and the knowledge and practice of these virtues will not end at 13 years of age, when the child goes to the field or factory, where he will probably ponder very little on the metaphysics of language, the nouns and verbs, and parsings and complex sentences, or on the compass, or the motions of the earth, or the conquest of England or Henry VII., unless he has a leaning towards them. The Code places properly these moral subjects before reading, writing, or arithmetic, but does not lay down definite rules for their being taught.

7. I now come to what the Code calls domestic economy for girls, which it places as the last and tenth division after nine others, being—1, English literature; 2, mathematics; 3, Latin; 4, French; 5, German; 6, mechanics; 7, animal physiology; 8, physical geography; 9, botany; and 10, domestic economy. Will anyone venture to say that a knowledge of health, good food, thrift, and the like is not of much greater value to every one of the three millions of children of working people (under 13 years of age), than Latin and every other of the subjects I have named, and yet the teaching of domestic economy is discouraged unless the child "parses a simple sentence, and knows the geographical outlines of the colonies!"

8. Daily attention in schools to one or more of the subjects of domestic economy will lay the foundations of knowledge the most useful throughout a whole life. This knowledge is easy to acquire; it is not abstract, but practical, and not easy to be forgotten. It cultivates all the faculties. Its elements may be taught in the infant school, and may be made most interesting. Children may begin with it even before attempting the three great arts. Moreover, domestic economy will impress the value of public education far beyond anything else on the minds of the working classes, and make them friendly to it.

9. It is my conviction that if the several subjects embraced under domestic economy, and none others, were connected with reading, writing, and arithmetic, throughout all the six standards, and all other subjects whatever, of grammar, geography, and history, were made optional, and left to night classes, the results of the State systems would be much less "meagre" than my Lords of the Education Committee at present deplore that it is.

10. But we ought to be grateful to the Duke of Richmond and Gordon, and Lord Sandon, for being the first to introduce domestic economy, even in its present humble and mis-recognised position, and I, for one, heartily am so; but if they desire to see the work done effectively, I think they must seek for better advisers and far more earnest administrators, who really know what the children of the labouring classes are.

11. I venture to suggest that her Majesty's Government refer this question of the practical value of a knowledge of domestic economy in the cultivation of the three primary arts to a small Commission of five persons permanently sitting two of whom should be women, which might also consider the use and economy of the present public examinations. I have no doubt that a result would follow which will commend itself to the judgment of the Government, the Parliament, and the people.

12. Every branch of domestic economy is directly connected with the health of the people. I conclude with reminding you of the eloquent words which the most powerful man in this country at the present time lately uttered:—"The health of a people is really the foundation upon which all their happiness and all their power as a State depend. It is quite possible for a kingdom to be inhabited by an able and active population; you may have successful manufactures, and you may have a productive agriculture; the arts may flourish, architecture may cover your land with temples and palaces; you may have even material power to defend and support all these acquisitions, you may have arms of precision and fleets of fish-torpedoes; but if the population of the country is stationary or yearly diminishing—if, while it diminishes in number, it diminishes also in stature and in strength, that country is doomed. The health of the people is, in my opinion, the first duty of a statesman."

So said the Earl of Beaconsfield. I say Amen! and add that the pathway to health is found in a knowledge of the principles of domestic economy acquired through the three arts—reading, writing, and arithmetic.

TEXT-BOOKS ON DOMESTIC ECONOMY.

By Rev. J. P. Faunthorpe, M.A.,

Principal of Whitelands College, Chelsea.

The Names.—I have been requested by Sir H. Cole, who is vigilant to ask and determined to have, to prepare a short paper on text-books on domestic economy.

Domestic applies to everything in and about a house.

Economy has become degraded in meaning. Economy, economical, and economising, have come to mean parsimony, stingy, and saving. The original Greek word has a much wider and nobler meaning. The same root covered all these meanings: house, home, householders, and everything in connection with them; such as, to manage, order, arrange, or be conversant with the management, order, or arrangement of a house. The functions of housekeeper, housewife, steward, bailiff, &c., came under the same term.

The Congress treats the term in this wider sense, and is at one with Dr. Johnson, who makes it include—

1. The management of a family; the government of a household.
2. Distribution of expenses.
3. Frugality, discretion of expense, laudable parsimony.
4. Disposition, regulation of things.
5. The disposition or distribution of everything in its proper place.

Limitations for this Paper.—Of course, all these cannot be taught in our schools, whether primary or secondary, but the principles of them all can. Of course, further, I cannot enter into anything like even a list of books on these subjects, much less an exhaustive treatment of any of them. It will be well, then, now to limit the meaning of domestic economy to what it is made to include in the fourth schedule of the Code, p. 28:—

Stage 1. Food and its preparation. Clothing and materials.

Stage 2. The Dwelling; warming, cleaning, and ventilation. Washing materials and their use.

Stage 3. Rules for Health. The management of the sick room. Cottage income, expenditure, and saving.

These stages have to be taken in schools of the first grade (public elementary schools) in separate and successive years.

Text-books.—These stages have produced text-books innumerable. That demand creates supply we have heard *ad nauseam.* Most of the enterprising publishers have a series more or less good, more or less bad, chiefly the latter. Most of them have been done in a hurry. The consequence is, they are crude, ill-considered, pitch-forked together, without arrangement, and without interest. They are written either by teachers who did not know the subjects; or by professors who knew the subject and knew nothing of teaching; or by mere book-makers.

A friend of mine, who has gone carefully over most of the manuals on this subject for a special purpose, makes the following criticisms:—

Criticisms.—"1. The radical fault is that most of the school books on this subject have no fundamental idea, no foundation.

"2. Scientific terms are misunderstood or misapplied, and yet abundantly used.

"3. There is no attempt at organic treatment of the whole.

"4. In almost every book scientific truth and scientific theory are hopelessly jumbled.

"5. Instead of a broad principle, carefully worked out, they are taken up with trifling detail; each lesson having no connection with what has gone before, or with what follows:—A class-book on domestic economy ought not to be a cookery-book, or a recipe-book.

"6. Morality is dragged in by the heels."

Some writers do not know what teaching is; some do not know their subject except in the most superficial, notes of lesson manner; some do not know what real live children are capable of learning.

Mistakes may be classified as (1) ignorant, (2) learned.

1. Ignorant mistakes have been made by those who know superficially, or not at all—mistakes, not only of fact, but of principle, even of common scientific principles. This has taken place in books of a story or dialogue form.

2. Learned mistakes. These are chiefly over-estimates of what children can learn, and teachers can teach, in the given time. Teachers and pupils alike become disgusted. The children addressed are imaginary beings, inhabitants of cloud-cuckoo-land, not real girls of flesh and blood, daughters of labourers and artisans, and the future mothers of labourers and artisans.

Illustrations.—The illustrations in many cases are poor, worn-out plates, not good as pictures; utterly worthless as illustrations.

Some have tried to enlist a series of writers, and kept the arrangement in their own hands. But in this method of treatment there can be no unity of method, nothing fundamental. The Rev. C. A. Stevens has three excellent little volumes on the subject in hand; but they are open to this criticism.

Principles on which Text-books should be Prepared.—There should be a foundation well laid, well explained, out of which the subjects should arise naturally and connectedly. Their foundation should be scientifically correct and capable of easy illustration. The writer should have a complete grasp of his subject. If not a teacher, the book should pass through an experienced teacher's hands, with free powers to him or her to alter and amend.

Classification of Books.—The number of books is legion. I will attempt some classification. Books on domestic economy are required for—1. Teachers. There is no good book in existence. 2. Children in schools. 3. Children at home.

1. *Books for Teachers.*—Teachers should have some knowledge of physiology and chemistry. They should, if possible, pass the Science and Art examinations in physiology. In any case, they should have a good manual of physiology. The Society of Arts has offered a prize for a book, which ought to be a good book for teachers. Physiology—Huxley, 4s. 6d.; Kirke, 12s. 6d.; Dr. Carpenter, 28s. Tegetmeier's "Economy" (Home and Colonial School Society) is about the best yet produced, and it is cheap. Dr. Mann's "Book of Health" and "Knowledge of Life."

Many of the little works published by the Ladies' Sanitary Association are excellent in their way for teachers, children at schools, children at home, or parents. I have suggested that these works be not called tracts. People expect tracts to be goody-goody. I have also suggested that they be not labelled for poor people. A man that can bring up his family and pay his way is not poor.

2. *Books for School Use.*—A really good book is still to be written. That published by Messrs. Nelson is about the best. The information is carefully given, carefully graduated, and arranged into convenient lessons. A really good book for teachers might be drawn up on the model of this little work. Such a book should be scientific, simple, and should give abundant data. Many of the works of the Ladies' Sanitary Association are suitable for school use. The children should be encouraged to buy them. Few children cannot afford 1d. or 2d. for a book which is to be their very own, which is to have their name written in it, and which they may take home.

3. *Books for Home Use.*—I have suggested some above. Children might buy, also, Messrs. Nelson's book, and use it both at home and in school. Mr. Stanford is publishing a series of little works at 3d. each, suitable for home use.

It is taken for granted that teachers do not spoil the natural thirst for knowledge which every child possesses.

Some Suggestions on the Subjects.—Books on this subject should aim, first, at spreading sound knowledge. Let it be true. Let the consequences of obedience and disobedience be pointed out, and then leave the subject to tell its own tale. One of the best ways of teaching kindness to animals, is by lecturing on the anatomy of the donkey. It has been proved on costermongers. Harriet Martineau proved that the best incentive to temperance was a graphic and true account, illustrated by large diagrams, of the vital organs of an intemperate.

Food.—Information sound and good is needed. The vulgar prejudice that cheap foods are bad needs to be dispelled. The very poor refuse Australian mutton, as Sir John Bennett has proved. Some of the workhouses have proved it too. Cheap fish, salads, soups, oatmeal, and brown bread are not eaten by the wage-earning population.

Cooking.—All girls ought to be taught to cook. All girls, not all poor girls. How to turn food to the best account, how to make it look nice, how to make it tasty—these things are yet to be taught.

Cleanliness.—Our labourers are not cleanly. If ; were really proved to them that a good wash in warm water when they came home would make them comfortable, many of them would stay there.

The security and safety of a nation is its home life, as the Earl of Beaconsfield wisely said, when presiding at the opening of the Victoria-buildings for artisans, in Battersea-park-road. If a man like his home, he will stay there; he will like the nation and the country which affords it him; he will be a loyal and contented citizen. If he dislike his home, he will, perhaps, become a drunkard, a thief, a rebel.

Ventilation.—The value of pure air has yet to be learnt by cottagers, especially in towns. What many a district visitor and clergyman can say of the air of the rooms they are compelled to enter! One's gorge rises at the recollection of it. And it is the result of gross ignorance.

Clothing. — Judicious information needs to be given on clothing. It is no use preaching against ribbons and fine dresses. Let people know what is best worth money, what will wear best, what will look best, what will work best, keep its colour best, and why, and they may be trusted. Let the advice on finery be:—"Do not imitate the goose with the peacock's feathers. If you want any finery, buy the best. If you cannot afford that, go without till you can." Many do not practically know so simple a fact as that the English climate necessitates flannel to be worn next the skin.

Providence needs enforcing by precept and example. I shall be repaid if every one who reads these few words will see that his or her maid or man servant saves money. Help them to save. Encourage them to save. Help them to begin. It is a lamentable fact that hardly two per cent. of our servants have saved anything. It would be a helpful thing if men on weekly wage were always paid on Friday night.

Above all, girls should be taught needlework, thrift, and neatness. It is the slatternly, dressy, gossipping wives that send husbands to beer and the Devil. Anyone that helps to make a working man's home in any sense a *dulce domum* deserves well of his country.

DOMESTIC ECONOMY; TEXT-BOOKS.

By Rev. Edwd. T. Stevens, M.A.,

Vicar of Sibford Gower, Banbury.

The *Times* of December 10, 1875, speaking of the wisdom of the Education Department in making domestic economy one of the specific subjects of secular instruction, for which additional grants would be given to elementary schools, says:—"Unheralded by any flourish of trumpets, the Education Department, last Session of Parliament, in a modest way, introduced a feature into the Revised Code of Education of high national importance, which is destined to have a great influence on the future development of public education, more or less affecting all classes of the people."

The importance of this step is here by no means overstated, and its object being to make the homes of the people happy, it is one which must commend itself to every philanthropist, every statesman, and every loyal citizen. For "the home is the unit of civilisation, and from it spring all those influences which give a character to society, either for good or for evil, either of a beneficient or disturbing character. The man who feels that his home is 'Home, sweet home,' is proud of the community in which he dwells; but the man who feels that his home is a den of misery and crime, immediately assails that society of which he believes that he is the unjust victim."*

Not the least important outcome of this action of the Education Department is the present Congress, which, it may reasonably be expected, will do a great deal towards removing many of the difficulties which at present stand in the way of domestic economy as a branch of general education, and will help to lay down the lines on which instruction in the subject should be built up, and of the best modes in which the work can be carried out.

Probably only those persons who are not experimentally acquainted with the great education question, imagine that practical domestic economy, by which I mean the actual cooking of food, making or mending clothes, washing of pans, scouring of kettles, nursing of babies, tending the sick, and the many other kinds of labour involved in the term, can be taught in day schools, whether of the poor or the well-to-do. There may be, and are, schools of cookery, as well as classes for cookery, held in connection with elementary schools; but there are thousands of places in England, to say nothing of Ireland and Scotland, where these cannot be maintained on account of the expense connected with them; and cookery, however important a branch of the subject, is by no means the whole of it.

It follows then, from this and other considerations, that in most localities, all or nearly all the domestic economy taught in schools for the poor, except sewing, knitting and cutting out, must be taught from books and by means of oral lessons given by the teachers. There might, indeed, be in every country and town parish, however small, a weekly class, in which those ladies who take an interest in the subject, should voluntarily teach all the girls of a suitable age who choose to come to them for instruction, practical cookery, washing, cleaning furniture, and the like; but, still, the bulk of the children from the 4th to the 6th Standard in elementary schools, must, even under the most favourable circumstances, be mainly dependant on "Text-books of Domestic Economy," and those children who have learnt most about the practical part will be likely to take most interest in the theoretical, and *vice versa.*

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* Earl of Beaconsfield, June 23, 1877. Inauguration of "Victoria Dwellings' Association."

The action of the Education Department in adopting the system of payments of grants by results, has been a very beneficial one, for the art of reading has, of late years, been far better attended to than formerly, so that girls in the 4th Standard, when domestic economy must be one of the subjects taken up for a special grant, can now read any ordinary book placed in their hands. A few years ago, however, it was not seldom found that children in elementary schools were unable to read any book to which they were not accustomed. Not that teachers were less diligent then than now, or less qualified, but the temptation to give undue attention to geography, history, grammar and other subjects, the poverty of the schools, and consequent inadequate supply of fresh reading-books, together with the irregular attendance of most of the children, combined to produce the results I mention, and which led to the introduction of the present system.

Those who can spend all their girlhood at school, may well be expected to have at least a general acquaintance with geography, history, English literature, and the like, but a child who must leave school at 12 or 13 years of age, to become general servant, or nurse-girl, or mill-hand, or home-helper, can have little if any time for them, and it may even be desirable to diminish the quantity of arithmetic demanded of them under the Code—useful as the mental discipline involved in the study of it is—in order to afford more time for domestic economy. It is a subject, too, which most girls will like better than arithmetic (especially "puzzling" Rule of Three, and "maddening" Practice), and they will not only remember it better, but will derive greater advantage from their knowledge of it than from any of the so-called "higher subjects," and it will not have so great a tendency as these to "puff them up" with the "little knowledge," that is the "dangerous thing."

Reading-books on domestic economy, should, therefore, occupy the first place, next to the Bible, in every girls' school, and especially in those attended by the children of the poor. But these books must be as interesting as they can be made. A cookery book, say "Cookery by a Lady" for instance, which has reached, I believe, an almost fabulous number of editions, would not be very interesting reading for little girls from 10 to 12 years of age, nor would "Enquire Within," nor Soyer's well-known "Shilling Book of Cookery," chatty and funny as they are; nor Cassell's ponderous "Household Guide," however important a contribution to the literature of domestic economy it may be. Publications of this kind are out of the question for girls' schools. Books must be specially prepared for them, instructive, reliable, written in plain language, but made interesting by means of pictures, stories, conversations, and sketches, so that the children may take pleasure in them.

A great deal is said by some writers against this method of conveying instruction to the young; but if it seemed good to the Great Teacher of spiritual things in the case of grown up persons, surely we may think it good in imparting knowledge of secular matters to children. Besides, it is just as well to take learning in rather small doses at a time. "Treat your mind like a narrow-necked bottle, and don't try to learn too much at once," said my old schoolmaster to me when I left his roof to begin the battle of life; "If you try to fill the bottle too fast, very little will go into it." Every mother knows well how to give "baby" a powder, and the principle must be borne in mind in the preparation of text-books on domestic economy for little girls. For why should they be content with dull books, any more than you and I are content with dull sermons, or an after-dinner auditory with a dull speech, though the theology of the one, and the political economy of the other, may be alike unimpeachable?

In such books then as I speak of, there will be no recipes given to be "learnt by heart," nor anything of the sort. Indeed, the New Code specially warns teachers and school managers against attempting to teach domestic economy "by rote;" but the various branches of the subject will be treated in such a way as to include useful knowledge, and, above all, sound principles.

Such text-books would be suitable for girls of the age referred to, in schools of all grades, and, if generally and intelligently used, though by no means superseding the desirableness of practical instruction in cookery, needlework, &c., would pave the way for it, and could be used at times when, and for those to whom, the practical instruction could not be given.

Manuals of domestic economy suitable for housekeepers and ladies who manage the home affairs of large or small households, exist in plenty. They are, for the most part, very good, but are necessarily beyond the means of the poor, for whose use at home it would seem advisable that a series of tracts on the subject should be prepared and sold at 1d. or 2d. each. One might be devoted to food, and contain rules for judging of its quality, as well as recipes, especially for preparing cheap and nourishing dishes where mouths are numerous and means limited. A second might take up the subjects of water and air; a third, clothing and furniture; a fourth, sanitary matters and domestic medicine; a fifth, the treatment of children; a sixth, savings' banks, building societies, benefit clubs, and the like; a seventh, cottage gardening and pig and bee keeping.

I scarcely need say that these "tracts" should be written in good plain English, avoiding technical terms wherever possible, and carefully explaining them where they are necessarily used, and they should be illustrated with suitable engravings where needful.

The preparation, publication, and circulation of these tracts among the poor throughout the country would be a work of real utility. But they must be made to reach the people; must be taken to their homes, and, probably, if they could be published at the low price I have mentioned, the clergy, ministers of various Christian bodies, and district visitors would be able to induce many thousands to purchase them.

As to the scope of the school text-books, the divisions of the subject laid down in the 4th Schedule of the new Code, 1876, will do as well as any other for the three standards that will take it up for examination. They are as follow:—

1*st year, for Standard IV.*—Food and its preparation. Clothing and materials.

2*nd year, for Standard V.*—The dwelling: warming, cleaning and ventilation. Washing materials and their use.

3rd year, for Standard VI.—Rules for health: the management of a sick room, cottage income, expenditure, and savings.

Under the head of food, instruction will be given as to the properties of various kinds: flesh-forming, heat-giving, &c.; how to choose and how to cook them; the nutritious value of fish, and the cheaper kinds of food, such as liver, tripe, fry, and how to cook them in the least wasteful and most palatable manner; the importance of avoiding waste, and how to make good and nourishing soup out of what many persons throw away; the importance of cleanliness in person and apparatus whilst cooking; instructions for the economy of fuel, and other kindred subjects.

Under the head of clothing will be taught the importance of adapting it to the circumstances, employment, and means of the wearer; the most serviceable kinds of material for the clothing of women and children, and how to preserve, clean, and repair it. Instruction in sewing and knitting must be given by the teacher. I once tried to learn plain knitting from a MS. on the subject, which was sent me with a view to its publication as a text-book for school use, and I failed ignominiously. It was an experiment of mine, to ascertain whether it would be worth while to print such instructions for the use of little girls, and I decided that it would not.

In the second year's book, for Standard V., information will be given as to the dwelling, *i.e.*, in what the healthiness or unhealthiness of it consists, showing that while the average death-rate in the filthy slums of our large cities is from 40 to 60 per 1,000 of the population every year, and that for the whole of London is 22 to 25, that in the improved dwellings for the poor is only 14. The pupils will be told how the dwelling may be duly warmed without unduly excluding fresh air, especially in the bedrooms at night; how the air, inside and out, should be kept as pure as possible, by removing all refuse; how to clean the house, and how and when scrubbing should and should not be done; how the furniture should be cleaned and preserved; the need for frequent washing of articles of wearing apparel, especially those worn next the skin; the principles which should prevail at the wash-tub and the ironing-board; something about the deleterious effects of certain washing powders; with other similar subjects.

In the third book, for Standard VI., various general rules should be given, especially the advantages resulting from temperance, and a good wash from head to heel before going to bed at night; the symptoms of common, especially infantile, ailments, and their mode of treatment, with instructions what to do till the doctor comes, in cases which appear serious; the dangers arising from breathing foul air and drinking impure water; the value of vaccination; the importance and means of disinfection; the management of the sick-room; the treatment of children; the duties of various classes of servants, &c. Something can be said, too, of savings banks and cottage incomes and expenditure, showing the proportion which one item should bear to another, though, of course, no hard-and-fast rule can possibly be laid down for all. I have known agricultural labourers to bring up large families of eight or more children respectably, and have them sufficiently educated at the parish school, on an average income of certainly not more than 16s. a week, with an occasional addition from the wife's earnings. The father of one of these families, an excellent fellow, could neither read nor write, but his wife was a pretty fair scholar and a capital manager, and she and her three younger children who attended school, were always among the neatest and best dressed in the parish. The man himself, his wife, and four grown-up sons and daughters, were parishioners of my own, and communicants of the Church of England. I mention this fact to prove, what many deny, that the thing can be done, because it has been and is done. And any man or woman who will show the English workman how to do it, and persuade him and his wife to carry it out, will perform a great and good work. The Education Department has done well in calling attention to the subject, and a chapter or two about it in a school text-book on domestic economy, will at least open up the question and lay down some lines for guidance.

In these text-books, principles should receive the first consideration. If these are carefully inculcated and properly appreciated, and some necessary details mastered during the school period, a good foundation will be laid, and an interest will be excited which will be of the greatest service to those who may have the opportunity of attending classes for the practical study of cookery, needlework, or any other branch of domestic economy.

The poor woman, at home or in service, will perhaps require text-books that will enter more closely into details, giving a good collection of recipes for her use, and partaking of the character of hand-books or books of reference. The "tracts" and other books I have mentioned, together with those published by Mr. Buckmaster and Mr. Tegetmeier, will afford an abundant choice, and, probably, any one of the larger works would convey more than all the information required by the public generally, as well as by students in training colleges.

But over and above all these, it appears to me probable that a well-edited, well-illustrated, and well-printed magazine, devoted mainly to the subject of domestic economy in all its bearings, with an attractive running story, and published at a half-penny or a penny weekly, and circulated through every parish in the United Kingdom by means of commissioned agents, or the clergy and district visitors, would be calculated to do as much good as any other of the thousand-and-one magazines published. But it must be as good and as interesting as any, and then, in the course of two or three years, it might reach the hands of every poor man's wife in the country. It would probably, however, be too costly and hazardous an undertaking for any mere private person.

Girls brought up in homes where filth, and squalor, and drunkenness reign, and where the inexcusable and wicked extravagance of to-day is often followed by privation to-morrow, cannot be expected to make good servants or good wives, unless some strenuous efforts are made to counteract the evil example and training such homes afford. This must be done in school if done at all, and the dissemination of text-books on domestic economy, whether they take the form of school reading-books, or tracts, or magazines, or all three, cannot but be attended with good results, and do something towards making the women of the future better servants, more helpful daughters, wiser mothers, more thrifty wives, and better qualified mistresses than those of the past.

THE MODE OF INSPECTION, AND ADMINISTRATION OF GOVERNMENT GRANT, FOR SUBJECTS INCLUDED UNDER DOMESTIC ECONOMY.

By the Rev. E. F. M. MacCarthy, M.A.,

Member of the Birmingham School Board.

This paper points out the most practicable conditions under which Domestic Economy may be included in the curriculum of our public elementary schools, as far, at least, as the action of Government, by its code of regulations and its administration of grants, is concerned in the settlement of that curriculum.

1. The old proverb says, "You may take a horse to water, but you cannot make him drink." As a matter of fact, the horse will only drink under two conditions, both of which are necessary to be fulfilled: first, he must desire to drink; and, secondly, the water must be such as will help him to support life. Now, public elementary schools are, in respect of this subject of domestic economy, in exactly the same position as the horse in the proverb. First, they must see the desirability of the subject, and towards that we may fairly hope that the discussions at this Congress will materially assist; but, further than this, they must be quite satisfied that the subject will help to support them. Those who are familiar with the working of public elementary schools, are aware that every subject of instruction is, by the existing payment-by-results method of apportioning Government grants, contributory to the school expenses; and, as experience has shown that a subject which is not thus contributory stands but a sorry chance of admission into the school curriculum, domestic economy must be no exception in this respect. This second question, then, viz., under what conditions domestic economy may be made to pay its fair share of the school expenses, is of the utmost practical importance, so much so, that little way will have been made in the matter, if the attention of this Congress be confined to simply proving the desirability of its introduction into schools. Obviously, considerable ground is covered by this question. We ought to consider the most suitable range for this subject to take, when taught in elementary schools; the best subdivisions of the subject into groups or stages, so as to form a programme of progressive study both for scholars and pupil-teachers; the nature of the inspection and examination, with the mode of conducting the latter; and, lastly, the apportionment of grant. This paper will devote itself solely to the question of inspection and examination.

2. The best way will be to consider, in order:—(*a.*) What the Code does for domestic economy at the present time; (*b.*) What it does not do; (*c.*) What it might do.

(*a.*) All the subjects which the Congress is considering under the heading Domestic Economy, have already, with one exception (Practical Cookery), a place in the Code, and, consequently, are at this moment, to a greater or less degree, subjects for which grants may be earned. Of these needlework occupies by far the most prominent position, standing in quite a different category to the others. Before any grant is made to a girls' day school, the Education Department must be satisfied that the girls are taught plain needlework and cutting out, as part of the ordinary course of instruction (Code, Art. 17, (*f.*). The sum of 4s. per scholar (reduced to 2s. under certain circumstances), in average attendance above seven years of age, is paid, if the classes from which the children are examined in Standards II.-VI., pass a creditable examination in needlework and one other subject. (Code, Art. 19, c. 1.) Needlework must be taught according to a system approved by the inspector, who will judge of it by specimens worked on the day of inspection by girls or classes selected by him for the purpose. A schedule laying down standards of needlework for girls in Standards I. to VI., and also for infants, has been added in the Code of 1877 (Schedule III.), and after the 31st of March, 1878 (which date Lord Sandon has, I believe, promised in the House of Commons shall be extended to the 31st March, 1879), the examination in needlework will be conducted according to the standards prescribed in this schedule.

Passing on to another part of the Code (Schedule IV., column 10), we find the following subjects classed under the heading Domestic Economy:[*]—(1) food and its preparation, (2) clothing and materials, (3) the dwelling, warming, cleaning, and ventilation, (4) washing materials and their use, (5) rules for health, the management of a sick-room, (6) cottage income, expenditure, and savings.

These subjects first found their way into the Code in 1875, and the regulations concerning them came into operation on 31st of March, 1876. They figure in the Fourth Schedule as a three years' course of study in domestic economy for girls in the upper standards, and a grant of 4s. per head is made for every girl presented in Standard IV. to VI., who passes in the year's course. Thus domestic economy is one out of ten specific subjects of instruction for which this grant is payable under Code, Art. 21; the other subjects with which it is classed being English literature, Latin, French, German, mathematics, mechanics, animal physiology, physical geography, and botany; but, unlike those other subjects, domestic economy is restricted to girls. By the Code of 1877, as modified in the House of Commons, it is enacted that on the 31st March, 1878, every girl presented under Art 21, must take domestic economy as a subject of examination; which is equivalent to saying that no girl will be qualified to earn a grant in any other subject in this schedule—French for instance, or botany, who is not presented at the same time in domestic economy. The importance attached by the Education Department to this subject, as part of the higher training of girls in our public elementary schools, is strongly brought out by this regulation.

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[*] It must be noted that the term Domestic Economy as used by the Code, only includes the subjects here named, and therefore is not co-extensive in definition with the term as used by this Congress, which embraces in addition, needlework, practical cookery, &c.

(*b*.) Next, let us notice what the Code does not do for the important branch of education whose claims we are considering. While provision has been made, as above described, that in future needlework shall be thoroughly, systematically, and universally taught in girls' schools, the Code has somewhat overlooked the needs in this respect of the pupil-teachers, upon whose efficiency as teachers of needlework depends so largely any real advance in the standard of needlework attainments in the schools. Pupil-teachers are engaged for three, four, or five years, and at the end of each year have to pass a progressive series of examinations in the subjects which they are teaching or will eventually be called upon to teach. The subjects of examination are graduated, and appear in a tabular form in the First Schedule of the Code—with the exception of needlework, which is relegated to a note at the bottom of the page, to the following effect:—"Female pupil-teachers, before admission, must produce a certificate from the school-mistress and managers that they possess reasonable competency as sempstresses, and at the annual examinations must bring certified specimens of plain needlework to the inspector. The inspector at the time of examination, or afterwards, will obtain the opinion of some competent person upon the merit of the needlework." It is obvious that this provision affords a very inadequate guarantee for good needlework among pupil teachers, and experience proves that such is the case. Miss Kenrick, speaking at the Birmingham School Board on this matter, stated that she had had considerable experience, some years ago, in examining pupil-teachers' needlework in a neighbouring district, and this experience showed her that this branch of education was very much neglected, and that many specimens of work were inferior to what might have been expected from girls in the second or third standard. On Miss Kenrick's representations to this effect, the Birmingham School Board resolved to memorialise the Education Department, suggesting "that it would be desirable to introduce into the first schedule of the new Code a graduated scheme of examination in needlework for the several years of pupil-teachership, and that the plan laid down in the work, entitled 'Plain Needlework in Six Standards,' with a slight modification, be recommended as the scheme for pupil-teachers under this schedule." Again, as regards domestic economy, no provision is made that female pupil-teachers shall show a progressive knowledge of the subjects classed under that heading in the Code, during the several years of their apprenticeship. The note to the first schedule, quoted above, simply requires that they shall bring with their specimens of needlework "a statement from the schoolmistress, specifying whether they have been receiving practical instruction in any other kind of domestic industry." It is extremely doubtful whether a statement that they have not received such instruction would at all prejudice their position in the eyes of the Department. The note further draws their attention to the fact, that "a paper of questions on domestic economy is given to the female candidates for admission to training colleges," in other words, that if they wish at the expiration of their apprenticeship to obtain Queen's Scholarships, some knowledge of domestic economy will be of service to them. In that examination, the subject is an important though not a qualifying one. Students of training colleges are examined in needlework, and in domestic economy, but in neither of these subjects does failure exclude a candidate from her certificate.

Here, however, for the first time, we find that absence of all practical knowledge of domestic economy subjects will be a positive disadvantage to the elementary teacher, that is, if the following note may be considered to have, in practice, the intended effect:—"Only a per-centage of the marks for domestic economy will be given in the case of those students who do not present a certificate signed by the superintendent, to the effect that she is satisfied with their practical proficiency in some specified portion of the work usually comprehended under the name of industrial training." Speaking, then, generally of the practical side of domestic economy studies, it is evident that the recognition it meets with, at the present time, from Government, whether in the way of inspection, examination, or grant, is—needlework excepted—almost microscopically small. For scholars in day-schools it is, with the above exception, absolutely *nil*, and in the case of pupil-teachers' and training college examinations, her Majesty's inspectors have to be satisfied with the statement of the mistress of the school under inspection, in the one case, or the certificate of the superintendent of the training college under inspection, in the other, that they are satisfied that some utterly indefinite amount of practical proficiency in some branch of domestic economy has been attained. But if the importance of practical cookery and practical laundrywork for girls in elementary schools is only second to that of practical needlework, as many educationists are now beginning to believe, it is quite certain that it will be the paramount duty of Government not only to put facilities in the way of these subjects being taught in elementary schools, but also to see that they are taught, and to pay a grant per head upon the results of examination.

(*c*) Supposing, then, that public opinion is found to be ripe for the addition of these practical studies to the curriculum of our schools, and that Parliament has decided to carry out the national will in this matter, the question remains: What form should the inspection and examination of these subjects take? We have already one subject of a practical kind—needlework—in the Code; is the mode in which inspection and examination of this subject is conducted so satisfactory, that it may be repeated with good effect in the case of these other subjects? The experience of many members of this Congress will, I feel sure, suggest a prompt answer in the negative. The facilities for the study of needlework at Oxford and Cambridge are not very great, and her Majesty's inspectors consequently do not all enter upon the duties of their office, in respect of needlework, with that confidence which inspires the performance of their other duties. Nor do they all find those opportunities for overtaking their ignorance in the subject, which the proficiency of a sister or a wife might afford—nor, even given such opportunities, are they all equally capable of making such good use of them as to become adepts in the art. The consequence is, that as everybody knows, needlework lies under great disadvantages and discouragements in the districts of some of her Majesty's inspectors we wot of. One has heard of needlework as a subject of class instruction under Code, Art. 19, being quite unknown in some districts, owing to the strong predilection shown by the inspectors of these districts for history, or geography, or English grammar, in preference to, or to the exclusion of, needlework. Nothing, too, can be more unsatisfactory than the almost universal appeal of the judge from his own verdict to that of parties interested in the suit,—to the wife of the vicar or squire, to the School Board inspectress of needlework, and to the statements or certificates of mistresses and superintendents. If this be done in the green tree, what will be done in the dry? We have a definite schedule of needlework for each year of school life, from 5 to 13, coming into operation shortly. Under these circumstances may not even the vicar's wife fail the inspector in the hour of need? And what will happen if we have practical cookery also in the Code, and standards of attainment precisely laid down and to be tested annually? May not even the vicar's wife be altogether insufficient for these things, and fail the inspector in the hour of his still greater need? Then, again, as to that subject, domestic economy, which now stands in the table of specific subjects (Code, Fourth Schedule), and which is compulsory upon all girls examined under Act 21, after the 31st of March next—although it is intended to be got up from text-books, yet will not some of the ablest of her Majesty's inspectors distrust their own powers of testing the value of answers upon food, clothing, washing, and the like?

It must be borne in mind that circumstances have very much altered the relations of inspectors towards specific subjects, since they were first introduced. Previous to 31st March, 1876, teachers had considerable latitude in the choice of extra subjects of instruction; even domestic economy, although not distinctly specified, might have been taught, but there was a "protection-order" for inspectors in the shape of a memorandum that "Teachers intending to introduce an extra subject should confer with the inspector when he visits the school, and settle with him the plan to be pursued during the year, so as to ensure its acceptance at the next examination of the schools." This memorandum obviously gave the inspector complete control over, and, we may say, a direct veto upon, the specific subject to be introduced. But henceforward he will have no option but to examine upon domestic economy when a school returns that subject upon the examination schedule, with the risk of exposing his own ignorance or discharging his duties perfunctorily—it may be, by means of an unaccredited sub-examiner.

There are other subjects at this moment in the Fourth Schedule of a purely technical or scientific character, such as animal physiology and botany, for instance, which are not likely to be strong points with the majority of inspectors of schools. Is it likely that, with the inspectors' present control of the time-tables of elementary schools —which is great—they will encourage the introduction of these subjects into the schools in their districts, notwithstanding that the individuality of a particular school, from the special knowledge of the head teacher, or the surroundings of the school, would make the introduction of one or other of such subjects peculiarly suitable?

Lastly, is it not more than probable that the fact of the strain upon the omniscience of her Majesty's inspectors being already very great, will make the Government very loth to put a further strain upon it, by the introduction of fresh subjects, especially subjects of a practical and technical character, such as cookery, laundry-work, &c.? Is it not most certain that this consideration will largely operate upon the Government in the direction of maintaining the *status quo*; and, therefore, that our best chance of gaining our object is to show that all danger of present or future strain of this kind may be averted by a modification of the present system of inspection and examination of schools? To this end we suggest:—(1) The appointment of special inspectors, who shall be women, for the practical part of the education of girls, such as needlework, cookery, laundry-work, &c., throughout the country. Inspectors of singing and music (as now employed in training colleges) might be appointed for elementary schools. (2) The separation of the examination in all scientific and technical subjects of instruction from the ordinary school inspection and examination.

This first question will be treated of in another paper in this section of the Congress. But, with regard to the second, it appears to me that a great gain on all sides will accrue if the work of her Majesty's inspectors be confined, as far as examination is concerned, to the ordinary subjects, reading, writing, arithmetic, history, geography, grammar, and the specific subjects of a literary kind, viz., English literature, Latin, French, German, and, in addition, mathematics—surely a wide enough range of knowledge for one man—and that the other subjects, singing and music, and needlework (Code, Art. 19), domestic economy (not restricted to girls), mechanics, animal physiology, physical geography, and botany (Fourth Schedule), and such subjects as mensuration, agricultural chemistry, physics, practical cookery, &c., to be hereafter added, be placed under other examiners, under the direction of the Science and Art Department of the Committee of Privy Council on Education, or some other body.

The Science and Art Department naturally suggests itself as the proper authority for carrying out these examinations, because (1) it is only another department of the Committee of Council on Education, and, therefore, is under the same supreme control as the Education Department; (2) it has already introduced its machinery into elementary schools; it undertakes the examinations in drawing for day scholars, pupil-teachers, and students in training colleges. It examines scholars in elementary schools who have passed Standard VI. and candidates for admission to, and students in, training colleges, in those very subjects—mechanics, animal physiology, physical geography, botany—in which her Majesty's inspectors are required to examine when these subjects are taught to scholars in elementary schools, who are in Standard IV. and upwards. There does not appear to be any ground to justify this remarkable anomaly. That some clashing of the Education and Science and Art Departments has already occurred, in consequence of this divided authority over scientific subjects, is apparent from the proviso (Code, Art. 21 *d* and note) ensuring that scholars shall not earn a grant in science in the same year from both Departments. The principle of separation of examination from inspection has already been admitted and applied, more or less, in the following cases: (*a*) Drawing, as above stated; (*b*) the ordinary examination of pupil-teachers, in which the papers are set by examiners at the Education Department in London, and distributed all over the country, all those schools whose school-year ends in a certain month having their pupil-teachers examined simultaneously. The papers are looked over by the respective inspectors of the schools, but are returned with the results to the Department, and the verdict of the inspectors is, as I understand, subject to revision at headquarters; (*c*) again, in the Training College examinations, the examination papers are set in London, and the work of the students is distributed among the whole body of inspectors, according to the subjects for which they are considered to be specially qualified, so that the inspectors of schools constitute with the examiners at the head office a special Board of Examiners for the purpose.

With the examination of "Domestic Economy" under the Science and Art Department, an expansion of the subject would be immediately practicable beyond the narrow limits of the meagre information which can be procured from text-books (these might still be used as reading-books in the Standards with good effect) without practical work of any kind, and which at present is all that is required in order to earn a grant under Schedule IV. These limits must inevitably remain narrow as long as the present arrangements hold good, for this reason—if for no other—that it would not be fair to exact from the present body of examiners —her Majesty's inspectors of schools—considerable knowledge of subjects so purely technical as those included under domestic economy.

Practical educationists have already come to see that in the suggested transfer of domestic economy to the Science and Art Department, lies the solution of the real difficulty which threatens the general adoption and free extension of this subject as part of the education of our public elementary schools. In the spring of the present year, a large number of memorials went up from School Boards in England and Scotland to the Education Department, asking that a modification of the Code regulations might be made, somewhat in this direction. A copy of that forwarded by the Birmingham School Board is appended to this paper:—

To the Right Honourable the Lord President, the Lord Vice-President, and the Lords of the Committee of Privy Council on Education:—

The Memorial of the School Board of Birmingham.

Respectfully Sheweth,—That your memorialists consider a knowledge of Practical Cookery, as part of the education of girls in public elementary schools, to be of the utmost importance.

That while regarding with satisfaction the introduction of Domestic Economy into the Education Code, as a specific subject for girls, your memorialists are of opinion that many of the subjects at present classed together under that heading, and especially that of "Food and its Preparation" (which should include Practical Cookery), are of such importance as to justify a division of the subject (Domestic Economy) into two or more separate subjects, upon each of which grants could be earned.

Your memorialists therefore humbly pray:—

1. That your Lordships would be pleased to provide in the Education Code that grants may be made on the results of instruction in Practical Cookery, as a distinct subject, on the same principle upon which grants are now made to elementary schools through the Science and Art Department.

2. That aid be given towards the proper fitting up and furnishing of places for practical instruction in cookery; and

3. That female teachers be encouraged to pass special examinations with a view to the teaching of Cookery.

And your memorialists, &c.

THE EXAMINATIONS OF THE SOCIETY OF ARTS IN DOMESTIC ECONOMY.

By Charles Critchett,

Educational Officer of the Society.

The examinations in domestic economy, held under the auspices of the Society of Arts, were originally commenced so far back as 1861, and may be said to have been mainly originated by the late Mr. Harry Chester, one of the assistant-secretaries to the Committee of Council on Education, and for many years a most active member of the Council of the Society of Arts. Mr. Chester induced his friend, the late Dean of Hereford (the Very Rev. Richard Dawes), well-known as a warm and steady advocate of the education of the people, to undertake the office of examiner, and a programme was drawn up, embracing the whole subject of domestic economy in a somewhat popular form. It then formed one of the twenty-nine subjects in which examinations were held; a first prize of £5, and a second prize of £3 being given to the two best candidates in each subject, provided they obtained First Class Certificates.

The subject was defined as meaning a knowledge of the management of household matters, and the principles on which they are conducted, the "why and the wherefore" of everything under this head. This included food — animal and vegetable—how differing in nutriment; cookery; clothing of various kinds, how best fitted for varying climates, seasons, and occupations; the sanitary regulations of the house, such as ventilation, warming and lighting, drainage, &c.; a knowledge of weights and measures, prices of provisions, &c.; in fact, how to make the most of a small income. The principles of the savings bank, of the benefit society, and of present and deferred annuities, also formed portions of the the subject, and it may be interesting to quote at random a few of the questions from the first paper set:—

For the site of a house what soils are best? What soil is the worst? What aspects are best, and what aspect is the worst, and give your reasons for your opinion?

Explain why ill-ventilated and crowded cottages are prejudicial to health; and give any reasons or proofs of this from your own experience.

Describe the various causes which make a chimney smoke, and the modes by which you would endeavour to cure it.

Which is most conducive to health, an uniform or varied diet? Give reasons and illustrations of your answer.

Of the modes of cooking—roasting, baking, and broil-ing, frying, boiling, stewing. Explain each process briefly, and state which is the most economical.

Candles and soap. At what time of year should a stock be laid in? Why? What precautions are requisite in storing them?

Detail the weekly expenses of a family, consisting of a man earning 18s. per week, his wife and four children aged 4, 6, 8, and 12 years, for food, fuel, and light.

In household management, what is meant (1) by necessary, (2) by current, (3) by occasional, and (4) by contingent expenses, and what things does each embrace?

What are the advantages to a family of paying ready money, and never running into debt; and the disadvantages of not doing so. Explain the necessity of keeping an exact account of income and expenditure?

How is the domestic economy of the labourer or operative affected by having part of his wages on a truck system, such as a dwelling rent-free; drink, as in the cider counties, as a part of wages throughout the year, or any other article of food on truck?

My object in quoting these questions is to show that, in the first instance, no attempt was made to give a scientific character to the examination, which, it will thus be seen, merely required such familiar practical knowledge as was capable of being readily and quickly acquired by any fairly educated person.

In the first year, as will be seen by the accompanying table, only four candidates appeared, all of them being females. The number gradually rose to thirteen, in 1865, but in 1866 there was a falling off. In 1867, however, the attention of the Council was more especially directed to the encouragement of female education, and special prizes for female candidates were offered in several subjects, including domestic economy. Owing to the stimulus thus given, and to other causes not easy to discover, the number of candidates rose from six, in 1866, to thirty-four in the following year. In 1868, Mr. Thomas Twining, one of the Society's Vice-Presidents, offered four additional prizes in this subject, and in that and the following year the number of candidates did not materially vary, though it may be remarked that the proportion of females was less.

	Prizes.		Examined.	Passed.	Male.	Female.
	M.	F.				
1861	..	..	4	4	..	4
1862	1	..	8	7	1	6
1863	1	..	11	8	5	3
1864	2	..	10	8	7	1
1865	2	..	13	11	9	2
1866	2	..	6	6	5	1
1867	2	1	34	29	12	17
1868	4	2	32	19	9	10
1869	2	1	31	25	13	12
1870	2	..	13	10	7	3
1871	2	1	29	27	23	4
1872	2	..	13	8	7	1
Totals..	22	5	204	162	98	64

In 1865 an attempt was made to induce candidates to base their knowledge of this subject on something like a scientific foundation. The programme for that year says:—

"Domestic economy being mainly based on the applications of chemistry and physiology, both male and female candidates will be required to show an acquaintance with the rudiments of these sciences. It should embrace the phenomena of nutrition, respiration, the functions of the skin, &c.; the rationale of lighting, warming, ventilating, cleaning, disinfecting, &c.; of cooking, preserving, &c.; and the origin and manufacture of household articles, as far as this may be necessary for a correct appreciation of their relative value for use, and for the detection of defective quality, adulteration, or fraud; the essentials of a healthy and comfortable dwelling—clothing in relation to sanitary principles—food; dietaries; effects of stimulants and narcotics; fuel, and other household stores; weights and measures; keeping of household accounts.

"The questions for male candidates will refer to such subjects as the materials and appliances involved in the construction of dwellings; co-operative building and investment societies; savings banks and annuities. Those for female candidates include the management of infants, and the care of the sick."

In 1867, the Dean of Hereford died, and Mr. E. Carleton Tufnell, one of Her Majesty's Inspectors of Schools, a gentleman whose especial devotion to the cause of education has long been known, undertook the office of examiner. By him the scientific element in the examination was still further developed. The programme for 1868, which was drawn up by him, says:—

"Candidates will be expected to possess such a knowledge of the essential elements of mechanical and chemical physics, chemistry, and physiology, and of the general outlines of natural history, as may enable them to describe the origin and properties of the articles, and the rationale of the processes indicated or suggested by the following heads, as well as to explain the practical rules which science suggests for the promotion of health and comfort, and for turning limited means to the best advantage."

After giving the heads referred to, he adds:—

"Sound practical notions of the most essential points throughout the whole range of subjects are desired, rather than a deep knowledge of a few of them."

The examination was conducted by Mr. Tufnell on this system up to and including 1872, but the candidates continued to be but few, and there was a remarkable falling off in the number of females who came forward.

In the programme for 1873 several of the subjects were omitted, amongst them being domestic economy, and it was not till the year 1876 that it was again inserted; this time, however, in an improved and expanded form. The importance of the subject as a branch of education, especially for females, was beginning to be acknowledged, and when again restored to the Society's list, it was divided into four heads—(1) Clothing and its materials, (2) Health, (3) Housekeeping and thrift, (4) Cookery. The programme for that year says:—"These examinations apply particularly to women, but there is no reason against men taking certificates in them. In the Code of the Education Department they are limited to girls, and this is a good reason why young men should not be excluded from the Society of Arts' examinations in them, if they please to attend to these important subjects. The object of the examination is not to test the power of candidates to repeat what they have acquired only from books, but, as far as possible, to elicit evidence of practical knowledge and skill in each subject. The questions will, therefore, be framed with this special object."

This examination, which is still continued annually, is conducted, as before, by papers of questions, and the examiners are as follows :—In Clothing, Miss Mary Willis ; in Health, Dr. Wm. Ogle, Medical Officer of Health for East Hertfordshire ; in Housekeeping, Miss Emily Shaw-Lefevre ; and in Cookery, the National Training School for Cookery.

The candidates in Clothing are required to draw or cut simple patterns for the making and cutting-out of clothes, such as a child's pinafore, &c., giving the quantities required, and to state the reasons for and experience in selecting different kinds of materials for dress and underclothing—their comparative usefulness, economy in wear, durability, &c. They should also show a knowledge of the sewing-machine as well as of hand work.

Under the head of "Health," candidates are asked questions as to the structure and management of drains and closets, water-supply, warming and ventilation, diet, disinfection, precautions in case of infectious disease, and all other matters, not being strictly professional, which affect domestic health. Candidates for a first-class are also expected to have (1) so much knowledge of domestic medicine as will enable them to act judiciously in sudden emergencies before the arrival of a medical man ; (2) so much knowledge of sanitary law as is practically required by a householder ; (3) so much knowledge of health statistics as will enable them to calculate death-rates, to judge of their being excessive or otherwise, and generally to draw fair inferences from such returns as are periodically issued by the Registrar-General ; (4) as much knowledge of the preventible causes of disease as can be expected from non-professional persons.

The papers in Housekeeping and Thrift contain questions on the purchase of house furniture, especially bedsteads, bedding, carpets, and kitchen utensils. Questions are asked as to the care and airing of bedding and linen ; as to the use of cleaning materials for house and kitchen ; as to the purchase of grocery stores ; as to the economical purchase of meat, bread, and fish ; as to the different modes of lighting rooms, and their comparative economy ; also as to the harmful preparations used in washing household linen, &c. Candidates should also be able to write out a table of weekly expenditure for a small family, and to answer questions respecting the investment of small savings ; on the comparison of the Post-office with other savings banks ; on the relative results of life and deferred annuities ; and other kindred subjects.

The subject of Cookery, the immense importance of which seems, strange to say, to be only now beginning to be seriously recognised in this country, forms the last sub-division. Under this head questions are asked to ascertain the candidates' knowledge of the first principles of cookery, and the reasons on which they are based ; of the reasons for employing various kinds of food in reference to nourishment, &c. ; what are the essentials of good cookery ; what the candidates can cook, and how to cook it.

The following table shows the number of male and female candidates examined and passed in the two years during which this new examination has been held. It will be seen, that not far short of three times as many candidates were examined in the second as in the first year, and considering the large amount of attention now being drawn to the subject, especially that branch of it that includes drainage, ventilation, and other sanitary questions, we may fairly anticipate a large increase in future years.

	Prizes		1876.			
	Males.	Females.	Examined.	Passed.	Males.	Females.
Clothing	..	2	10	5	1	4
Health	1	..	8	1	1	..
Housekeeping ..	1	1	9	5	1	4
Cookery........	..	2	10	10	1	9
	2	5	37	21	4	17
			1877.			
Clothing	1	1	16	15	2	13
Health	2	..	35	9	8	1
Housekeeping ..	1	1	17	9	4	5
Cookery........	..	2	26	26	9	17
	4	4	94	59	23	36

I feel that I should give but an imperfect sketch of the action of the Society of Arts in reference to domestic economy were I to omit to mention the efforts of Mr. Thomas Twining, long one of its Vice-Presidents, whose interest in this subject was evinced many years ago by the formation of a Museum of Domestic and Sanitary Economy, under the auspices of the Council of the Society. The movement was first designed by Mr. Twining in 1850, sanctioned by the Council of the Society of Arts in 1852, and inaugurated by an Exhibition of Domestic Economy at Paris, in 1855, on which occasion the Cross of the Legion of Honour was conferred on its originator. Other temporary exhibitions were held in various parts of Europe, thanks to M. Ducpetiaux, of Brussels, M. Helm, and other eminent philanthropists. The collection formed by Mr. Twining, which was designed to be of a permanent and educational character, was begun at the House of the Society of Arts, in 1856. The Food Department was exhibited in embryo at South Kensington, and gave rise to Dr. Playfair's Food Museum. The next year it was transferred to the Polytechnic Institution, where other classes were added. In 1860, the collection was removed for more convenient development to a special building at Twickenham, close to Mr. Twining's own residence. Unfortunately, in 1871, the building, with most of its contents, was destroyed by fire, but a full description of it is given in a work by Mr. Twining himself, entitled "Technical Training, a suggestive sketch of a National System of Industrial Instruction, founded on a general diffusion of Practical Science among the People." In speaking of the collection, Mr. Twining says :—

> "This repertory of useful information for every-day life has been established with a view to impart, in a manner at once scientific and entertaining, that knowledge of common things, which is so necessary for

securing health and comfort. Here all classes of society, and especially those whose income is small, are shown how their dwellings should be constructed in accordance with sanitary principles, what household improvements they may derive from the discoveries of science, or borrow from the customs and appliances of other nations, what fabrics they should wear, what food they should eat, and how it ought to be cooked, how they may distinguish things which are genuine, wholesome, substantial, durable, and really cheap, from those which are cheap only in appearance, and in short how they may live with judgment, and get the best money's worth for their money."

I may mention that a museum of hygiene, as a memorial to the late Dr. E. A. Parkes, is being formed at University College, Gower-street, which covers nearly the whole ground of Domestic and Sanitary Economy, and of which a member of the Committee says that "those who remember the Twickenham Museum will, it is hoped, have the satisfaction of seeing many of its best features resuscitated in the Parkes' Museum."

As bearing immediately upon the objects of this Conference, I ought to mention that, some months since, the Council of the Society of Arts, with the view of aiding in the teaching of domestic economy in elementary schools, offered three prizes of £30, £15, and £10 respectively, for the best syllabuses of a course of instruction in that subject. The conditions state that "under the head of domestic economy are included (1) food, cookery, and clothing; (2) health, the management of the dwelling, and the sick room; (3) cottage expenditure and thrift. The syllabus should give in detail the heads of such instruction as can be taught in an ordinary elementary school; and should be accompanied by explanatory notes as to the manner of imparting the instruction, and the various requirements for conducting the classes efficiently." It was made an essential condition that the subject should be treated in a manner suitable for elementary schools, but that long dissertations should be avoided; the syllabus, to be, in fact, a skeleton course of instruction, to be filled in by the teacher, with such notes and suggestions as the author has found practically useful. It was also to be carefully framed with reference to the time and opportunities of instruction available in the elementary schools of the country.

Thirteen competitors have appeared, and the judges nominated by the Council; viz., the Rev. Canon Tinling, the Rev. Newton Price, Major Donnelly, R.E., and Miss Chessar, a member of the School Board for London, with the valuable aid of Prof. Huxley, have kindly undertaken the duty of examining the syllabuses, and adjudicating upon them. Their award is expected shortly.

In 1867, there were 2,449 miles of railway built in the United States; in 1868, 2,979 miles; in 1869, 4,953 miles; in 1870, 5,690 miles; in 1871, 7,670 miles; in 1872, 6,167 miles; in 1873, 4,049 miles; in 1874, 1,911 miles; in 1875, 1,910 miles; and in 1876, 2,856 miles.

Information has been received by the Department of Science and Art, through her Majesty's Secretary of State for Foreign Affairs, that it is intended to hold an Art Congress at Antwerp on the 19th of this month, on the occasion of the tercentenary of the birth of Rubens. Further details with respect to the proposed celebration may be obtained on application to Monsieur Leopold de Wael, Burgomaster of Antwerp.

MISCELLANEOUS.

PHILADELPHIA EXHIBITION REPORTS.[*]

Edge Tools, Hollow Ware, Safes, &c.

Mr. David McHardy gives a long and elaborate report on this subject, devoted mainly to an examination into the American exhibits in this class. Beginning with edge tools, the first place is given to what may perhaps fairly be called the American tool *par excellence*, the axe. The shape of the American axe, with its uniform taper from crown to edge, is well-known even in this country, and the reporter, like all who have used it, was struck with its perfect adaptability to the work it has to perform. Some picks are noticed for a device by which the head, is rendered interchangeable. A socket on the handle receives the head which is formed with a recess thereon. The top of the socket fits into the recess, and a wedge prevents the head from slipping. The "Lightening Saw" tooth is illustrated by a woodcut. This, with many other American saws, was described in the Rev. A. Rigg's Cantor Lectures on "Tools," a series of which Mr. McHardy speaks highly in one part of his report. It is a little curious that the form of tooth now so widely adopted in America closely resembles the "M" tooth of which Holtzapffel, writing in 1856, speaks as being "now but very rarely employed." A simple method of strengthening hand-saws is mentioned. The blade is continued right through the handle, which is formed of two pieces, having between them the handle-shaped continuation of the blade. A saw frame, in which the saw is kept strained without the use of a brace, is also remarked upon. Several varieties of augers are noticed, especially an "Expansive boring bit," with an adjustable cutter, for boring large size holes. After a few remarks on the extreme beauty and accuracy of some "tools of precision"—rules, squares, &c.—Mr. McHardy goes on to the planes, in which the ordinary beech stock is replaced by one of cast-iron, the sole sometimes being formed of an adjustable slip of steel for planing curved surfaces. This also was fully described by Mr. Rigg. The carpenter's brace, with an expansive chuck to take bits of different sizes, was another tool which attracted the notice of the reporter. The different varieties of parallel and "grip" vices are also noticed. On the files it does not seem to have been practicable to have formed any decided judgment. Many of the Americans were machine-made; those most admired by Mr. McHardy were of Swiss, Belgian, or French make.

As regards agricultural and labourers' tools, most of the improved forms now common in England are of American origin, and consequently there appears not to have been much which struck the reporter as new to this country.

The cutlery shown by American exhibitors gave proof of considerable advance. It was stated, however, that Sheffield steel was generally used for the finer branches of cutlery. In considering the whole of this class, Mr. McHardy considers that America took the first place in table cutlery. In pocket and fine cutlery, several Sheffield firms maintained our own reputation. France scarcely did herself justice in this department. The German display of pocket cutlery was "no doubt equal to any from the United States, showing great beauty and high excellence of finish." "The Russian exhibits from Novgorod showed an advance which we were scarcely prepared to see." The Swedish exhibits also were noticeable.

The application of emery in cutting wheels did not come within the scope of the report, but Mr. McHardy comments on the quality of this and other polishing materials.

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[*] Continued from p. 863.

Some of the ornamental castings attracted great notice, both American and European. A novelty noticed was the utilisation of worn-out tin plate by melting it down and casting it into various articles. At Philadelphia this alloy seems only to have been employed for the purpose of making sash-weights, but Mr. McHardy considers it might be applicable for more important purposes. It may on this be permissible to remark that at the present price of iron it can hardly pay even to collect old tins, &c., and the most valuable portion of the alloy, the tin, appears to be wasted, unless indeed the alloy is applicable to purposes for which cast iron alone cannot be used. At present the chief use of tin scrap is to manufacture salts of tin for dyeing purposes. Processes for recovering the metallic tin appear, at least in this country, to be less successful. It so happens that the writer of this notice has had an opportunity of examining specimens of this alloy, which as Mr. McHardy says, resembles spiegeleisen in its fracture, and is of a surprising hardness.

The next class included in the report comprised bolts, screws, horse shoes, &c. Mr. McHardy specially notices the use made of cold punching, a practical application of M. Tresca's theory of the flow of solids. The work is effected by introducing the element of time, and operating with a certain slowness. In another section of this class was "a grander collection of horse shoes, both as regards finish and variety, than has at any previous time been presented to the world."

Some space is devoted to an account of the safes shown. The most novel of these was a spherical safe, the body of which revolved within an outer casing, so that the door was turned round and covered by the solid outer shell. This was an American invention. There were also several other notable safes, including Chatwood's, with its shell of spiegeleisen between two skins of soft steel.

In summing up his observations, Mr. McHardy remarks that it would be idle to ignore the fact that at Philadelphia Great Britain was face to face with her greatest rival. It was obvious that the American manufacturers were on their own ground, and, consequently, at an advantage. For this due allowance must be made. In table cutlery, tools, and safes, America was before Great Britain, and "a strenuous effort will be required from Sheffield to hold its own in the race of progress." Besides the good quality of the American tools, their appearance was attractive, and they were well finished.

Military and Sporting Arms, &c.

In his report on these classes, Major Noble gives a good deal of space to the American collection, which was naturally the largest. Amongst the ordnance shown there were guns representing several different systems, breech-loaders and muzzle-loaders, principally the former. These are all briefly described and the results given of experiments with them. An account is also given of a series of experiments carried out by the United States authorities, to ascertain whether smooth bores could be advantageously converted into rifled guns. Among the more notable exhibits was an improved Gatling gun. This gun had been fired at the rate of 1,000 rounds a minute, its ordinary rate of rapid firing being about 700 rounds per minute. Fired deliberately at a target 19 feet long by 11 high, range 1,000 yards, it scored 665 hits out of 1,000 shots. Germany had a fine display of artillery by Krupp of Essen. Great Britain sent no ordnance, but the exhibit of sporting small arms was particularly good. The other countries mentioned in the report are France, Russia, Sweden, Spain, Belgium, and Brazil.

Railway Appliances.

Captain Douglas Galton, in his report on railway appliances, confines himself almost wholly to the American exhibits, which, in a class like this, naturally formed by far the larger portion of the whole collection. Besides noticing the principal objects shown, he gives a short account of the railway system of the States as it present exists, thus continuing and bringing down to date the report which he prepared for the Board of Trade in 1856 on the same subject. The American system grew out of very different wants from those which originated our own. The railway, instead of uniting established centres of commerce, had to open out new districts, to give rise to the growth of towns, and to develop its own traffic. Hence arose a necessity for a road which should, in the first instance, be inexpensive, however much it might afterwards require improvements. The permanent way of the earlier American railways was of the simplest and cheapest character. The line followed the sinuosities of the ground in order to avoid cuttings, and the consequent sharp curves and steep gradients involved certain adaptations in the rolling stock. The stations also were of primitive construction, and it was found less costly to carry on in the cars themselves much of the business which, with our greater local traffic, we conduct in our stations. Tickets, for instance, are both issued and collected in the cars. From similar considerations the signalling system is less developed, while much greater control over the train is given to the engine-driver. This necessitates the use of continuous breaks, the Westinghouse being the one almost universally employed. The patent of Smith's vacuum break has being bought by the Westinghouse Company, and in certain cases this break is used by them as well as their own. Several other continuous breaks were also noticed by Captain Galton. Among the novelties in the construction of the rolling stock, paper car wheels claim a foremost place. These, as is now well known, are formed of paper compressed by hydraulic apparatus; one was shown which had run 302,900 miles under a Pullman car, and its tyre showed but slight marks of wear. The duration of the ordinary cast-iron wheels was given at 50,000 to 60,000 miles. Tabular statements are given of the dimensions of several of the locomotives exhibited, and the chief points of difference between English and American engines are commented on. A specimen table is also given, showing the method in use of calculating and publishing the cost and performances of each engine of a line.

The "fast freight system" is fully described. The principal company working this system is the Empire Transportation Company, which was called into existence to remedy the inconveniences arising from the numerous sections of lines under different proprietorship over which through traffic had to pass. A curious feature in this company's work is its system for the conveyance of petroleum. This is conveyed from the wells by "pipe lines" with force pumps at intervals, by which the oil is conveyed over long distances from the wells to stations, where it is delivered into the railway cars.

Some space is devoted to a consideration of the narrow gauge system, which is used to a considerable extent in America. Captain Galton observes that if it could be proved a success in America, this would be a good argument for employing it in India and in our own colonies. He, however, does not appear to think that these lines are a success. He acknowledges their value as pioneer lines, but says that as in districts where the traffic increases it will always be necessary to replace them with the broader gauge lines, it is generally preferable to construct light railways of the standard gauge in the first instance.

The report concludes with some remarks on the traffic, and the tariffs and the legal enactments connected therewith.

In the half-year ended June 30th, the value of imports from Persia amounted to £51,961, against £27,170 in 1876. The exports this year of British and Irish produce amounted to £74,961, and last year, in the same period, to £44,852.

THE EARLY HISTORY OF TORPEDOES.

It seems a common impression that the torpedo, though long known as a weapon of defence, has only recently become one of attack. This, however, is a mistake, and is, indeed, so far from the truth that, as a fact, the first torpedoes were all looked upon as offensive weapons, and were, indeed, so used. The idea of protecting a coast or harbour by stationary torpedoes was more recent, and now we are but going back to the proposals of the earliest inventors of these terrible weapons. It was in America that the torpedo originated, and its inventor seems to have been one David Bushnell, of Connecticut. His idea was to fix a small powder-magazine to the bottom of the hostile vessel, and to explode it by a clockwork arrangement. To enable him to do this, he contrived, and actually constructed, a submarine or diving boat. Of the existence of this extraordinary vessel we have ample proof in American official records and elsewhere. A MS. description of it is preserved in our own Patent-office Library, and there are also several printed accounts of it by Bushnell himself and others. The best of these is in a book by Commander Barnes, of the United States Navy, which gives an almost exhaustive history of the invention and early employment of the torpedo. It may at once be acknowledged that much of what follows is taken from this source. The boat was tortoise-shaped, made of two shell-shaped iron plates. It contained air enough to support a single person for half an hour. It was propolled by a sort of screw, and guided by means of a compass made visible by phosphorus. The torpedo was carried on the outside of the boat, but could be detached by the concealed operator within. It was connected by a line to a screw, which was to be driven into the bottom of the vessel attacked. As soon as this was effected the torpedo was to be cast off, when it floated up against the vessel's side. The action of casting off started the clockwork, and thus time was allowed for the operator to retire to a safe distance before the final catastrophe. The whole apparatus being completed by 1775, that it might be used in the War of Independence, an attempt was made in that year upon an English 64-gun brig, the *Eagle*. It appears that there was considerable difficulty in finding anyone who would risk himself in the boat, and the inventor's brother, who first worked it, fell ill. However, a sailor, named Ezra Lee, undertook the attempt, and he actually got under the *Eagle* and attempted to drive in his screw, but was prevented by striking an iron bolt or bar. Seeking another place he lost the ship, and daylight coming on he thought it best to return. It does not appear that any further attempt was made with the boat, but the evidence that this one attempt was made seems as good as any evidence can be at this distance of time.

In an attack on the *Cerberus* frigate with a towed torpedo, Bushnell was so far more successful that he blew up a schooner astern of the frigate and killed three out of the four men on board. This schooner, then, was the first vessel destroyed by a torpedo attack.

For some time after this we hear little of torpedoes, and when we do hear of them it is still an American who is the inventor. This time it is Fulton, the father of steam navigation in America, who curiously enough was so mistaken as to the comparative value of his two schemes that he wrote to a friend that his method of propelling ships by steam was not "half so important as the torpedo method of warfare." How far his idea was original, and how far it was a revival of Bushnell's plan, there is no saying, but he certainly seems to have taken to himself the whole credit of the invention. Like Bushnell, he had a submarine boat, and with it, in 1796, he blew up a hulk in Brest Harbour, before the Emperor Napoleon. He also made an unsuccessful attempt on an English brig. Further than this he does not seem to have gone in France, but nine years later we find him in England, under the assumed name of Francis, offering his services against his former friends, the French. Of his doings here he has himself left us an account in his "Torpedo War," published in New York in 1810. Of this curious book a copy is preserved in the library of our Patent-office. It was some time before he could get much attention paid him, but at last he was allowed to make an attempt upon the *Dorothea* brig, which he blew up successfully. Here he did not use his diving boat, but towed his torpedo against the ship's side. After this, in 1804, a "catamaran expedition" was fitted out against the French shipping in Boulogne harbour, but as this was unsuccessful, Fulton wisely ignored it in his own narrative. Eventually his plan was condemned by a commission consisting of Sir Joseph Banks, Rennie, Congreve, and others. The method of attack on which he lays most stress in his book he does not seem to have practically tried. He proposed to employ a harpoon gun, mounted in the bows of the boat, the end of the harpoon line being attached to the torpedo. The harpoon was to be fired into the side of the vessel attacked, when the torpedo, which was detached as the gun was fired, floated up against her side. Fulton's last set of experiments were made in New York harbour, but in these he seems to have had no success at all. He made a sham attack on a vessel protected by nets and by dummy torpedoes on spars, but was not able to get near her. It must, of course, be remembered that he had but inferior means to work with;—and had his row-boats been exchanged for steam launches, and had electrical fuses taken the place of his flint locks, he might have been more successful. Wherever he went, he had to contend against a strong opposition on account of the "inhuman" nature of his proposals, and on more than one occasion the same fear was expressed which we have recently heard, that the use of torpedoes would put the weakest naval power almost on a par with the strongest. In the war of 1812, several attempts were made upon English ships in American waters, principally with stationary or towed torpedoes; we also hear of several submerged torpedo rams, but the ill success of all their attempts was such as to discredit considerably this method of attack. The fixed torpedo, it may be said, was of comparatively small use until the application of electricity to fire it. The credit of this is given to Colonel Colt, the inventor of the revolver, who also is said to have used what was practically the first submarine cable for the purpose. In 1843, he blew up several hulks, and one brig, which was sailing at five knots an hour. She was, of course, deserted by her crew after having been directed over the torpedo. Before this, electricity had been used to explode mines, frictional electricity having generally been employed.

This invention brings us down to our own times, but there are still several more instances of torpedoes being successfully used. In our own war with Russia we were more frightened than hurt by the torpedoes round Cronstadt, though one English vessel, the *Merlin*, was nearly destroyed by them. These torpedoes were both electrical and made to explode by contact. In the latter case the explosion was caused by the breaking of a little glass tube charged with acid, and placed in the midst of a chemical compound (potassic chlorate and sugar), which took fire when touched by the acid.

Following up the history of our subject, we have to pass over to America once more. In the last great war torpedoes played a very important part; in fact, it may be said that they were then for the first time used in war to any extent. The Southern coasts were, in many parts, lined with torpedoes, sunk, floating, and fixed on frames or barricades at the entrances of rivers and harbours. The torpedo was also used as a weapon of offence by both sides; and the "Davids," as, from their diminutive size, the torpedo rams were called, both injured and scared away Goliaths of vessels, of many times their own size. In one instance, the exploit of Lieut. Dubasoff on the Danube was anticipated by Lieut. Cushing, in the Federal service. He, in a steam launch, attacked the

Confederate ironclad *Albemarle*, as she lay moored to a wharf with a barrier of logs around her. With reckless daring he charged the barrier, burst through it, and exploded his weapon under the quarter of the ironclad, which immediately sunk. The launch herself was swamped, but her gallant commander escaped by swimming.

But the most marvellous exploit ever yet accomplished by means of a torpedo was the destruction of the *Housatonic*, a Federal sloop-of-war, by a submarine boat, while she was lying outside Charleston harbour, on the night of February 17th, 1864. The officer of the watch observed something like a plank rapidly approaching the ship. In another two minutes it was close to the ship, and an explosion took place before any preparations could be made, either to back the engines or to repel the attack. The ship sank immediately, but the crew, with a few exceptions, saved themselves by getting into the rigging. The attacking boat went down with all her crew, being swamped by the sinking ship. This was indeed the third crew the boat had drowned, for she had sunk twice in experimental trips, and had been raised. She was of boiler iron, 35 feet long, and manned by a crew of nine men, eight to work the propeller and one to steer. She could either carry a torpedo at the bows or tow it behind her.

Since the close of the American War we have heard little of submarine boats. A few patents have been taken out, and several models have been exhibited, but all these appear never even to have reached the experimental stage. In practice the difficulties in the way have tacitly been acknowledged insurmountable, and our engineers rely either on speed and dash in the torpedo-launch, or on mechanical accuracy in the automatic torpedo. Yet from what has been done, it is evident that the idea of a submarine boat is not absolutely chimerical. It is conceivable that a boat might be constructed which should approach an iron-clad from below, silently attach its engine of destruction, and as silently depart. Fulton and Bushnell went very near it, the destroyers of the *Housatonic* went nearer still. Had these last been provided with the means of attaching their torpedo, and leaving it to be fired when they had reached a safe distance, they might have escaped unhurt to have repeated the performance on other ships, and the example thus set would probably not have lacked imitators, and perhaps we might have had fleets of submarine boats, instead of steam launches. However, it must be owned that the experience gained has not been encouraging. The only party which succeeded in their attack lost their lives in the venture, and those alone came off safe who effected nothing.

CORRESPONDENCE.

DOMESTIC ECONOMY CONGRESS.

The recent Domestic Economy Congress, held in Birmingham, under the auspices of your Society, is calculated to tend more than anything has hitherto yet done, towards the furtherance of that important branch of economy; and, by the circulation of the papers read at the Congress, public attention has, to a large extent, been aroused to the importance of developing that great mainspring of our social organisation. It also has, and will yet further, inculcate the advantage to be accrued from its tuition in elementary public and private schools.

Much is now said of the rapid strides education is making; but, it has yet to achieve something more auspicious than the mere routine of the "three R's." Schools ought not to be the simple nurseries of such, but the laboratories for higher branches of study, *e.g.*, that of domestic economy, which is undoubtedly the source of the enjoyments of an English life, although our knowledge, both in the school and homestead, is at present comparatively speaking quite in embryo.

The education now imparted is not exhibited before the lens of children's minds in the practical way it could and ought, though of late years, diagrams, &c., have been introduced into national and other public schools as a means of conveying practicality, and have, in a degree been found useful; but, still there is reason to fear that subjects are not sufficiently pressed upon children, so as to exhibit fully the advantage education will confer on them in after years. The courses of study are not placed before them as vividly as they might be; hence the common saying, that "such and such a branch of mathematics, classics, &c., will be of no service in my intended vocation," therefore little or no attention is paid to that particular study. How frequent in after life, however, is the counterpart heard, that "I wish I had acquired so and so whilst at school." The sole reason of this is that each subject is not brought sufficiently home to children, and the benefits to be gained by a knowledge of all that is within their reach. As an illustration of what I mean—a child may be taught barter, brokerage, profit and loss, and other commercial rules; but the chances are very doubtful whether he grapples in ordinary school life what these transactions really signify. Consequently but little attention is devoted to them, and when business life is assumed, and the youth is brought into direct contact with the above rules, his knowledge of them is dim, for the single want of proper adaption and application. To overcome this evil, Mr. George C. T. Bartley, very ably advocated at your Congress the establishment of school penny banks, which I am sure would obviate this want of application in the illustration now given. I can only hope, in conclusion, that the admirable recommendation of Mr. Bartley's will be adopted in every seminary throughout the kingdom. Henry J. Spear.

Bristol, August 6, 1877.

GENERAL NOTES.

The Dangers of Surface Wells.—A recent weekly return of the Registrar-General calls attention to two fatal cases of fever registered at Enfield, which exemplify the danger of surface wells as a source of water-supply. It appears that the fever was attributed to the use of water from a well at Grove-place, Enfield-wash, which had been for some time previously disused. Inquests were held to inquire into the facts connected with these deaths, but, as is too often the case at such inquests, the evidence was of a contradictory character and the verdict far from satisfactory. It is not long since an outbreak of enteric fever occurred at Ponder's-end, which is, we believe, also situated within the Enfield Local Board district; and it is to be hoped that the Board will deal vigorously with the water-supply difficulties of their district.—*Lancet.*

The Suez Canal.—The transit revenue of the Suez Canal Company in 1870 amounted to £206,360. In 1871, the corresponding revenue was £359,720; in 1872, £656,280; in 1873, £915,980; in 1874, £994,362; in 1875, £1,155,440; and in 1876, £1,198,960. The number of ships which passed through the canal in 1876 was 1,457, and the aggregate weight of goods carried through it during the year was 3,072,000 tons. In the first five months of 1877, 766 vessels passed through the canal, and the transit revenue collected amounted to £600,929. The corresponding movement in the corresponding period of 1876 comprised 692 ships, while the transit revenue collected in the first five months of 1876 was £549,315. It will be seen that the transit revenue increased last year to the extent of £43,520, as compared with 1875, while in the first five months of this year, as compared with the corresponding period of 1876, the corresponding increase was £51,614.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,291. Vol. XXV.

FRIDAY, AUGUST 17, 1877.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

DOMESTIC ECONOMY CONGRESS.

The following papers were among those brought before the Congress at Birmingham :—

SKIN CLEANLINESS; HEAD TO FOOT WASHING; PUBLIC MEASURES PROPOSED FOR ITS PROMOTION.

By **Edwin Chadwick, C.B.**

Personal cleanliness is one of the greatest topics of sanitation. In our children's institutions, where reductions of sickness and death-rates by one-third have followed the production of clean air; by the constant removal of putrescible matter, by self-cleansing drains and sewers, and by ventilation—there reductions of the sickness and death-rates by another third have followed the production and maintenance of clean skins by regular head to foot ablutions with tepid water. We found in the school stages of life in England and Wales an excess of some fifty thousand deaths, a large proportion of which there was reason to believe was occasioned by massing filthy skinned and filthy clothed children in ill-ventilated schools, which are centres of ravaging children's epidemics. Skin cleanliness is certainly a great preservative against passing epidemics and against visitations of the most infectious and contagious diseases. Experienced trained nurses, regularly attending scarlatina patients, give themselves regular head to foot ablutions twice a day, and a change of clothes once a day. Medical men of experience, who serve amidst plagues and the most terrible epidemics, do the like. Whether it be that beside foul insects, the imagined germ spores of disease find their lodgement on filthy skins, and their entrance thence into the human system, has not, that, I am aware, been shown, but certain it is that skin cleanliness affords so powerful an immunity from the attack of epidemics, that if I had again to serve as a member of a General Board, and had to exercise authority in providing defences against epidemics, I would propose regulations for the immediate and general "tubbing" of the population, and have it seen to as sedulously as vaccination for protection against small-pox. For I observed, in my service at the General Board of Health, that during the cholera visitation, the attacks upon the cleanly, the "tubbed" classes, were extremely rare. Whatever infectious property there might be in the disease, it came in clouds, but amongst the washed prisoners in the prisons of this country there was an immunity, whilst amongst unwashed prisoners in some Indian prisons, equally protected from contagion, the ravages have been terrific, as was the case in our own prisons before Howard's time and before sanitation. Skin cleanliness has a great effect on the assimilation of food. It has been proved that pigs that are washed put on a fifth more flesh than pigs that are unwashed. Indeed, in well ordered, first-class stables, horses are washed from head to foot daily, and I am assured that the work is considered to be remunerative. I might adduce the like evidence, at length, in respect to the effects on the human subject. A friend of mine, in command of a brigade in Spain, was hemmed in, and his men were put upon very short rations, and to amuse them—it being summer time—he encouraged them to bathe daily in a river close by, and he marked, as a result he had not expected, that his men were in as good strength as the unwashed soldiers on their full rations. In well-kept prisons the prisoners increase in strength and health on very simple dietaries, costing some 1s. 6d. a-week, and are exempted from epidemics, and have a general sickness and death-rate greatly below that of the outside unwashed population. I attribute this result, in great part, to forced frequent head to foot ablutions. The loss from waste of some fifth of a nation's food, and of a power of sustaining a fifth more of a family and of population, forms a heavy item in a nation's budget, surely to be commended for serious national consideration and distinct public exertion.

There is also a large public moral and social element involved in the maintenance of conditions of personal cleanliness. Persons of limited knowledge of the conditions of the lowest class of the population are apt, on view of rags and filthy clothes, and filthy persons, to take them as outward and visible signs of blameless poverty, and of reasons for the gratification of benevolent impulses —to bestow immediate relief in alms. But relieving-officers and others, the police, accustomed to deal with such cases, see in the foul skins the outward and visible signs of moral depravity, of idleness, mendicity, and the lowest vice. And as a rule they are never in default in their stern conclusions in respect to them. Mendicant filth and depravity are inseparable. Foreign hygienists are of accord with us on the social evils attendant on filth. Fonssagrives cites Schmalz, who says :—"Not only does the health of man depend largely upon cleanliness, but cleanliness is a condition of their activity, of their good temper, of their eternal satisfaction, and even, to a certain degree, of their morality. It is in dirty villages and hovels that idleness, degradation, theft, lying, and all vices flourish. Want of cleanliness not only sullies the purity of the body, but that of the soul too." If cleanliness be next to godliness, filthiness is next to devilishness.

I was invited by two ecclesiastical friends to write sanitary sermons, which I was promised should be preached in one, and probably two, cathedrals; but I was obliged to forego that honour, from feeling that it was not in my vocation, and, moreover, that it would have launched me into polemics, for I must have denounced prevalent doctrines in respect to baptism as pernicious heresies; the doctrine that treats the use of water as merely typical and symbolical; the doctrine, no matter of what sect, that accepts as sufficient the dipping the finger in water and leaves the entire body in filth and impurity, and by consequence, the *morale* also. The plague of insects, and other pains attendant on conditions of bodily filth, may be taken as visitations upon them and as appointed penalties. The account of the condition of filth into which the depressed populations of the Holy Land now are, may be taken as being the same as that in which they were, for which baptism in the literal sense of physical personal purification was then, as it it is now, the great remedy. This is not the place for such a discussion, but I cannot help believing that literal personal purification is a Christian ordinance, and that the symbolical sense in which baptism is now regarded is a pernicious heresy. It is shown by Bingham that the early Christians had baptistries in their houses. This would not merely be to dip the finger in as a typical ceremony. Our Saviour reproved Simon for a neglect of duty in not providing water for the cleanliness of the person, and ointment for its agreeableness; and we have the text "Wash and be clean;" and I might cite other texts in vindication of personal cleanliness as a literal Christian ordinance and duty. However, a distinguished prelate, with whom I recently conversed on the subject, proposed a compromise which I deem acceptable on the question. Admitting the extent of the evils, he said, "We should have a division of labour to overcome them. I would leave to you the work of cleansing the outside, provided you leave to me that of cleansing the inside."

The sanitary evil of the personal filth of the population is of such a magnitude as to call for large special exertions by a great national league for its remedy, a "Cleanliness League," of greater importance than a temperance league, which would, I would venture to submit to Sir Wilfrid Lawson, find, in conditions of filth, conditions of depression provocative of the evil against which he directs his exertions. Cleanly classes are not of the intemperate classes. Personal filth and intemperance are found together.

In answer to the appeal made to me to give a paper on the subject to the Congress, I might have answered that it was too large to be mixed up with discussions on any other subjects, and I only appear to offer a vindication of its distinct importance as a high sanitary policy. The Ladies' National Health Society, of London, are ready to devote themselves to such work, and I hope they may have the support of a "health society" in Birmingham.

I submit for consideration a course of exertion. Primarily it would be to direct attention to the civic duty of providing appliances for cleanliness by water carried into houses and into the apartments, of all houses of every degree, with means for the immediate discharge of all fouled water through self-cleansing channels.

In the next place it is a civic duty to remove the causes of bodily filth from dust and dirt, by better cleaning the streets and public thoroughfares, as we have contended by street washing. Exertions should then be directed to the enforcement of cleanliness in the infantile stage, most particularly at schools. An honourable member, a representative of the specially unwashed of Sheffield, told me that he was taken to see one of the new schools there, when he found the smell from the children so overcame him that he was obliged to get out of the school. The children were led before him at the door, but he found the smell there intolerable. The evil habit of filth is not confined to the poorest classes. A lady manager of an elementary school in London for girls, comprising children of the class of shopkeepers, with clean faces and clean hands, and clean clothes, found from the smell that they were, nevertheless, untubbed. She undertook to give them a head-to-foot washing herself. Their condition was of incredible filth, and she was made seriously ill and suffered permanently by the effort. Clean clothes in our towns too commonly cover foul skins. The best examples of cleanliness are at some of our district half-time schools of orphan children near London, which give the extraordinary sanitary results of a death-rate of not more than three in a thousand, with almost an immunity from "children's diseases." Moreover, these clean-skinned "half-timers" are equal in book attainments to the filthy-skinned "long-timers" of the Board and common elementary schools; whilst they exceed them in aptitudes for labour, imparted by suitable bodily exercises. The duty is well attended to in the best schools of Holland. The school teacher has an attendant, a *bonne*, who, if any child, on removing some of the clothes, appears not to have been properly cleaned, takes it aside with provision of water, and remedies the neglect. If the conditions are found to be frequent, serious admonitions are conveyed to the mother for her culpable failure in maternal duties.

The extent of the common neglect in this country are now beyond belief. Compulsory attendance at common schools, in the existing conditions, is compulsory exposure of children to disease, and good mothers of the cleanly classes may well feel repugnance to it; and many pay largely for private schooling, though so far as the book teaching goes, it is of an inferior character. The danger is, moreover, aggravated by long-time school teaching, which is long-time exposure; the filth of the children is a barrier to that common elementary education which is admitted to be so desirable. To be rid of dirt is a main end of education. All schools ought to be provided with proper appliances for the use of tepid water, for its solvency, and superior cleansing power, as well as for its agreeableness. One teacher of a ragged school whom I knew, being oppressed and made ill by the foul air from the filthy skinned children, in self-defence tried to enforce head to foot ablutions, but it was with cold water, which drove them away. Cold is painful, and the cleansing rites repulsive to persons of low circulation. He then used tepid water, which made the operation agreeable, and it brought them back again. The agreeableness of the operation should be everywhere studied. Filthy children should not be allowed to be at large in the streets, but should be taken home, with admonitions to their parents for the neglect of duty. School inspectors or officers of health should be required to see to due provisions. Provisions for cleansing should be required to be attached to all workshops and manufactories of the dirty trades. I long ago pointed out the use of the waste, warmed, condensing water of the steam-engines of factories for the purpose, and very good examples have been provided by intelligent and benevolent manufacturers. Officers of health, as factory inspectors, should be empowered and required to see to the enforcement of proper provisions and their applications.

The provision of such appliances are not taxes, but means of relief from taxes—from the heavy taxes of excessive sickness and premature disability, loss of productive power, and the interruption of the manufacturer's operations. I have estimated that, by combined sanitation, comprehending the condition of the habitation, of the places of work, and of habits of which skin cleanliness forms a large proportion, the duration of the British artisan's working ability may be extended by some ten years.

Provision of mechanical conveniences and appliances must precede and facilitate the formation of habits. Hence the provision of water supplies should be on a public footing, and the distributary apparatus of the house service pipes should be carried into all private tenements and maintained from the rates. There should be no fetching and carrying of water from out-door stand-pipes, or the labour will be omitted and the cleansing too.

A considerable improvement in the collective work of head to foot washing, with a large economy of time and of water, deserving of extensive application, has been made in France. At the large prison of Rouen, containing about a thousand prisoners, the work of head to foot cleansing by the common bath was found to be very inconvenient, occupying a long time, and with prisoners, whose skins had never been washed for years, the work was not very completely done by simple immersion. Open recesses were constructed in which squads of prisoners, after they are undressed, are placed. Over the head of each is a spreader, from which a spray or douche of tepid water to cover the whole body is sent down in a shower. At command each soaps himself from head to foot. Immediately that is done, another shower descends upon each person simultaneously. Another soaping and another shower may be given. Each prisoner then wipes himself dry with the towel, and the work is done. They dress, and are marched away, and another squad succeeds. The operation of complete washing is thus effected in five minutes instead of the twenty minutes, or more, occupied by the method of the bath, with a tenth the quantity of water needed for the common bath and with greatly less of filth, as the bath, if not changed, becomes unutterably filthy.

This method commends itself for introduction in public institutions, in schools, and in workshops.

At the Congress of Hygiene, at Brussels, we had some very improved shower baths, by sprays with tepid water, for use at hospitals. For washing on the same principle by the spray in private houses, a hand-bucket may be used, with a pump fixed in it, an adaptation of the pump called the "Tozer," used for the extinction of fires, with a flexible hose. The pump may be worked with one hand by the individual, and the hose, with a spray such as is now used by hairdressers for head washing and shampooing, may be directed with the other. Tepid water should be used in the bucket. The individual may stand upon a Mackintosh bath-sheet, such as are now in much use. With these appliances the work of head to foot ablution may be most quickly performed, in places where there are no baths or fixed apparatus, and may be performed with great rapidity and comfort. Washing by the spray or the douche has the advantage over washing by the common bath, that the same dirtied water is not used over again, and that the whole operation is performed with clean water—with "running water"—mark the old orthodox provision for baptism. The work of washing children by this method may be made very agreeable to them. Where, however, such apparatus is not to be had, the work may be performed in a little more time (as described by Miss Florence Nightingale in her notes on nursing) for which all that is wanted is a wash-hand basin three parts full of warm water, the commonest soap, a stiff brush, a sponge, and a rough towel.

If we have national compulsory attendance at school, I repeat that it should be compulsory attendance in a condition of scrupulous personal cleanliness—the habit of personal cleanliness being one of the most important elementary trainings that can be given to them. Dirty children should on principle, and as a measure of police, be driven from the streets and sent home, with the admonition to the mother—"You are not to allow your children to go at large in that vile, filthy condition." In the workshops it is abominable to see women, as well as men and children, without stockings, with their legs and feet that have never been washed, encased in dirt. It should be the province of the medical officer of health, or the factory or workshop inspector, to see to this evil, and treat it as an offence against decency as well as against health. The condition of our population, as the great unwashed, is worse than is conceived. Medical officers who have to inspect men as recruits are frequently made sick by the odour of the rooms from their filthy skins. A large proportion of well-to-do people never wash, as hairdressers who have to stand over them experience. Amongst our higher classes the use of the tub is, however, in most beneficial and exemplary extension. It was not always so, and they partook of the personal filth of the general population. The Order of the Bath, the institution of which was of the most ancient times, as the records tell us, was really a personal distinction. The initiation was not by the sword, by the accolade, but by bathing and putting on clean linen, with vigils and prayers to give solemnity to the habit and the duty. It was the Order of the Washed. A washed and clean man, with clean linen, was admitted as a companion of the bathed, "the tubbed," the distinction from the filthy. The Dean of our Order, Dean Stanley, says I am correct as to its origin, and that Evelyn mentions that he was present at a *séance* of the knights of the Bath, under Charles II. when they were all in their baths. A small tooth comb was once an emblem of nobility. There now are few well-appointed houses where the host is amenable to our Saviour's reproof to Simon for his neglect of the duty of providing the means of personal cleanliness; and it will be a happy advance in sanitation and civilisation, if by a due consideration of the evils to be prevented and adequate exertion, we can achieve a general levelling upwards, and a national abolition of all distinctions in this respect of the washed and the unwashed.

The cause may be seriously commended to the active special exertions of school teachers as well as to those who, having to serve amidst befouled atmospheres, have a more serious interest than they are commonly aware of in the maintenance of the purity of the air which they have to breathe daily during long hours. The service of school teachers, amidst atmospheres from closely-packed, foul-skinned children—the impurity of which is measured by the thermometer from the heat and indicated by the smell—is, I know, a service that entails upon them excessive sickness, premature disability, and the loss of several years of life by premature mortality. Whilst the mean death-rate of adults in various comparatively healthy conditions is some sixty-five years, the mean age of death of schoolmasters in England and Wales appears, from the Registrar-General's return, to be not more than fifty-three years. Their doom, from the existing conditions of their profession, is, therefore, of some ten years' loss of life. Their lot, as to their means of livelihood, is mitigated since the time of Erasmus, but the lot of a large proportion of the school teachers in the common, long-time elementary schools is little better than that he described as the lot of the grammar-school teachers in his day, "always to be damned to be choked with the dust of their unswept schools (schools shall I call them, but rather Bridewells and houses of correction!), to wear themselves out in fretting and drudging, and deafened with the noise of bawling boys, and stifled with heat and stench."

My early colleague, and most esteemed friend, Sir Alfred Power, the worthy executive chief of the Local Government Board for Ireland, has warmed up to his sanitary service, and has written some sanitary rhymes, which he has done me the honour to dedicate to me. Permit me to commend them for popular circulation and school teaching, and to quote some lines on our topic for your judgment:—

There's a skin without, and a skin within,
A covering skin and a lining skin;
But the skin within is the skin without,
Doubled inwards and carried completely throughout.

The palate, the nostrils, the windpipe and throat,
Are all of them lined with this inner coat,
Which through every part is made to extend,
Lungs, liver and bowels, from end to end.

The outside skin is a marvellous plan
For exuding the dregs of the flesh of man,
While the inner extracts from the food and the air
What is needed the waste of the flesh to repair.

* * * * *

Good people all have a care of your skin,
Both that without and that within,
To the first, give plenty of water and soap,
To the last little else but water we hope.

* * * * *

All you who thus kindly take care of your skin
And attend to its wants, without and within,
Need never of cholera feel any fears,
And your skin may last you a hundred years.

This verse, I apprehend, expresses the true prophylactic. "As a rule,'" as he states, "diseases arise from some deterioration of the blood; and again, as a rule the latter proceeds from some hindrance or abuse of the functions of the skin, noxious matters being introduced thereby into the blood. Bad air, bad water, bad food thus take effect through the inner skin. With regard to the external skin, it must be noted that the "dregs" spoken of are taken up by the blood vessels and conveyed to the skin for expulsion through the pores. A true skin-washer will never be found who has not realised the nature of perspiration, &c., which is nothing more or less than an excremental deposit from the blood, which should be constantly washed away from the three or four million of orifices, in order to encourage the free escape of what comes after it; otherwise the orifices do not act, and the excrement remains in the blood. It is, in fact, the last stage of the "sewage" of the body, which Carpenter alludes to in his account of water in his "Animal Physiology."

BATHS AND SWIMMING FOR THE CHILDREN OF ELEMENTARY SCHOOLS.—WORK OF THE LONDON SCHOOLS' SWIMMING CLUB.

By **Miss Chessar.**

It is not the purpose of this paper to enlarge on the advantages of bathing; these are too obvious to be mentioned. Nor will it be necessary to say much as to the special need which we, as a maritime people, have for learning to swim. It is a fact that the baths and places where swimming can be taught are very few. In London, with its population of nearly four million, the public baths number only twenty-seven, some of which are extremely small. It is also another fact that the art of swimming is possessed by comparatively few of our population, and that daily experience near canals, rivers, docks, and the seaside, shows that the want of a knowledge of swimming causes many otherwise avoidable deaths. In London, the deaths in the River Lea alone are so numerous that, by a grim figure of speech, it has been called the River of Death.

In swimming, as in other physical exercises, it is true that the younger the learner—provided only he be old enough to have some sense as to taking care—the more easily is the art taught. "After thirty," said a swimming teacher, "it is very difficult to learn to swim." But children learn easily, and retain their power of swimming when once the art has been acquired.

I am about to describe an effort which has been made to introduce the use of the bath, and to teach swimming to the children of elementary schools in London. I am not aware that a similar effort has been made in any other town, but I hope that the mention of the subject may induce persons in other places to take the matter up. I also hope that, public attention being drawn to the subject, more opportunities may be afforded for children to learn to swim, and, specially, that more facilities may be given for the teaching of girls and of women to swim, and for the opening of baths to females. In the case of boys, the difficulty as to their learning is one which has arisen merely from the small number of baths and of places where they could bathe and swim. In the case of girls, there have been additional difficulties arising from the following facts. Of the whole number of baths in London, only three make special provision for women, and when girls and women are admitted to other baths, they can only be so by reserving them for a day or part of a day; this bath proprietors have shown themselves most unwilling to do, declaring, generally without trial, that women and girls would not come in sufficient numbers to pay for the reservation of the baths for their use. Again, with boys, so many already know how to swim, and so many men have been found willing to act as teachers, that there has been no difficulty in getting them taught, and even when fees have been paid for teaching, they have been but small. On the other hand, the women and girls have had to be taught, and as there are very few women who professionally teach swimming, high fees have had to be paid in order to get teaching. In one case, indeed, a class which was formed could not be carried on for want of a teacher. This, however, is a difficulty less felt this year than before, and one which will be still less felt as time goes on. Some teachers and pupil-teachers who have learnt to swim will be found ready to take the part of instructors either gratuitously or for very small fees. The slight expense of the provision of a bathing-dress has not proved a hindrance to those girls and teachers who have learnt to swim.

The effort to teach swimming to the children of elementary schools has been made by the London Schools' Swimming Club. This club originated among the clerks of the School Board for London; but, at the suggestion of Sir Edmund Hay Currie, it was extended so as to take in teachers, both men and women, of all grades. It followed almost inevitably that a desire was felt to admit children to such benefits as might be derived from learning to swim, and it was soon found that boys and girls came forward in considerable numbers anxious to learn the art.

The first meeting of the London Schools' Swimming Club was held at the Harp-alley Board Schools, in March, 1875. Mr. John MacGregor (the well-known Rob Roy) then a member of the Board, was in the chair, Sir E. H. Currie, Dr. Bennett, and other gentlemen being present. It was suggested that permission might be obtained to use the lake in the Victoria-park as a bathing-place; and, on the application of Sir E. H. Currie, Her Majesty's First Commissioner of Works, Lord Henry Lennox, granted the use of the swimming lake to the male members of the club and the boys of elementary schools. (It may be noted in passing that, though the club was originated by persons connected with the School Board for London, its members belong to elementary schools of all kinds.) Of this privilege, the boys at once largely availed themselves. The average attendance at Victoria-park every Saturday morning, when between the hours of 9 and 11 a.m., they were collected to receive instruction both from voluntary and paid teachers, was about 1,500 for the first three months, commencing June 12, 1875. During the summer of 1876, the attendance was equally great, and, in the season which is now in progress nearly 1,000 present themselves for instruction every week. The instruction is now given chiefly by lads who have themselves learnt in connection with the club; but there are always present many gentlemen who attend to see that all is being properly conducted. Teachers also, who bring their scholars, remain with them to see that due order is kept. The park-keepers also assist in this work. All round the lake stations are marked off at which the boys collect according to arrangement, certain stations being appointed for certain schools. The teachers sometimes enter the water, sometimes they take their places on the pontoons at the ends of the lake, sometimes on platforms on wheels, which can be moved to whatever place is desired for the lesson. To guard against accidents, two boats row up and down during the whole time that the boys are bathing. I am told that, on bright mornings, the greenness of the park trees, the bright costumes of the park-keepers, and the eager liveliness of the boys contribute to make the scene of the bathing most interesting and picturesque. In addition to the large number of boys taught at Victoria-park, a nearly equal number are receiving instruction in twelve baths in different parts of London, at the reduced rates which have been conceded to those who learn in connection with the club—namely, a penny or three half-pence for each visit to the bath, in addition to three pence entrance fee paid to the club by each child. By far the largest number are being taught at the Lambeth Baths. The total number of boys under instruction at present is about 2,000.

The classes for the female members of the club, owing to the difficulties before stated, have not effected so much for women and girls as the classes for male members have done for men and boys, although they have been organised at much greater expenditure of both time and money. It is obvious that "Victoria-park," or any other lake is not available for women and girls, and long distances to be travelled to reach the bath not only take up much time, but add greatly to the expense. In each year, however, two classes for female teachers and pupil-teachers have been held, and one class for children. This year three classes for female teachers are already at work, and we hope to have two more; while two classes for girls have been already established, and we hope that the arrangements for two more may speedily be completed. Little as it has been possible to do, the committee of the club yet feel that some progress has been made. They have at least discovered that when classes for women and children are opened, they will attend, and that the use of the bath having been once learnt, is a thing which is not willingly dropped. In this lies their hope for the future. Almost all that can be done for this year has now been set going; but it is intended in next year to attack the bath proprietors early in the year, and to endeavour to get more baths open.

The length of the course of instruction has varied from 8 lessons to 16. It will be asked whether much has been accomplished in that time. In answer, it may be said that in one course of lessons boys quite unacquainted with swimming have learnt enough to enable them to swim across the Victoria-park lake, and for the length and back of the Lambeth Bath, (244 ft.). The girls, at their competition at the end of last season, swam across the Marylebone Bath and back (132 ft.), and some were able to swim the length of the bath and back (146 ft.) several times. The children also have learnt to dive and swim in different ways. I cannot, personally, speak of the feats of the men swimmers; but the female teachers who have joined the classes have all learnt to swim, and some three or four can be pointed to who swim with as much ease and grace as their professional teachers. All who learn are willing to join again, and to induce others to come. The classes of women teachers have varied in numbers from 15 to 30, and of girls have averaged about 30.

During the last two seasons more than 6,000 teachers and scholars, male and female, received instruction under the club, and it is hoped that at least 3,000 more will be added to the number of those who have acquired the art of swimming by the work of this season.

The work which the club does is chiefly by paying the expense of swimming lessons, by endeavouring to obtain for its members, and for children, additional facilities for bathing and swimming, and by enabling scholars to purchase bath tickets at reduced prices. The members of the club (not scholars) have no benefit from reduced prices of ticket. They have either to provide, or to pay for, the use of their bathing-dresses, and they pay the price of entrance to the bath each time. They get, however, instruction, and they have a chance of winning prizes in the competitions which take place at the end of the season.

The club has not only ordinary members—whose subscription is 5s. per annum for those over 19 years of age, and 2s. 6d. for those under—but it has honorary members, who subscribe a guinea a-year, and life members, who become so by a donation of five guineas. The President is Sir Charles Reed, Chairman of the London School Board; the Vice-President is John Macgregor, Esq., while the Rev. John Rodgers (Vice-Chairman of the London School Board) is the treasurer. The committee has both ladies and gentlemen as members, many of them teachers, some clergymen, others members of the present or of the late Board.

A considerable amount of general interest has been shown in the movement. In 1875, shortly after the commencement of the club, a meeting to promote its objects was held in the Mansion-house, under the presidency of the then Lord Mayor (Alderman Stone). Prizes to be competed for have also been given. Watches and silver medals have been given each year as rewards, both of skill and of diligence and success in teaching scholars to swim, and medals, work-boxes, and books have been distributed, through the kindness of various friends, to the best swimmers among the children, both boys and girls. It is hoped that, as the work of the club becomes more known, it will not only receive more of the support which it so much needs, but that it may be successful in rousing up so strong a general interest in the matter that baths will be thrown open to teachers and children more readily than they are now.

ON WASHING.

By the Rev. Harry Jones,

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We are fond of praising our modern civilisation, but, though there can scarcely be anything which marks a civilised state more than cleanliness, there is nothing in which we have come behind the ancients more than in washing. There are Roman ruins in England which testify that in those old times what is now looked on as an expensive luxury for the rich was a cheap provision for the poor. A sumptuous public bath was part of the inevitable equipment of every community, and the people bathed to an extent which is now inconceivable to many. St. George's-hall, at Liverpool, is said to be the most exact copy in modern times of a part of one of those edifices in which the Romans washed themselves. The whole building, however, is less than one-fourth of the size of the central mass of a large Roman bath, and therefore gives but little idea of the immensity of one establishment for washing in old times.

Other ancient nations notoriously bathed much. In the Bible we see washing raised to a sacred eminence. And existing peoples use water or the bath to a degree which we in England hardly realise. A bath is a necessary of life in Russia, and is to be found in every village. The Japanese are, perhaps, the most universally sedulous nation in the matter of washing themselves. The cheap native prints of scenes in their domestic life generally contain a representation of the family tub or spout. The ablutions of the Mohammedan and Hindoo are well known. I remember, moreover, when on the scene of the making of the great Atlantic Railway across America, which was partly built by Chinese navigators, that one great wonder and complaint of these pigtail labourers, on being brought near the Irish navvy, was that he did not wash himself after his day's work.

It might be difficult to trace our decline into that form of uncleanliness which is exhibited in the neglect of washing. But the fact is that, practically and generally, the average Briton does not wash himself. Even the tub, which is now used widely by one class, was, not so very many years ago, regarded as almost a sign of eccentricity, and it is at present chiefly used only in houses which contain dressing-rooms. It has not come into anything like general use. The phrase, "cleaning one's self," common among working people, is mostly considered to be realised after what Sam Weller called a "rinse," and, perhaps, the putting of a fresh shirt over an unwashed skin. The habit, moreover, of wearing the beard among those who are engaged in dirty or dusty businesses restricts still further the small surface touched by the water and the towel.

I might remark, in reference to even partial washing, that disease may easily be, and often is, taken into the system by the mouth, and that, as the hands may have been in unconscious contact with the germs of death, if they are not washed before eating, neglect may be speedily and seriously avenged.

I must, however, in this passing glance at a great subject content myself with general reflection. And I would therefore submit this. Considering that each man, roughly speaking, is made of a peck of solids and so many pails of water, and that provision is made by nature for the continuous distillation of this liquid through thousands of pores over the whole of his body, and that the natural clogging of these drains is aggravated by the wearing of the same unwashed clothes, in many instances, for considerable periods, it does not need much physiological perception for anyone to perceive that, especially if he be a working-man, earning his bread by the sweat of his body, he might take a lesson from the old Roman and the modern Chinese in washing, unless he is content to carry about on his person and in his clothes the worst deposits of those innumerable drains with which he is furnished by nature, and from the outflow of which he is intended to be freed.

It would be difficult to exaggerate the importance or necessity of fixing this impression on the minds especially of the young. Washing, bathing, and swimming should be prominently explained and encouraged as an integral part of education. British conceit in current civilisation should be diligently assailed by showing how far other nations, whom we consider inferior to us in many respects, have been and are superior to us in the civilised habit of personal cleanliness. This is a matter which might well be taken up vigorously by every School Board and teacher. And, where possible, the addition of a bath to the equipment of a school might be ranked along with the provision of a playground.

We have, indeed, so much lee-way and lost time to make up, in respect to washing, that some can hardly at first perceive how far we have fallen behind in this branch of civilisation, and be tempted to rest content in the furnishing of a school with a few taps, basons, and towels, and calling the result by the imposing name of a lavatory, whereas it seldom involves more than such a temporary cleaning of hands as shall retard the smearing of the books which the children use.

I might add that, beyond the direct sanitary benefits which follow from a proper use of water in washing the whole person, we might reckon the encouragement of much self-respect and of a radical distaste for, or repugnance to, manifold phases of dirt. Habit is the act of yesterday; and a man who has once thoroughly washed himself immediately afterwards resents the presence of what is stale and sour. He will not endure a stuffy room or offensive drain with the forbearance with which he tolerated it in his unwashed state, when he carried about with him a cognate atmosphere. The habit of cleanliness will tell all round—in his house, his family, and daily surroundings. Being clean himself, he will shrink from, and protest against, many other forms of uncleanness which are depressing and degrading.

Thus, washing carries a train of wholesomeness behind it besides directly producing a sentiment of healthiness. Some good deeds are followed at a long interval by their results. We have to wait patiently for a return. But there is nothing in which cause and effect can be so immediately and easily connected and enjoyed as in obedience to the great law and command of the kingdom of God, where that which is fair ever fights against the foul, as "Wash, and be clean."

ON THE SUBSTITUTION OF SCIENTIFIC STUDIES FOR FANCY WORK IN THE EDUCATION OF GIRLS.

By Frances Elizabeth Hoggan, M.D.

In the education of our upper and middle-class girls, fancy work still plays a part as one of the branches taught in fashionable schools; and, after a girl returns home, at the expiration of school life, it, in common with the three-volume novel, frequently monopolises her life, to the exclusion of more useful kinds of work.

Much diversity of opinion exists as to the proper place which fancy work ought to occupy. Some assert that it is utterly to be condemned, as a mere waste of time; others, again, claim for it that it developes the taste, that it is a graceful and womanly accomplishment and one of the lesser fine arts. The first opinion is, as regards the generality of girls, not far from the truth. Mere mechanical copying, even of prettily designed objects, has no very elevating effect on the mind, affords no training which can be strictly so called, and has a direct tendency to foster habits of frivolity and idleness; and when it comes to be, as it often is, the copying of impossible flowers and leaves, unnatural birds, and other purely conventional objects, still less can be said in its favour. When, however, there is found originality to devise and execute pretty fancies, a plea may be put in for fancy work as a lesser fine art, immeasurably inferior to all other fine arts, but still worthy to occupy a place in a woman's life. But, even where such pleasing facility is found, fancy work is, properly, but the pastime of a leisure hour or the means of gaining a livelihood, and should be only taught in technical schools. Being of no educational value, it should not be allowed to encroach on the valuable time of school life, which ought to be entirely devoted to studies of a more serious kind.

It has already come to be recognised by thoughtful parents and teachers that a girl's education is incomplete if she be not taught the rudiments of certain sciences, as for instance botany, which has been largely introduced of late years into the higher schools for girls. I am, however, by no means inclined to admit that it is usually taught to the best advantage. Too often the whole aim of teachers seem to be to teach the classifications and name of British plants, and more especially the Latin names. To my mind nothing could be more unsatisfactory than a string of long names which leave the pupil as ignorant as ever of the beautiful features and lessons of plant life, which can only be learnt by the aid of the microscope and a little easily acquired skill in preparing the tissues for examination. With the scientific knowledge accumulating at the present day, a microscope should be considered as indispensable as a piano in every school. What a store of inexhaustible interest is to be found in botany so studied, where the pleasure grows with the application, and what study more fitting to engage the leisure of our gentlewomen than the varied and beautiful arrangements with which organic life, whether vegetable or animal, abounds. I, however, in no way desire to place such knowledge above the great practical lessons which ought first to be taught to enable the pupil to recognise some of the more important natural orders and their peculiarities, a knowledge which may be of the greatest service in the emergencies of life. Every one ought, for instance, to be able to recognise the *cruciferæ*, and to know that every member of that great class is useful as food, if ever hunger renders that knowledge necessary. In the same way it should be generally known that all members of the poppy family are narcotic, as by this knowledge relief from pain may be obtained in countries where there is no medicine chest at hand. Again, one ought to know that the members of the *ranunculaceæ* are for the most part acrid and poisonous, and ought therefore to be avoided. These lessons are of primary importance, but after these ought to come the search after the wonders of plant life. Luckily the manipulation required is of the simplest description and easily learnt, and it never causes the feeling of repulsion which the handling and preparation of dead animal tissues often engenders. Such a study forms a fitting and natural introduction to the more difficult but more important study of the elements of animal life, and into that study every apt pupil would pass easily and without effort.

Professor Huxley has indicated the pleasure and advantage that there would be for the young in the study of physiology, but he has had the misfortune to be misunderstood by well-meaning persons, who feared that the study of the elements of animal life meant the study of the elements of animal torture. I may almost claim to be exempted from the same misunderstanding, while I fully share his hope that physiology will at no distant period come to be regarded as an indispensable branch of a girl's education. To bring the young into close relationship with the beautiful facts of physiology, to teach in the most practical manner, that is, by direct observation, with the aid of the microscope, of the different animal structures, is what should be aimed at. Those who learn, while the heart is still young and fresh, to admire the marvels of arrangement and construction in all created beings, will carry with them into mature life such feelings of tenderness towards living creatures in general as will be the best preventive against cruelty of various kinds; and surely at no age are lessons of kindness to animals more needed than in the ignorant age of childhood, of which Lafontaine has so appropriately said, *cet âge est sans pitié*. The sooner the lesson is taught that cruelty is the worst kind of immorality the better, and who does not see what high moral training there would be in keeping constantly before the minds of children that they must curb their curiosity whenever its indulgence would result in suffering to even the meanest creature. Taught in this humane spirit, physiology would be fruitful of good, and is deserving of an honoured place in every school.

But not alone in favour of the above two sciences may a strong plea be put in against the superficial accomplishments which have so long found favour with those whose duty it is to direct the education of girls; with equal force might the claims of physics, chemistry, and geology be advocated, if girls are to share, as share they must, in the intellectual movement of the age.

But how can all this be compassed? How can sound instruction of even the most elementary kind be given in these various sciences, without unduly taxing the strength of growing school girls, who are even now almost always kept at their desks for too many hours, and especially for too many consecutive hours in the day? Assuredly only by carefully weeding out unnecessary accomplishments, and by substituting for them serious studies of a kind calculated to strengthen the powers of observation, develop the reasoning faculty, and stimulate into healthful activity the natural curiosity of the young mind. Banish altogether from the school such idle tasks as that of tearing out bright or dull coloured wools and silks into fantastic shapes, and substitute for such frivolities one or other branch of scientific study. Again, let it not be supposed that one teacher can reasonably be required to teach all or many branches of science, and let due provision be made for getting the best and most varied teaching-power for scientific subjects, attaching to them the same honour and remuneration as are now attached to music and other so-called accomplishments.

Leaving aside altogether the question of plain needlework, which girls must learn at some period of their life, and which it would be no disadvantage to boys to know something of, I am strongly of opinion that fancy work should be relegated entirely to those more mature periods of life with which educationalists have nothing to do, when individuals have a right to choose for themselves, both their occupations and their pastimes, and that it should never be allowed to form part of the school course. I would also urge that a certain amount of instruction in the use of the microscope be given in all middle and high class schools for girls, as that is in itself the first step towards a right conception of the wonderful phenomena of life and of the causes which may lead to health or disease. The example of Mrs. Somerville ought to familiarise the mind with a type of woman not necessarily unskilled in the refinements of needlework, and yet admirable as a student and teacher of science—a type which it would be well to find oftener in our English homes.

Unfortunately, the great objection to the substitution of one study for another arises from the unwillingness of teachers who have spent much time and labour in acquiring the power of teaching any particular branch, to see that branch cut off. As a matter of fact, however, from ten to twenty special lessons ought to be sufficient to qualify any ordinarily intelligent teacher for teaching the use of the microscope and the preparation of objects for examination, and the foundation might thus be laid of what would be at once an employment and a pastime of the highest value throughout the whole of life. One, and not the least, of the advantages which would in this way be gained, would be the facility girls would acquire in the manipulation of instruments other than the needle, which has been supposed to be typical of their sex. When a boy would have presented to him a knife or a hammer, and would be using both in the manufacture of whistles, boats, and other toys, anything besides a needle has been considered unfeminine in the hands of a girl of the same age. The consequence is, that on reaching adult life, a woman can seldom mend a pen or pencil or handle any simple tool properly, unless it be in the exceptional case of only daughters, who have shared their brothers' studies, employments and pastimes. If a woman has acquired in early life the taste for scientific knowledge, and has the energy and will afterwards to continue in its pursuit, she will have no monotonous, weary hours, will escape much of the nervous suffering which clings like a Nemesis to idle, aimless lives, will have the satisfaction of adding one to the patient army of searchers after truth, and will, if she marries, be none the less able to fulfil her duties as a wife and mother, the helper of her boys equally with her girls, and the true helpmate, as well as the companion of her husband.

A BIRMINGHAM BOARD SCHOOL BANK.

By J. A. Langford, LL.D., of Birmingham.

On the publication of Mr. J. F. Fitch's proposal for the establishment of savings banks in Board schools, the Education and School Management Committee, of the Birmingham School Board requested one of its members to examine and report upon the scheme, with a view to its adoption by the Board, and the subsequent opening of banks in the various Board schools. The report was presented in June, 1875, and stated that in the opinion of the writer the plan was worthy of adoption by the Board; that it would entail little trouble on the part of the masters and mistresses; could be simply and easily carried out; and that the establishment of such banks in the Board schools would be productive of much good to the scholars. The report concluded by recommending:—

1. That in each Board school a savings bank be opened.

2. That the head-master, or one of the assistants, be appointed for that purpose, receive the deposits from the boys; the head-mistress, or one of the assistants, from the girls; and the mistress of the infants' school from the infants.

3. That two or three managers be appointed to act as trustees of the bank, who need not necessarily be members of the School Board. Their duties would be to open accounts with the Post-office Bank, to see that all accounts were properly kept, and that the sums received from the children, when they had reached a fixed amount, were deposited in thePost-office Savings Bank.

4. The duties of the receivers would be, to receive the small sums from the depositors, enter them in each depositor's book, and at stated times, to pay over the sums to the trustees.

The controller of the savings bank department will supply forms, and deposit books for the use of the children without any charge, and the authorised rules issued by the department for such banks are:—

1. Deposits of one penny and upwards will be received at   every   from   till   o'clock.

2. The money received will be invested in the Post-office Savings Bank, on behalf of the above-named penny bank, in the following names, being those of the trustees of the said penny bank.

3. Depositors may withdraw all or a portion of their deposits on giving one week's notice. The deposit book to be left with the trustee in attendance.

4. Women and children may deposit and withdraw money in their own names.

5. No person will be allowed to have in this penny bank more than £5 in all. So soon as the amount paid by any depositor reaches £1, he will be assisted to open a separate account in his own name at the Post-office Savings' Bank, and he will thus be able, if he wish it, to make his subsequent payments direct to the Post-office. As, however, no deposit less than one shilling can be received at the Post-office Savings' Bank, he may continue to pay into the penny bank as before.

6. Each depositor will be furnished with a bank-book free of charge, but should it be lost he will be charged twopence for a new one.

7. Strict secrecy will be observed respecting all deposits.

8. Interest will be allowed at the rate of $2\frac{1}{2}$ per cent. per annum.

The report and its recommendations were approved by the Committee, and afterwards adopted by the Board. It was determined that the experiment should be tried for a time in one school only, and that in Elkington-street was selected for the purpose. Mr. J. S. Wright, vice-chairman of the Board, consented to act as trustee or treasurer. The bank was opened, and the first deposits received in June, 1876, so that at the time of writing this paper the bank had been in existence for a year, a period sufficiently long to enable us to form a judgment as to the probable usefulness of such institutions, and the desirability of establishing one in every school.

The average attendance of children at the Elkington-street School is:—Boys, 315; girls, 301; total, 616. During the year the number of depositors has been:—Boys, 247; girls, 152; total, 399, or more than half the average school attendance. The total amount of deposits has amounted to £121 11s. 4d., of which sum the boys had deposited £61 10s. 2d., and the girls, £60 1s. 2d., which shows that a larger capacity for saving has been displayed by the girls, the average amount of the individual deposit being, for each boy depositor, 4s. $11\frac{3}{4}$d., and for each girl, 7s. $10\frac{3}{4}$d.

At the present time, June, 1877, the total number of depositors is 187: boys, 97; girls, 90; the sum in the bank being only £36 2s. 8d., of which amount £18 3s. 6d. stands to the credit of the boys, and £17 19s. 2d. to the credit of the girls. This is not a large sum, nor is the number of depositors satisfactory; but it must be borne in mind that a great depression of trade has been felt for a long time, and that almost all the children attending the Board schools belong to the working classes, whose means for saving, small in the best of times, are entirely taken away when trade is bad. Much good has, doubtless, been effected by the working of this Board school bank. Habits of thrift have been contracted by the children, which may be productive of incalculable good in their future lives. They have also been taught the value of a little foresight in providing for some object which they desired to obtain, for the largest amount of withdrawals from the bank has been at Christmas, Easter, and Whitsuntide, which shows that they were saving for the purpose of obtaining extra clothing in winter, or, perhaps, for a healthy holiday in summer, both of which objects are deserving of encouragement and praise. Altogether, I think the results of this little history of a Birmingham Board school bank are sufficiently encouraging to justify the Board in establishing one in every school under their management and control; and I trust, before this Congress holds its next annual meeting, that this will be done. Every one who has paid any attention to the subject will, I feel assured, agree with me that the establishment of such banks will be productive of great good to the children, the parents, and the community at large, and will join with me in wishing them every success.

PROVIDENT DISPENSARIES: A MEANS OF PROVIDING FOR SICKNESS.

By **Lawson Tait, F.R.C.S.**

A Congress met to discuss questions of domestic economy could hardly be complete unless it included within its programme a consideration of some method by which the distress occasioned by the sickness inevitable in all households may be provided against. It requires no prolonged or special acquaintance with the lower middle and the industrial classes to know that a very large amount of domestic distress, sometimes of an almost permanent character, is due to the want of provision for the time of illness. For the purely artisan population there is everywhere an amount of accommodation for the treatment of their illnesses by gratuitous medical relief, which is (in appearance at least) quite adequate for all demands upon it, if indeed it be not really superabundant. But to those who are acquainted with the details of hospital work there are defects here which need not be at present alluded to; and it is, moreover, becoming apparent to all who are interested in questions of domestic economy, that the growing tendency of our working-class population to trust to the help of others in their hours of need, is becoming more and more disastrous to that spirit of self-help, without which no populace can maintain a healthy social life. It has, indeed, been said, and with a large amount of truth, that the multiplication of the sources of gratuitous medical relief is the cause, and not the result of the demand for it.

Bearing upon this evil, then, are a number of issues which might be raised here if time permitted, but it is more pertinent to the purpose of this Congress that I should confine myself to the benefits to be derived from the establishment and extension of the system of provident dispensaries, as a means of obviating the hardships incident to sickness, and resulting from the expenses which are inseparable from it.

Let us suppose the wife of a clerk, the mother of three or four children, to be suffering from one of the many accidents incident to motherhood. Her husband is in receipt of thirty shillings a week, and upon this they can contrive to maintain a comfortable and respectable position, meeting their daily wants as they arise, and keeping out of debt. The expected addition to their family has necessitated a little pinching, to provide for extra expenses, and if the mother's recovery had been uninterrupted all would have gone well. But she does not recover as she has done before. The attendance of the doctor has to be prolonged for three, six, ten, or fifteen weeks. Assistance has to be got for the household work, or the poor mother has to work before she is fit to do it. A nurse may be required for her, neighbours have to take pity on the husband and children, and it may end in the necessity of special advice, or admission into hospital for charitable treatment. And even then the husband finds himself involved in debt to the extent of fifteen, twenty, or even thirty pounds, and it may be years before he is able to free himself from the incubus. That this is no fancy picture every practitioner of medicine will freely admit, and I could give innumerable instances of it from real life. I hold that the possibility of such distressing results is a blot on our social system, and it is the duty of such a gathering as this to assist in the consideration of the remedy.

We do not know much about the statistics of illness, but we know that it is written down that disease is the lot of all domestic life. To those whose incomes allow of a margin for contingencies, provision against sickness is not important; but to that enormous class whose life is, to use the forcible colloquialism, from hand to mouth, it is an incumbent duty to make that provision.

To a large extent this has been already done, and in many instances the methods have been perfectly satisfactory. But it is evident that, to be efficient, a provident system must be on a very large scale, must include as much of as possible, if not the whole of that population for whose wants it is devised; and, more especially, its executive must be managed with the utmost regard to rigid economy, and to the full requirements of those for whom it is instituted.

We have, therefore, initiated a movement in this large centre of industry which I personally hope to see conducted on a plan such as I proceed roughly to sketch out, and which I trust will speedily be imitated throughout the country. We can hardly claim for it originality in any important particular, and we must yield to Manchester the credit of being the first important community to carry out in a spirited fashion the system of provident dispensaries. Indeed, I almost fear that we must be ashamed of our negligence in Birmingham, for it was in this county that the system had its birth, in the village of Southam; and in a neighbouring city, Coventry, it has had a flourishing existence for nearly a quarter of a century.

The chief object of the dispensaries must be to include as large a number of members as possible, and for this purpose it is to be hoped that the cooperation of the medical charities, and of those friendly societies already dealing with provident medical relief, may be obtained. No hard and fast wage line can be adopted, as this has always been found unequal and oppressive, and every encouragement must be given to the habitual hospital patients to cease their application for charity. Here a system of careful inquiry must be instituted, as in Manchester; and no person should have gratuitous medical relief until it has been ascertained that the applicant is a fit and proper person to receive it.

At the other end of the scale some latitude must be allowed, and it is sincerely to be hoped that the medical profession will see that their interests are here quite co-incident with those of the public; for while it must be admitted that occasionally a "good private patient" may be admitted to the benefit of provident membership, it must be borne in mind that if the scheme is made successful by the loyalty of the doctors, it will not only entirely prevent the distribution of gratuitous medical relief to improper recipients, but that it will practically put an end to the entry of those bad debts into the medical ledger which so many of my brethren have to deplore.

The number of practitioners engaged upon the staff will be so large that practically the patients will have quite as good an opportunity of selection as the most affluent private patient could exercise; and the amount to be paid for all emergencies, even of the most serious kind to which a household can be subjected, would not exceed on an average three shillings a year from each member. This would include not only medical attendance and drugs, but could be made to pay for specially skilled advice, and for trained nursing by such a plan as has been recently proposed by the Institute for Trained Nurses in this town. It would also include admission into hospitals for the treatment of those cases which require such attention or such special appliances as cannot conveniently be employed in the houses of the members.

The details of this scheme cannot be given more fully here, but if carried out as they have been, and may be in almost any community, it may be commended on the following grounds:—

1. It encourages habits of prudence and forethought.
2. It prevents the incurrence of debt.
3. It diminishes the amount of gratuitous medical relief, and limits it to proper recipients.
4. It will relieve our hospitals from the incubus of the hosts of applicants whose wants could be better attended to elsewhere, and who, at present, prevent the proper amount of care being given to the more necessitous class of cases.
5. It enables the sick poor to be treated and nursed in their own homes.
6. And finally, by introducing into the houses of our industrial population skilled attendants, whose chief interest it will be to diminish and prevent disease, it will do a great deal to advance sanitary improvement.

It is from the advantages to be gained on this last-mentioned ground that our chief arguments for the system should be founded. Preventive medicine is now the great field of labour, and no more efficient weapon could be placed in our hands than is proposed by this movement, for correcting those numberless errors in hygiene which exist in the houses of the poor, and which arise solely from ignorance. With these no mere sanitary authority can cope. In this town we have lately taken enormous strides in the direction of preventive medicine, but I see daily, in my double capacity of a member of the Health Committee and a practitioner of medicine, matters with which we are wholly unable to cope.

Perhaps the most important of these is the matter of the death-rate of our infant population. Looking week after week at the mortality returns, we are inclined to flatter ourselves that our community is a healthy one, because the number of deaths for every thousand of the population is a comparatively small one, and one which is, I am proud to say, constantly diminishing. But no mere statement like that will reveal to us the terrible items of mortality with which we have to contend; that is, those which are removable. Now, the factors of infantile mortality which are within the present power of remedy are such as produce more than one-half of the deaths of children under five years of age. The terrible effect which they produce in our town is shown by the fact that the last return of the Medical Officer of Health for the Borough tells us that the average age of all who died within the preceding fortnight was only 21 years and 5 months. During the winter, when infantile mortality is not so high, it was about 26 years; so that we may conclude that the average death age of our whole population is not much over 25 years. This is a most terrible revelation. Death is the unavoidable fate of all, and if that can only be put off for 25 years, we surely must regard all our costly efforts as having, so far, had but unsatisfactory results. It is, of course, in the numerous deaths of young children that we find the factor of this low average, and it is in that direction also that the remedy must be applied.

It is, therefore, with the utmost pleasure that we must look upon the splendid efforts which are being made by the authorities of our children's hospitals to grapple with this great difficulty, and I regard the new movement in which we are now engaged as another great engine for good, dealing as it does with a means for educating the people in those matters of domestic economy upon which they one and all depend for their health and the prolongation of their average life period.

THE INFLUENCE OF ORDER, METHOD, AND CLEANLINESS IN FACTORIES AND WORKSHOPS UPON THE HOMES OF THE INDUSTRIAL POPULATION OF LARGE TOWNS.

By S. Wall Richards.

Among the subjects in which instruction is most urgently needed by the industrial population, and to which attention should frequently be drawn in any course of education on domestic economy, there are few more important than the one I have endeavoured to illustrate in the following paper.

Having had frequent opportunities of comparing workmen's homes in the textile districts of Lancashire and Yorkshire with workmen's homes in Birmingham and neighbourhood, I have been led to inquire into the cause of the differences between them.

Many of the houses of the operatives of the northern counties are characterised by an air of cleanliness, freshness, and an appearance of general comfort that is altogether wanting in a similar class of houses here.

A different spirit seems to pervade the household, and is a striking feature to a resident of the Midland Counties.

There is no doubt in my mind that the superior manner in which houses are built, the more complete domestic arrangements that are made by architects and builders of this class of property in the North, has a great deal to do with the general cheerfulness of home life there.

But what are the influences at work that create the taste and demand for this class of house, influences not in operation here?

I have never seen ordinary workmen's homes here that would compare at all with those there.

In Yorkshire there is on the ground-floor a living-room, with a second apartment in the rear, that serves the purpose of slop-kitchen and wash-house, being fitted with open furnace or boiler; also a good supply of water laid on, and, what is very important, a current of air could pass through these two lower rooms.

The living-room is invariably fitted with what is known as the "Yorkshire range," with an open fire, and on one side a hot-water boiler, on the other side a large baking oven, large enough to bake a batch of bread; the fire-grate itself, with sufficient polishing surface to tempt a "Lancashire lass" that was "house proud" to try what "Baker's brilliant blacklead" would do towards supplying a mirror for the use of the family.

But the marked features of the northern home do not end here; under the bars of the grate there is always to be seen a bright red glare; no accumulation of ash; no contrivance for hiding dirty sides running back to the chimney. Ashes are not allowed to accumulate, because the floor immediately underneath the bars is invariably whitened over with a brush and wet whitening, and the ash that falls is removed frequently.

Working men and working women in this neighbourhood have not the remotest notion of the attraction of a Yorkshire fireside. Whether the bright hearthstone is the complement of the general cleanliness of the walls, which are painted (not covered with a tawdry paper, as with us), or the whitened ceiling, a crowning feature of the whole, is a moot point.

The advantages of painted walls are well known by those who live in high-rented houses, where, as a rule, the best kitchens are always painted, and cleaned frequently with soap and flannel.

Well, the walls of the living-rooms of the northern dwellings have many of them an occasional cleaning with soap and flannel, and the ceilings are whitewashed twice a year.

I once remarked on seeing a ceiling of a living-room whitewashed at Christmas, that I had observed being whitewashed at Midsummer, "Why do you whiten them twice a year?" the reply was, "We should be dirty people if we allowed them to go as long as the factories before they were done, that is, only once in fourteen months."

Happy operatives, indeed, are they who can speak of the factories they may work in being whitewashed once a year.

Now, what is the interior of the homes of the operatives in Birmingham? How compares it with the same class of house in the North?

A single living-room on the ground floor in a court of houses, a "*cul de sac*," with no second apartment; a cramped room with a ridiculously small fire-grate, no hot-water boiler, a small baking-oven on one side only (nine or ten inches square) divided in two parts, a fire-grate, perhaps the cheapest, commonest, and most useless design ever made; no back apartment, wash or slop kitchen, no painted walls, but, instead, walls covered with a cheap, showy paper, that is never cleaned or changed for years, a contrivance for harbouring loathsome insects; and ceilings that are whitewashed at long intervals of years also.

That adjunct of comfort, and promoter of cleanliness and health, a good supply of water, the operatives here are also denied; a common pump in the centre of the court, into which the sewage may percolate, and be of serious mischief, is the usual, and in most cases the only supply, and the wash-kitchen, or wash-house, available by the housewife, is a general one, common to the whole of the neighbours in turns, and used only on certain days, or portions of days, as when there are more than six houses to only one wash-house. Each tenant cannot have the wash-house for even one whole day out of the six.

This very slight sketch of the houses inhabited in Yorkshire and Lancashire by the operative classes, and of houses inhabited by the same class here, will, perhaps, enable those not having an acquaintance with either to form an idea of the conditions of home-life in the two districts.

The immense difference so much in favour of Lancashire and Yorkshire I attribute to the order, method, and cleanliness observed in factories there, and the entire absence of corresponding rules and regulations in factories and workshops here till recently.

Since the Act of Sir Robert Peel, in 1802, and subsequent Acts of 1833 and 1844, controlling and regulating labour in factories, and determining the conditions upon which it shall be carried on in the interests of the physical growth and health of children, young persons, and females, it may be said these northern districts had enjoyed advantages during the period represented between the dates 1802 and 1867 that have not been permitted to operatives here.

The magnificent factories, with every appliance and contrivance that could be suggested by human ingenuity for securing the most favourable conditions upon which the gigantic industries could be carried on, have aroused and kept alive the desire of the factory *employés* for clean, convenient houses. To these causes I attribute their growth and development; and, where they do not exist, something exceptional has come in the way.

What has been the rule, method, or custom here? Most factories in Birmingham may be said to consist of a series of workshops that have grown from month to month and year to year, without symmetry or design, that the largest of them are, with few exceptions, agglomerations of shops, all shapes and sizes, forming irregular masses of buildings (very frequently a *congeries* of six or seven houses, communication with each other through two holes in the walls) with no principle observed, securing to the workers either proper light, ventilation, or cleanliness. All these important considerations have been ignored, so that, as a rule, places are built subject to no supervision, and, in consequence, are in direct contravention of the laws of health, and sometimes even of decency.

Systematic cleanliness in workrooms is a term almost unknown, I regret to say. Except in rare instances, observed, perhaps, in not more than 10 per cent. of the various trades of Birmingham; and, if a hundred workshops or manufactories were visited, I doubt whether, previous to the Factories Act Extension Act, 1867, more than 5 per cent. of them had been whitewashed in a decade, and since, from the relaxations embodied in that Act after the most persistent opposition by our Chamber of Commerce, and especially to the whitewashing clause, I doubt very much, up to the present time, whether the practice of whitewashing has by any means been general.

From the above outline of the different influences and surroundings of those occupied in daily labour in the North—and it must be remembered that females are more largely employed there than here; as many as 800,000 are computed to be engaged in the textile trades—it will be seen, and admitted, that the character of these surroundings is all-important.

The members of this Congress will be able to account for the less favourable appearance here of operatives, generally in their dress, which partakes of the character of their homes—tawdry, not substantial, not what a Yorkshire lass would call wholesome or cleanly—and their contentment with a state of things that would not be tolerated in some parts of Lancashire and Yorkshire for 24 hours.

It is wearying to hear the working classes so continually rated for their shortcomings and preached to, whilst the class above, who have so many opportunities, and so many obligations to discharge, neglect both.

It has always appeared somewhat of a mockery to me that such efforts should be made by a community to erect hospitals to cure diseases, whilst so little is done by the same community to prevent them. Birmingham in every part of it is busily occupied in its thousand different trades daily, carelessly and thoughtlessly; aye! in the majority of workshops and manufactories preparing patients for the different hospitals and dispensaries, by its utter neglect and failure to observe the common rules of cleanliness.

It seems a sweeping charge to make, that our principal manufacturers, who live in suburban villas, surrounded with most of the luxuries of modern life, should be content to drive into town to their different places of business, and remain content when they see their workpeople occupied in the most loathsome of workshops, so unwholesome that they would be indignant if they were asked to use such workshops and hovels as stabling for their horses. Their stables and carriage houses, or even dog-kennels at their homes, are palaces compared with very many of their manufactories, and members of this Congress may, if they are so disposed, easily test it. Whilst they would be shown over the suburban establishment and have all the newest appliances explained to them, if they were anxious to penetrate the dirty hives that contain the sinful working bees some plausible excuse would be offered for not gratifying their curiosity.

I once knew a wealthy Birmingham brass founder who kept an expensive horse to ride backwards and forwards to his place of business; the horse was stabled at the manufactory during the day. The owner observing the horse was frequently unwell when in town, sent for a veterinary surgeon to examine the stable, and see if he could discover the causes of the animal's illness. This the "vet" soon did. "See," said he to the brassfounder, "the fumes that pour out from the doors and windows of this casting shop, adjoining the stable, affect the horse's health; you must build him a stable in another part of the premises." This was done at once, the animal's health improved, but the brass-casters—who were only men, whose health was not considered, and whose lives were certainly not so valuable from his point of view as the life of a horse—worked on under the same unhealthy conditions as before, and those of them not killed off by the noxious fumes continue working without a thought being given to them.

Till we have better influences pervading the towns generally—and I am sorry to say, Birmingham does not stand alone, all the towns surrounding Birmingham resemble us very much—till we have an "ideal" of what cleanly life should be, whether the ideal be created by our better educated and larger employers of labour, or whether the municipality set up the standard? till then, much of the philanthropic work of the many philanthropic institutions in our midst is neutralised. The late George Dawson once said, "What a famous thing it would be for this country if we could have a national annual scrubbing day." A people lost in dirt are lost to much of their self-respect; lift them out of this dirt, and you elevate both man and woman in their own and general esteem. The elevating process is going on slowly. When women were prohibited from the degrading labour of working in coal mines, an immense advance was made in the home-life of the collier, and when they are prohibited from working on the pit banks another great step will be taken forward.

I have within the past year seen a pianoforte being taken into the cottage of a working collier in Bilston.

Again, Mr. Robert Baker, of Leamington, and Mr. George Smith, of Coalville, have done the greatest kindness to the wives of brickmakers in their efforts to limit the labour of females in the degrading occupation of brickmaking.

Whenever a female loses her personal identity in the very dirty and repulsive occupations of some kinds of daily labour, from that moment one may expect self-respect to be on the decline. My experience of a quarter of a century amongst the various trades of Birmingham has taught me that the dirtiest shops in any trade are shunned till all others are solicited for employment and have failed; and that the dirtiest trades are only resorted to by females of the very lowest class, and only then from unfitness or disqualification, and all other occupations have been closed to them; and when once entered, they seldom are able to emancipate themselves.

To further restrict the employment of females in degrading labour I believe to be the surest means of improving their condition, physically, socially, and morally, the lady advocates for unrestricted employment of females notwithstanding.

Slow as all these changes are brought about, a change is coming over the habits of Birmingham industrial life; thanks to the unremitting efforts and untiring zeal, coupled with long experience, of Robert Baker, Esq., her Majesty's inspector of factories of this district.

When Birmingham trades were placed under the law in 1867, license, liberty, and irregularity were rampant in many of them; men, women, and children were employed how and when some employers chose to employ them, and under any conditions. Mr. Baker kindly, but firmly, told the irregulars that this state of things would have to be altered, peacefully if they chose, but altered nevertheless.

Happily his tact and urbanity reconciled the most incorrigible to the change, and the improved physical appearance of children, half-timers, consequent upon more wholesome factories and workshops, is largely owing to his labours.

There are other influences also at work; new manufactories are being built more rapidly than at any former period. These new buildings are now constructed with some regard to health and to the requirements of kindly, exacting, and beneficent legal enactments.

When labour generally is carried on, and the conditions of it are influenced by a healthy public opinion, very many of the faults with which the working classes are now charged will have passed away. Give them these altered conditions, and they will not long remain content with the miserable shoddy houses that are provided for them by a sordid, soulless class of speculators—notorious in this locality for the impunity with which they outrage, and cause to be outraged, the commonest decencies of life.

"House pride," a phrase in the North, that to most women belonging to the working class is and acts as a "talisman," is not understood or acted upon here.

Tens of thousands of our operatives, male and female, have never had any other school from childhood upwards, but the dirty, disorderly workshop, with its Saint Monday devotees as exemplars; and its early and late hours as the week advanced, its grand device for recovering time lost in drunken bouts at the beginning.

The influences of the factory and workshop are undoubtedly the most powerful in the life of an operative; they may be good or bad; the employer is frequently the only person occupying a higher social position that the employed comes in daily contact with; how important then, that the influence should be of the right kind; what a powerful agency it may and could be made.

In these modern days, the large employer of labour occupies a position relatively the same as that occupied in feudal times by the barons, when the welfare of those about them as retainers was a prime consideration.

We have had an Akroyd, a Crossley, and a Titus Salt, to remind us that these great responsibilities are not universally ignored, but these noble representatives of the old love and care for dependents are too few and far between.

As a manufacturer, engaged in one of the staple industries of Birmingham, I maintain that there are not any insuperable difficulties to be overcome, by four-fifths of the trades here, in any endeavours employers may choose to make to bring about a better state of things. If they desire order, method, and cleanliness in their establishments, the reforms are easy of accomplishment, and the inclination for them exists. The great variety of trades, and large number of small masters—who are constantly with their workpeople, and, therefore, are supposed to have the influence of personal supervision—make the attempt easy.

If it is urged that reform may be brought about in the smaller establishments, whilst it would be difficult in the large ones, I still maintain that the will only is wanted to reach the desired end.

My firm employ upwards of 400 operatives, three-fourths of whom are females; and I do not know of any beneficial change that suggested itself for our consideration, that we should hesitate to make.

The time-honoured institution of Saint Monday, for example, is not known with us. For many years the Saturday half-holiday is an institution that has been observed. We should not tolerate absence from work on Mondays, through idleness, from the most skilled operatives we employed.

Again, we have a rule which is cheerfully obeyed, and it is this: that the floors of every room in the factory in which any persons are employed be scoured with soap, soda, and hot water once the last week in every month. Some of the rooms are 150 feet in length. Every alternate month we have another rule, that the windows be cleaned throughout the works, and what is the result? why, an amount of cheerfulness and brightness not common in Birmingham manufactories.

It is scarce necessary to say that we have an annual whitewashing, so that each new year in the works is begun with clean rooms.

There is a library of upwards of 1,000 volumes which is free to all the *employés*; there is also a sick society, or club, in which for each penny paid as subscription, 2s. is received weekly in case of sickness, no one being allowed to subscribe more than 5d. per week.

We do not compel all who are in the works to become members; therefore, many who are seldom ill are not inclined to join.

The average sickness last year was four days for each member. Not having any knowledge of sick clubs that may be in existence in other manufactories, I cannot tell how it compares.

We had a very striking instance of how this habit of cleanliness in the workshops re-acted and stimulated to increased cleanliness. The works are heated by steam conveyed through 4-inch iron pipes, between one and two thousand feet, running through the different workrooms and warehouses. We never gave any orders about these pipes being kept clean at any time or in any particular manner, however, every month the females employed will laboriously blacklead them, and when asked why they do so, as some of them are partially out of sight, replied, "they looked so untidy against the clean walls and floors if not done." One day we noticed some girls industriously polishing the brass gas-pipes, quite a voluntary proceeding on their part. I mention these very small matters, but they are gratifying and encouraging to those desirous of cultivating a love of cleanliness and order in small things.

In conclusion, I would urge those employers who are sceptical of these good results to follow our example; the pecuniary outlay is not large for soap and flannel, or hot water, or for whitewash for the whole year. I would also urge these same employers willing, but doubtful, to try the experiment of meeting all their hands together annually at a social gathering. We have done it now for some years; the pleasure has been mutual. Working men and women are not surrounded by overwhelming refining influences, rather the contrary. An evening spent over a cup of tea with music and singing at intervals, a good supply of microscopic and other interesting objects, have an interest for those who have had as their only pleasant resort hitherto, the casino, the public house or the gin-palace, and it demonstrates to them the possibility of spending an evening rationally and enjoyably without having resource to stimulants. It would be unjust to insinuate that these better influences were thrown away on them; it would to ourselves, as employers, be disheartening if it could be proved it was not productive of latent good.

These sanitary considerations and improvements affect the relations between employers and *employés* in many ways. They lengthen the service, and make that service a pleasure while it lasts. In our own establishment the feeling of attachment to us is shown by the following statistics of the length of service rendered by those at present in our employ:—

	Per cent.
Under 3 years	30
Over 3 and under 5 years	30
„ 5 „ 10 „	20
„ 10 „ 15 „	10
„ 15	10

The business has only been in existence about 20 years.

At the present moment we have not a healthy public sentiment influencing the masses in the matter of cleanliness. The municipal authorities and other governing bodies of our town give little heed to it.

After our factories and workshops, the next dirtiest buildings belong to the Corporation and public bodies. Only last week the chaplain of the borough prison made formal application to have the rooms and passages of his residence (which belong to the town) whitewashed and coloured, pleading at the same time that they had not been done for six years.

Perhaps the most unwholesome public room that we have over had in Birmingham is the lecture theatre of the Midland Institute; a room that is used periodically for the delivery of lectures on the laws of health. To my knowledge it has gone as long as six or seven years without a coat of whitewash. Again, our School of Art was whitewashed and cleaned down a year ago, the first time for eight or ten years.

If the governors of a town are so negligent on this subject, and practice at such long intervals the habits of cleanliness, it is sheer hypocrisy to upbraid the "governed" with their shortcomings.

Dirt hangs like a pall over Birmingham, Wolverhampton, and Sheffield, and very many of our manufacturing centres, injuring the health of the mass of their several populations at the same time that it is degrading and debasing them. It is all the more remarkable that Birmingham, occupying such an advanced position in many matters, should be so indifferent to this momentous and vital question.

Finally, I attribute the more comfortable homes of the working classes in the textile districts to the wholesome influences that have been silently at work so many years, through the periodic and systematic observance of cleanliness in the manufactories there.

The homes of the same class here are as unlike as it is possible for them, and still be called by the same name. In the former, life is enjoyed; home comfort is a reality. In the latter, life is endured from necessity, so absolutely devoid is it of the commonest appliances that should and do contribute to domestic enjoyment.

Employers of labour, many of whom—

> "From want of thought,
> Rather than want of will,"

neglect to inculcate the love of order, method, and cleanliness, by not observing and not practising the same in their own workshops and manufactories.

Municipal and other public bodies, whether literary, scientific, or educational, forget all the means of usefulness at their command, if they do not systematically, by their own example, inculcate the love for, by the practice of cleanliness. Corporate bodies should observe this in the scrupulous cleanliness of the public buildings in their charge, their various offices, &c. Other institutions of an educational character in their lecture-halls, class-rooms, reading-rooms, libraries, &c.

As a large ratepayer of this borough, I should look upon the liberal disbursement of the rates for this purpose as one of the most legitimate items of outlay during the year.

If this paper should be the means of calling attention to a subject that has hitherto received but scant consideration, I think it may, another year, be taken up by abler hands, treated as a new branch of domestic economy, and form an interesting portion of the proceedings of your next Congress.

SANITATION IN DOMESTIC TRAINING.

By Edwin Chadwick, C.B.

Occupation in schools with lessons in cookery, and with exercises in household work, commends itself greatly to me, as counteracting the evils of excessive sedentary occupation in the long-time common elementary and secondary schools. Six hours' sedentary occupation is for young children, and especially for female children, a violation of the laws of physiology—even if seats and reading-desks were so adjusted as to avert the spinal distortions and near-sightedness which are everywhere common amongst the long-time school children. As against these evils, which are of greater magnitude than is yet publicly known, the household service of a good kitchen affords, in the water-lifting, the pot-filling, the siding, and other bodily work, very salutary gymnastics. Our professors of gymnastics, McLaren and Georgie, could not find better exercises to counteract over-sedentary work for females than some of the exercises of the household—twirling the mop, for example. The late Mr. Roberton, surgeon, of Manchester, in his practice as a specialist in female diseases, found traces of disease, which there were not with women with no servant, begin with women with one servant, get more pronounced with women who had two servants, become worse with ladies who had three servants, and worse still with those ladies who had four servants. He showed statistically that the deaths from childbirth were four times greater in the latter class than in the former class. He traced their origin in Manchester in this way. Parents of a robust stock from rural districts came there, settled, and became rich. The robust mother then sent her daughter to a boarding-school. There the girl was kept to long hours of sedentary work, with little bodily exercise, and none if she were at home. She thence became enfeebled bodily, and subject to various disorders which her mother never had. In a second generation the conditions became worse. The train of disorders generated under these conditions were specially of the nervous class and the disorders of the digestive organs. A physician who was in perpetual attendance on a patient of this class, whose habits he could not alter, at last gave up the case, and told the lady that she must find some one else. "Will you leave me, then! Can you do nothing for me, Doctor!" she asked, in despair. "No, madam. I can only give you this prescription: Do as your mother did. Live on a shilling a day, and earn it." Evils of this sort are, I am informed, becoming widely prevalent amongst females in the cities of America. The train of disorders from deficient exercise are most engendered in the infantile stages, especially of girls, in the long-time schools. With the few, the evils are mitigated, though not obliterated, by horse exercise, by games, as by archery, by lawn tennis, and now by skating-rinks. I hope that the new vehicle, the tricycle, may be brought in aid. But the many are excluded from such reliefs. Moreover, a time appears to be approaching of a scarcity of domestic service that will necessitate domestic exercise of this sort amongst the young of a class of society who do not at present benefit by it. The evils are prevented at their source by more than one-half in the half-time schools, where, if well organised, as much teaching is given as is compatible with the powers of mental receptivity, and better given and better received; whilst, in the district half-time schools, the training in the work of the kitchen, in cookery, and in washing, ironing, and other non-sedentary occupations, restores the natural and salutary order of life, with a due proportion of exercise. Domestic instruction will meet with resistance as encroaching upon the time demanded by long-time school teaching. It should, however, be pressed, as preventing or reducing the great sanitary evil of over-sedentary work in the common long-time schools. Apprehensions are expressed that in giving domestic training, and instruction in cookery, and other objects to children, we are giving "more than their little heads can hold." The evil is, that in long time—six hours' daily book instruction—more is now given of a sort than those "little heads" can or do hold, and that the change on the half-time principle, and a reduction of the excess of book-teaching in the abstract by the substitution of the concrete, is a relief, that gives them what it is proved practically they can and do hold and assimilate. As it is with the body, so it is with the mind—it is not what is eaten, but what is digested, that nourishes; and what we give on the half-time principle is received with an appetite and is the best digested.

The amount of telegraphic wire and apparatus exported this year was £924,985; last year, in seven months, £324,712.

The export of literature has increased in the first seven months of this year to £473,958 from £461,421 in the same period last year.

This year the value of coals, coke, &c., exported was £4,572,829, against £5,072,997 last year.

MISCELLANEOUS.

THE USES OF FISH SKINS.

By P. L. Simmonds.

Although the skin of some marine mammals, such as those of the seal, walrus, and the white whale, or Beluga (known as porpoise leather) have long been commercially employed, it is only lately that attention has been more generally directed to the utilisation of fish skins on an extended scale. Their employment hitherto has been very limited. Eel skins have been used for the thongs of whips and the attachments of flails, dried sole skins to clarify coffee, and some shark and ray skins by workmen to smooth and polish substances, and also to make a kind of shagreen leather.

At the Maritime Exhibition, held at the Westminster Aquarium this year, Mr. G. Kent, of Christiana, Norway, exhibited a variety of tanned skins, among which were:—

1. Whale skins tanned; the size ranges from 12 inches broad by 60 feet in length, suitable for wheel bands, for driving machinery, &c.
2. White fish, for upper leather, which can be prepared in pieces of 12 feet by 4 feet.
3. Skins of various flat fish, dressed and prepared for gloves. Fine upper leather can be made, often to be had in sizes up to 3 feet square.
4. Skins of soles, dressed and tanned suitable for purses, &c.
5. Skins of thornbacks, suitable for cabinet-makers instead of sand paper, and very much more durable.
6. Skins of eels, dressed and dyed suitable for braces and other purposes.

In Mon. Chas. Varey's "Scientifique Correspondence" from Paris, of August 7, mention is made of an industry carried on at Colborn, in Canada, in the skins of species of Silurids for glove-making, and this is to be prosecuted on a larger scale, both for the flesh for salting and the skin for currying.

Shoes have been made in Gloucester, Massachusetts, from the skins of the cusk or torsk (*Brosmus vulgaris*), the use of which has been patented. If this material for shoes proves what it promises, it will open up a new market for fish skins, which will, no doubt be highly profitable. In Egypt, fish skins from the Red Sea are used for soles of shoes. In the Animal Products Collection at the Bethnal-green Museum there are some tanned sole skins shown. The skin of the losh or burbot (*Lota maculata*), cleansed, stretched, and dried, is used by the country people in many parts of Russia and Siberia to trim their dresses, and instead of glass for the windows of their dwellings, being as transparent as oiled paper. It is also utilised by some of the Tartar tribes, as material for their summer dresses, and the bags in which they pack their animal skins. The inhabitants of the eastern coasts of the middle of Asia clothe themselves with the tanned skins of the salmon. It is asserted that it makes a leather as tough as wash-leather. The scale-marks give a very neat pattern to the leather.

W. Brozowsky, in his "Waarenkunde," Vienna, 1869, under "Fish Skin," says it is obtained from the sea angel (*Squalus squatina*, Lin.; *Squatina lævis*, Cuv.), the thorny shark (*Squalus acanthias*, *Sq. carcharias*), the tigered shark (*Sq. caniculata*), and some skates, as the angel skate (*Raja rhinobatis*), *Raja Sephen*, &c. The skins of these skates and sharks have spines of different sizes instead of scales. The skins are used for polishing, and, after the star-formed spines have been smoothed down with sandstone, for covering boxes and cases, &c.

The "Waaren-Lexicon" of T. C. Schedel enumerates the following fishes:—Sea-dog (*Squalus blainvellei*, Riss, Aiguillat, Blain), *Sq. acanthias*, and other small sorts, *Sq. carcharias*, Lin., *Sq. canicula*, and *Sq. catullus*.

Guibourt (sixth edition, by Dr. G. Planchon, 1870-71, vol. iv.), says, "The Sephen of the Red and Indian seas, belonging to the genus *Trygon*, produces the tuberculous and hard skin called Galuchat, after the name of a Paris workman who employed it first. The greater part of the Selacians, viz., the roussettes, sharks, humantins, aigullats, leiches, &c., have a rough skin, which is used for covering boxes, and also for polishing wood. The greatest confusion exists among merchants as to the names given to the different skins. Each tradesman applies, according to his fancy, the name of *peau de requin*, *peau du chien de mer*, *chagrin*, and even *galuchat*. I endeavoured to obtain specimens of the various skins, in order, if possible, to determine the species.

"1. Shark skin, from a young shark; small, imbricated scales, somewhat translucid, with longitudinal lines, the borders or edge entire and circular. This edge is free on the body, but attached on the fins. This skin serves for covering cases, &c., but is not rough enough for polishing.

"2. Skin of mottled *roussette* (*Scyllium*, Cuv.). Tuberculous, imbricated, horny, fine and hard scales, very near one to the other, and transparent, each triangular. Skin much used for polishing. Some persons state that 'false galuchat' is made of it by rubbing off the scales, which leaves a square figure that becomes very showy when the skin is applied on a green paper. I rather believe (continues M. Guibourt) that the false galuchat is made with the skin of the aguillat.

"3. *Peau de leiche* (*Scymnus*), sold to cabinet-makers under the name of *peau de chien de mer*, is covered with nearly rhomboid tuberculous semi-transparent scales, arranged one near the other in quincunxes.

"4. *Peau d' Aiguillat* (*Spinax acanthias*, Cuv.).—Viewed with a magnifying glass, this skin appears covered with small square opaline scales, not rough like the preceding, but much used by the 'gainiers' or sheath makers, for its glossy nacreous aspect.

"5. *Peau de Sagri* (*Spinax niger*, Cuv). Same uses as the preceding. The word *Sagri* is Persian; *Sagher*, Turkish, from its resemblance to the dressed leather made from the mule and ass, whence our word shagreen.

"6. *Galuchat* or *Sephen* skin, from the back of the *Trygon Sephen*, Cloq. It has numerous round tubercles, which become white by rubbing down, and in the interior opaque and nacreous. The skin is sometimes dyed for different colours, but it is often preferable to leave it the natural colour by only half polishing it."

The quantity of ray skins, dried or salted, imported into France in 1863 was about 18,000 lbs. weight, principally from Portugal. Formerly they used to fetch as high as 7 francs the pound, now they may be had for 1s. a pound.

The best galuchat, or what we should call shagreen, is made from the skin of the Sephen, which abounds in the Mediterranean Sea, and is also met with in the Red Sea and the Indian Ocean. This skin is remarkable for the size of the osseous protuberances. There are however two kinds of these rays, one with rough skin and the other with smooth.

From a certain portion of the skin of the angel shark (*Squatina angelus*) the Turks make the most beautiful sea-green watch-cases. These sharks, which form a connecting link between the genera of rays and sharks, are found in the Mediterranean principally, and the German Ocean sometimes. The skin being very rough, it is employed to polish wood and ivory, as well as for other uses in the arts.

Turners, ebonists, and carpenters in Europe use the rough skin of the blue dog-fish (*Squalus glaucus*, Linn.) like emery paper, for smoothing their work and preparing it for polishing. This shark skin is also used by the native workmen of the East for polishing wood and ivory, and it is made into shagreen. The best is that obtained from the *Rai Sephen* of India and the Red Sea. That most used now seems to be the skin of the ray (*Hypolophus Sephen*), which is very common on the Malabar coast, and an extensive commerce is now carried on in them in the Indian Ocean; they are found in the sea of Oman, and also taken at Mahe. The house of Giraudon, 48, Rue Moliere, Paris, makes excellent use of them for morocco and tabletterie.

Peau de Roussette (*Squalus catulus* and *caniculus*, Lin.). This fish, called *chat* at Marseilles, and *erin* in Catalonia, is smaller than the angel fish. The skin, reddish, and without spots, is of a uniform grain, flat, and only used to make cases and other articles known as shagreen. These skins come from the Mediterranean, and are imported in bundles by the sailors, selling, according to size, from 30s. to 36s. the dozen.

Peau de chien de mer is another name given in in France to some species of *Squalus* or *requin*. That usually found on the French coasts is known under the names of *chien marin*, *chat marin*, *roussette tigrée* (*Squalus catulus*, Linn.). Turners, cabinet-makers, and carpenters use the skin for scraping and smoothing their work before polishing; metal workers and others also use it. This skin, when worked up with the tubercules with which it is studded, takes the name of galuchat, and is ordinarily dyed green, to cover cases, sheaths, and boxes. Under the name of *chagrin* these skins used to be much employed in Turkey, Syria, Tunis, and Tripoli. That made in Constantinople was considered the best. It was coloured black, green, white, and red.

TOWN AND COUNTRY.

Mr. Gladstone, recently addressing a party of excursionists at Hawarden said—I hope some of you will live to see the time when there will not be such a complete contrast between manufacturing towns and the country as there is now. There must, however, always be a great contrast in many respects between places where vast numbers of people are gathered together and places where there are few. As a rule, there are three disgraceful things in large towns—one is noxious smells, one is the want of pure water, and the third is the enormous abundance of smoke. It appears to me that God Almighty never ordained any of these three things; I do not think it was His intention or permanent law that these things should subsist wherever people are gathered together in large numbers; and I cannot help hoping that some of you will live to see a great improvement made in some of these respects. Do not look upon this as hopeless; but it requires that people should think of it a great deal, for there is always somebody or other who thinks he is interested in maintaining the present state of things. Some manufacturers complain bitterly if they are not allowed to throw the whole of their filth and refuse into the water from which the people have to take their drinking supply. Some time ago I met a large manufacturer of paper, and asked how he was getting on. The answer was, "Oh, right well." You know the paper manufacturers generally said they would be ruined if the paper duty were repealed. However, this gentleman was not ruined, but, on the contrary, said he was getting on famously. I said, "You mean that you are doing more business," and he replied, "Yes, we do more business and we get more profit on it." "How does that come about?" I asked, and the answer was, "Well, formerly we used to throw into the river a large quantity of what we thought was mere filth and refuse—worthless stuff which came from the manufacture. We did not know how to make use of it; but by some legal or statutory authority we were prevented from putting any more refuse into the stream. We then had to consider what we were to do with this refuse, and we caused it to be examined by a chemist, who enabled us to turn it to account;" and the result was that this paper manufacturer made out of the refuse, which before then ran to waste and defiled the stream, a profit of £3,000 a year. Nobody likes to have the secrets of his business disclosed, and therefore, I must not tell you where this factory is. But you will see that in this case necessity was the mother of invention, and what was formerly mere waste was turned to account, while the running water was left clear, as God intended it to be. Then there is London, with its four millions of people. I have lived in the West-end of London for six-and-forty or five-and-forty years—I really cannot remember the exact number—but although there is a greater number of people there, and the town has spread in all directions, yet when you open a window now the air is purer and fresher, and fewer "blacks" come in, than 40 years ago. The reason is that Acts of Parliament have been passed to prevent people from wantonly and wilfully making smoke, and compelling them to consume it. This is now done to a great extent —not quite so much as it ought to be, but still a great improvement has been effected. Well, I am not going to talk about politics or party matters, though I should not be afraid of so doing, but I don't want to. I recommend you to think over these matters, because you have a great deal of power in your hands which you may employ usefully in getting these nuisances abated. God made this world to be pleasant to dwell in. I don't mean to say He made it to be without trial or affliction, but He made our natural and physical condition to be pleasant. The air, the sun, the skies, the trees, the grass, and the streams—these are all pleasant things; but we go about spoiling, defacing, and deforming them. We cannot, it is true, make the town as pleasant as God has made the country, but most of you can do something to prevent the pleasant things which have been vouchsafed to us from being deformed and defaced by the hand of man in the future. Take that as the moral of this little speech.

COOKERY IN THE TRAINING COLLEGES.

The following circular has been issued by the Committee of Council on Education, to the Training Colleges for Female Students throughout England and Wales. It may be hoped that it will be hereafter made applicable to all training colleges:—

Education Department, Whitehall,
3rd August, 1877.

Sir,—I am directed to request that you will call the attention of your committee to the question lately raised (10th July, 1877) in the House of Commons, by Mr. Leveson Gower, with respect to the encouragement of instruction in cookery in elementary schools.

It has been suggested that general scholars should be sent each year as students to the National Training School at South Kensington, either during, or immediately after, their residence in the training college. There are several objections to such an arrangement, which would be a costly one if carried out generally, and very partial in its effects upon the elementary schools throughout the country if it where applied to only a few selected Queen's Scholars from each college.

It is in their Lordships' opinion most desirable to secure that every student in the course of her training should secure a larger amount of systematic and practical instruction in cookery than is generally given at present. They, therefore, desire me to suggest for the consideration of the college authorities, whether it might not be expedient either to obtain from the Cookery School at South Kensington, the services for part of a year of a trained teacher, who could give your students instruction in the subject, or to send some officer of the college to South Kensington, to go through a course of training which would qualify her for teaching the students during their residence in your college.

The cost of carrying out either of these alternatives, *i.e.*, either the salary and expenses of a special teacher, or the payment made by your committee on behalf of an officer sent to South Kensington, might be included in the expenditure of the college, which would be recognised by the Department, under Article 89 (*a*) of the Code.

I have the honour to be, sir,
Your obedient servant,
(Signed) F. R. Sandford.

GENERAL NOTES.

Sanitary Conditions at the Seaside.—"A Sufferer" writes to the *Times* on the subject of Sanitary Reform in watering places:—"May I ask what is done in any town or village to prevent sewer or cesspool gas entering houses? Go where you will by the seaside for change of air, and where can you find sufficient attention paid to this important subject? I speak feelingly, having had illness in my house for 18 weeks due to this cause. One of my children fell ill the day after returning from a town at the seaside, and the disease, sore throat, was so infectious in its character that my wife and the rest of my family, six in number, who had all been in the same lodgings, followed one after another, and my wife is still very seriously ill. In the town where they were the public sewers had been constructed for some years, and were not sufficiently ventilated, while no provision was made by any bye-law to ventilate the soilpipes of w.c.'s or insure a separation in the oonnections of such soil pipes and scullery and other drains with the sewers. I found a noxious smell from the w.c. close to the sitting-room we occupied, and went to the town clerk's office to inquire if there was any such bye-law, but learnt that the majority of the Town Council were interested in the property, and that nothing of the sort was attended to."

New Paper Materials.—The application of new materials for paper stock, which has occupied so much attention of late, seems to have attracted some notice in the Philadelphia Exhibition last year. From Jamaica bamboo was perhaps the most important paper-making plant exhibited. Of the young bamboo stems, which are the best for the purpose, a very large supply, it is said, could be annnally, by systematic cuttings or croppings, furnished from plants flourishing in the humid parts of the island. It seems that the American paper manufacturers have also wished to make experiments with bamboo with the view, if possible, of introducing it into the American trade; so that, owing to the proximity of Jamaica to the United States, it is supposed that the supply of bamboo may eventually form an article of trade between the two countries.

Examinations in Localities in Cookery.—A course of 20 lessons in plain cookery, with practical demonstrations having been given in Bexley-heath, commencing February 5th, by one of the teachers of the National Training School of Cookery, the examination has been conducted by the Rev. Canon Smith, her Majesty's Inspector of Schools. On Wednesday, August 1st, the papers were prepared by the National Training School of Cookery, and returned there for examination.

THE LIBRARY.

The following works have been presented to the Library:—

Royal School Series—Domestic Economy (New Edition). London, T. Nelson and Sons. 1877. (From the publishers.)

Imperial Federation, edited by F. Young. London, S. W. Silver and Co. 1876. (From the author.)

Royal Colonial Institute—Proceedings. London, 1877. (From the Institute.)

The following have been purchased for the Library:—

Sanitary Arrangements for Dwellings, by W. Eassie, C.E. London, Smith Elder and Co. 1874.

Sanitary Engineering, by J. Bailey Denton, C.E. London, E. and F. N. Spon. 1877.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,292. Vol. XXV.

FRIDAY, AUGUST 24, 1877.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

TECHNOLOGICAL EXAMINATIONS, 1877.

The following is a list of the Candidates who passed this examination:—

Alkali Manufacture.

37747—Milnes, James Morris, 30, Widnes Science Class—1st Elementary, with the Prize of £5
37751—Upward, William, 23, Widnes Science Class—1st Advanced, with the prize of £7
37749—Williamson, Joseph, 29, Widnes Science Class—2nd Advanced
37750—Wylde, Josiah Rigby, 20, Widnes Science Class—2nd Elementary

Carriage Building.

50890—Hamshaw, William Harry Hamlin, 23, Leicester Science Class—1st Elementary, with the Prize of £5
61273—Mullins, Mathew, 23, Cork Science School—1st Honours [*]

Cloth Manufacture.

61271—Heywood, John, 25, Swansea Science Class—2nd Honours[†]

Cotton Manufacture.

61286—Kearsley, Alfred, 22, Oldham Science School—1st Elementary, with the Prize of £5
61285—Freeman, John, 23, Oldham Science School—1st Elementary
61287—Marcroft, John Garibaldi, 16, Oldham Science School—2nd Elementary
61281—Mellor, Charles, 19, Oldham Science School—2nd Elementary
61283—Taylor, William, 23, Oldham Science School—2nd Elementary
61292—Urmson, Samuel, 19, Oldham Science School—2nd Elementary

Gas Manufacture.

61269—Akroyd, Benjamin, 34, Elland Science School—1st Elementary, with the Prize of £5
61266—Dempster, John, 22, Elland Science School—2nd Elementary
61267—Dempster, Robert, 24, Elland Science School—2nd Advanced

Silk Manufacture.

61262—Wilkinson, Edward, 30, Leeds Young Men's Christian Association—2nd Advanced

Steel Manufacture.

61320—Chester, William, 20, Oldham Science School—2nd Elementary
61319—Cunnington, George Henry, 24, Oldham Science School—2nd Elementary
61255—Dawson, William, 17, Crewe Science School—1st Elementary
61263—Dobson, Stephen, 34, Old Ford Science School—1st Advanced, with the Prize of £7
61297—Dunkerly, John, 21, Oldham Science School—1st Elementary
61310—Garside, Franklin, 22, Oldham Science School—2nd Advanced
61300—Geddes, John William, 18, Oldham Science School—1st Advanced
61294—Gomersall, George, 21, Oldham Science School—2nd Elementary
61252—Harris, Sydney Joseph, 19, Manchester Mechanics' Institution—1st Advanced
61299—Harrison, George, 18, Oldham Science School—2nd Elementary
61295—Hayes, Thomas, 26, Oldham Science School—1st Elementary
61254—Latham, William Barnes, 24, Crewe Science School—1st Elementary
61309—Needham, Joseph Edward, 20, Oldham Science School—1st Elementary, with the Prize of £5
61301—Ogden, Fred, 18, Oldham Science School—2nd Advanced
61253—Pillow, Edward, 24, Crewe Science School—1st Honours, with the Prize of £10
61312—Platt, Travis, 17, Oldham Science School—2nd Elementary
61251—Sisson, William, 24, Royal College of Science, Dublin—2nd Honours
61298—Spencer, William, 19, Oldham Science School—2nd Elementary

Wool Dyeing.

61316—Aldred, James, 19, Oldham Science School—1st Elementary, and the Prize of £5
61272—Davis, Frank, 22, West Vale (Halifax) Science School—1st Advanced, with the Prize of £7

The following Candidates have passed in Technology, but have failed to obtain a Certificate, not having the requisite Science Certificates:—

Alkali Manufacture.

37746—Callander, William Scott, 25, Widnes Science School
37748—Fenney, Thomas, 26, Widnes Science School

Cotton Manufacture.

61280—Seaton, William Henry, 21, Oldham Science School
61291—Wolstencroft, William, 22, Oldham Science School

Gas Manufacture.

61317—Toulson, William, 22, Oldham Science School

Steel Manufacture.

61315—Andrew, Samuel, 17, Oldham Science School
35977—Beardshall, William, 16, Oldham Science School
61314—Platt, Joseph, 24, Oldham Science School
61313—Robinson, Robert M., 19, Oldham Science School
61296—Taylor, William, 15, Oldham Science School

EXAMINATION IN BLOW-PIPE ANALYSIS, 1877.

The following Candidates passed the examination in qualitative blow-pipe analysis:—

1—Kitto, Benedict, Camborne—Certificate of Proficiency, with a Prize of £3
2—Beringer, John J., Redruth—Certificate of Proficiency, with a Prize of £2
3—Beringer, Cornelius, Redruth—Certificate of Proficiency

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[*] This candidate has already obtained the Prize in Honours.

[†] The Scholarship of £105, offered by the Clothworkers' Company, has been offered to this candidate conditionally upon his arranging for such a course of instruction as will be approved by the Council of the Society of Arts and the Court of the Company.

HEALTH AND SEWAGE OF TOWNS.

Report of the Executive Committee.

The Executive Committee report that the Conference applied itself especially this year to the dry systems, as distinguished from the water-carried systems discussed last year, and have passed the following resolutions thereon :—

1. That the pail system, under proper regulations for early and frequent removal, is greatly superior to all privies, cesspools, ashpits, and middens, and possesses manifold advantages in regard to health and cleanliness, whilst its results in economy and facility of utilisation often compare favourably with those of water-carried sewage.
2. That hitherto no mode of utilising the excreta has been brought into operation which repays the cost of collection.
3. That the almost universal practice of mixing ashes with the pail products, though it applies these as a convenient absorbent, and possibly to some extent as a deodorant, is injurious to the value of the excreta as manure.
4. That, for use within the house, no system has been found in practice to take the place of the water-closet.
5. That, although there are appliances and arrangements by means of which the sewer-gases may be effectually prevented from entering houses, they still do so in the great majority of dwellings, both in town and country, including the metropolis.
6. That it is of the highest importance, in a sanitary point of view, that the metropolitan and local authorities should exercise great vigilance with respect to this matter, and that it should be made by law the duties of these bodies to enforce efficient measures for the exclusion of sewer-gases from dwellings, and to watch over their being efficiently carried out under such a system of payment as shall not press too heavily on those at whose charge the work is done.
7. That in every large town plans of its drainage should be deposited with the local authorities, and be accessible to the public.
8. That all middens, privies, and cesspools in towns should be abolished by law, due regard in point of time being had to the condition of each locality.
9. That the annual accounts of the Sanitary authorities, especially in great towns, should be prepared and published in sufficient detail.

(Signed by)

The Right Hon. James Stansfeld, M.P.,
Chairman of the Conference.
Lord Alfred Churchill.
Sir H. Cole, K.C.B.
Lieut.-Col. Sir E. F. Du Cane, R.E., K.C.B.
F. A. Abel, F.R.S.
General F. C. Cotton, R.E., C.S.I.
Capt. Douglas Galton, R.E., C.B., F.R.S.

GROSVENOR HOUSE.

The Duke of Westminster is desirous that designers, artisans, and the like, employed in any branch of Art applied to productive industry, should have the opportunity of inspecting Grosvenor House, with its Works of Art, daily, including Sundays, during the months of August and September, 1877, from 2 p.m. to 6 p.m. He regrets that, for want of room, he cannot extend the admission beyond the persons specified.

A number of tickets of admission have been placed in the hands of the Secretary of the Society, for distribution among persons answering to the above description.

Such persons can obtain tickets on application at the Society's house, by bringing with them a paper containing their names, addresses, and occupations.

Each ticket admits a party of four.

There will be no admission on wet afternoons.

DOMESTIC ECONOMY CONGRESS.

The following papers were among those brought before the Congress at Birmingham :—

BUILDINGS FOR WORKING MEN.

By Robert Rawlinson, C.E.

In attempting to treat the question submitted to me, namely, "Buildings for Working Men," I have not prepared plans either for sites or for buildings, as these would have necessitated details into which I have not had time to enter, and which I think this Congress would not have time to discuss. Each site may require special plans and special details.

Those whose duty it has been to inspect existing structures (I will not call them buildings) inhabited by working men all over the world, will, with few exceptions, find that they have been heaped or piled up out of the rudest materials and in the rudest forms. There has not been plan or thought to secure wholesome sites, and shelter in which health could be enjoyed. The results have been, and are, degraded populations and disease in excess.

Buildings for working men should be placed on appropriate sites, and should be constructed out of sound materials. The site should be dry, and should be within one mile of the place of labour, if this is practicable, or rail or tram communication should be included in the rent.

Plan.—As to plans, the site and surrounding conditions must in some degree dictate the plan. In a town where land is very dear the block plan may be adopted, as in the Waterlow, Peabody, and other similar blocks of model cottages, but where the price of land will allow of a more open arrangement, workmen's houses may be arranged in streets, but never in closed courts. The evils resulting from closed courts are many and great. There is not that privacy which is so necessary for family comfort; sunlight is excluded, and the circulation of air impeded; the children are an annoyance because there is no proper playground; and if there is one drunken, swearing, immoral family, all are liable to be tainted, all are made miserable. The evils resulting from court houses in towns has at length received legislative attention, and we have the Artisans' and Labourers' Dwellings Act, 1868, and the Labourers' Dwellings Improvement Act, 1875. Under the powers of this latter Act (which I do not need to describe to the people of Birmingham in detail), many existing evils will be remedied in towns and country. Structures in which disease is generated and paupers are grown, until the relieving officer pays more than the rent in out-door relief, may now be swept from the face of the earth, and on an improved site new wholesome dwellings may be erected, the old site being cleared, sewered, and made wholesome.

As Inspector under the Public Health Act, I have over and over again shown in my reports that court and cottage properties in towns existed, the value of which was not more than from three to five years' purchase, and that, area for area, the rent paid for some wretched den of a common lodging-house was more than the cost of a similar superficial area in Buckingham Palace. I have also shown that the money paid by a relieving officer was taken for the rent of the premises which bred the disease and poverty designed to be relieved, and that it would be far cheaper for the parish authorities to purchase such properties, pull them down, and build wholesome residences where there should be a chance of morality and health. The Labourers' Dwellings Improvement Act, 1875, is, I am happy to say, the result.

The question as to whose duty it is to provide wholesome buildings for working men may be discussed from several points of view—political, social, moral, and economical. It may be stated broadly and as a truth that—

Firstly.—There is no value without human life. The fairest portion of this earth's surface can only remain a desert without inhabitants, and these must be working men.

Secondly.—Moral and healthy human life has the greatest value, and imparts the greatest value to all surrounding things, land, and houses.

Thirdly.—The value of healthy human life springs from labour. Hence, that country will be the richest in which active, useful labour most abounds, and is most prized.

A country cannot be great and powerful without working men.

Human life is the prime source of value, and it is human law which creates property. A nation is an aggregate of individuals, and, consequently, as are those individuals, so will the nation be. Socialism, in some of its aspects, is not pleasant to contemplate, and yet socialism is at the root of national safety. The individual must be cared for and provided for by combination; but the less a State has to do with social combinations and arrangements, the better will it be for the entire community. It is, however, the duty of a State to enact just laws, and so to make morality practicable, to maintain order, and to punish crime; and when the use of this word "punish" can be dispensed with, it may be blotted from our dictionaries, as, in some forms, punishing crime begets crime.

Houses as they are.—Man, as he advances in civilisation, must be clothed and housed, each operation involving labour and wealth. As society is constituted, individual men cannot provide independently wholesome houses; these must, therefore, be provided for them (so far, involving landlord and tenant). Free trade in house construction has not worked advantageously for the tenants, as the fearful evils found to exist abundantly prove. Hovel construction in rural districts has pauperised entire agricultural parishes, and the slums of towns are known to be seats of disease, as also haunts of crime and vice. Investigations have ascertained the facts, and reports have set them forth, and the remedy. Good buildings for working men must now be provided. What constitutes a good building for a working man?

The site must be dry, and must be capable of being sewered and drained. There are hundreds of sites in Great Britain which are damp, and which also are so low as to be subject to flooding, and cannot be drained without pumping.

Good wholesome water should be available. There are thousands of cottages having no available water, but from an impure source.

Buildings for working men should be of sound materials—brick or stone—not mud, and, for several reasons, not of timber, though timber houses may in some districts be the cheapest; but there is the risk of fire, and they are subject to vermin.

Houses for working men should have sitting-room, kitchen, and scullery, and not fewer than three bedrooms. The meaning of the word "privy" should be realised. "Common privy" is a misnomer, and if more than one family is forced to use a privy in common it is likely to be abused, to become filthy, and to be neglected. Each workman's house, whether in town or country, should have a water-closet convenience. A sitting-room and best bedroom each should not be less in area than twelve feet square, and should have door, window, and fireplace.

In a workman's house no room should be less in height than nine feet from floor to ceiling, the window should be capable of being opened from the top, and there should be means for ventilation from the ceiling. As houses are at present constructed, no care is taken to preserve the spaces betwixt (underneath) the ground and the floor or the ceiling and the floor clean, but rubbish and shavings are left in to breed vermin and aid fire if one occurs. Thousands of workmen's houses in town and country are placed on improper sites because the land is cheap. The place may be a swamp; or, worst of all, a mass of (privy) refuse filled in over old brick-yards; or, a mass of chemical waste. A use of all such sites should be forbidden, and their occupation be prevented.

In workmen's houses it will not be practicable to give each house every necessary convenience, such as accommodation for washing, drying, ironing, and mangling.

The establishment of baths and washhouses has shown what may be accomplished in this direction; and, in place of building costly places (baths and washhouses) which are necessarily isolated and at long distances from working men's families, they should be small, compact, and multiplied over the entire inhabited area—a bath and washing establishment for, say, each fifty houses, that is one on each acre of town area; if for twenty-five houses all the better. Such an arrangement would be of more practical use then adding an additional room to each workman's house.

In the country, workmen's (labourers) cottages may have garden allotments.

The most comfortable and wholesome arrangements of workmen's houses in towns will be in streets, the houses on plan having front and back room, scullery, water-closet, and yard. The front street should be not less than 30 feet in width, the back street not less than 18 feet in width. There may be about 50 such houses on each town acre, having a population of 250.

Cottages in the country should not exceed 25 to the acre, having a population of 125.

Model houses, in blocks, will of course occupy much less space, and accommodate greater numbers.

Narrow streets, narrow courts, and narrow back passages in towns accommodate more tenements, but at fearful cost to health and morals, as may be witnessed by any person who will visit and inspect them. I have inspected, measured, and tabulated such dwellings in many towns, the remembrance of which is but as the remembrance of a nightmare. To reach some inhabited court houses, I have had to press in edgeways.

Museums, fine-art galleries, reading-rooms, and libraries have been established. Markets, slaughter-houses, and baths and washhouses have been erected, and in some instances to an extent not required, when things of more pressing need have been neglected. Museums, fine-art galleries, and statues may abound, as in Continental towns, in the midst of unsewered streets, undrained houses, and undrained pestilential suburbs. The unit man has not been considered in his dwelling. The outside of the platter has been cleansed, and the sepulchres are whited, and the world has been contented to admire and praise the magnificent cities. We shall learn in time that a clean city or village of plain but wholesome houses and cottages is relatively of more value than an unsewered and overcrowded city of palaces.

Recapitulation—Human life is the only source of wealth, and is, consequently, the one thing having most value. Healthy human life has the greatest value, and therefore deserves such attention as will secure health to the entire population.

Defective house accommodation and defective sanitary arrangements have tended to produce disease in excess. It has been learned by experience, and found upon inquiry, that in overcrowded (and ruinous) parts of towns, where the sexes are massed together, there disease, vice, misery, and pauperism are found, the rate of mortality ranging up to 150 per thousand.

Working men cannot, under existing circumstances, build their dwelling-houses, but must inhabit such places as are available, the results being, when driven into crowded courts or ruin-tenements, that health is lost, premature death removes the father, and the mother and children go to the workhouse. If, therefore, working men must have houses provided for them, in which health and moral order can be secured, it must be the duty of the municipality to see to this, and of the State to aid the local authority.

The strength of a nation is not exclusively in numbers, in personal accumulations of wealth, or in trade and manufacture, but rather in a free, healthy, self-supporting, religious, truthful, and working population. Wholesome buildings for working men are therefore at the root of a nation's power and endurance.

Appendix.

Artisans' and Labourers' Dwellings Act, 1875.—List of places in which the Act has been adopted. The Metropolitan Board have prepared nine schemes of improvement, as under:—

1. Whitechapel and Limehouse scheme for the construction of 1,077 tenements, to accommodate 3,600 persons.
2. Bedfordbury, St. Martin's-in-the-Fields.
3. Drury-lane, Prince's-street and Great Wild-street.
4. Pear Tree-court, Clerkenwell.
5. Whitecross-street, Golden-lane, Blue Anchor-alley, &c.
6. Philharmonic Theatre, High-street, Islington.
7. St. George-the-Martyr, Southwark, and district.
8. Old Pye-street and St. Ann's-street, Westminster.
9. Certain areas in Whitechapel.

The eight schemes (from 2 to 9) embrace an area of about 24 acres, having a population of about 15,000, or 625 persons to the acre. The buildings must of course be in flats.

Provisional orders have been obtained to put in force the powers of the Artisans' and Labourers' Dwellings Improvement Act, 1875, in Birmingham, Swansea, Nottingham, Liverpool, Norwich, Walsall, and Wolverhampton.

In each of these towns old or objectionable buildings are to be taken down, and new buildings for working men are to be erected under regulations as described, namely:—New main streets will be 36 ft. in width, and will be properly sewered. There will be footwalks 6 ft. in width on each side.

Plain, substantial, roomy cottages, ventilated on two sides, are to be built. Each cottage to have two ground-floor rooms, and two bedrooms, with fire-places.

Each house to have a separate and distinct convenience, with a dust-bin to each pair. Each house to have a separate yard, a separate drain and water supply. The backs of the houses to be from 36 ft. to 41 ft. apart.

House-room, cubic space per head, 1,140 ft.; sleeping-room, space per head, 520 ft.

The cost of the new houses will be from £200 to £250 cash. The rent may be from £10 to £12 per annum.

In Liverpool, court houses have been erected, at an expenditure of less than £100 each, as many as 200 being placed on one acre, containing from 1,000 to 1,500 persons, as lodgers are accommodated. Disease in excess has been a consequence, the deaths having been five or six times more than ought to have been allowed. Most of these courts have been erected within the last forty years, and the Corporation found it necessary not only to stop the erection of such houses, but, under the powers of a special Act of Parliament, to provide for the clearing away such courts, by purchasing half the houses and pulling them down; and now at length the obligation to erect proper houses for working men is nationally and municipally recognised. Sanitary acts, inquiries, and reports, have, through the earnest labours of Lord Shaftesbury, Edwin Chadwick, C.B., and others, come to fruition.

THE APPOINTMENTS AND APPEARANCE OF THE WORKMAN'S HOME.

By Frank Curzon,

Organising Secretary of the Yorkshire Union of Mechanics Institution.

If the school is to do its work efficiently. that work must be assisted and carried forward in the home. Our modern schools are now—thanks to the wise economy of more generous financiers—commodious and cheerful. The homes from which our children come to, and return from their school, are generally in the most dreary and dirty contrast. Is it not worth our while to spend a short time in considering how this can be remedied ?

Now, in nearly every considerable town in England the workman's home may be sketched in a few painfully truthful lines. In a back street, or a dark, crooked alley or yard, sometimes in a damp cellar, often in a garret without ceiling, and, when better off, occupying a couple of rooms in a second or third floor, a family group of six are lodged. There is no chance of dividing the rooms into distinct uses. Where they eat their meals half the family must sleep. As they rise to their early labour, those who work away from home take their food with them for the day, whilst the mother and the younger children, who remain behind, scramble through the day from meal to meal, often unwashed and half dressed, until the return of the bread-winners, whilst for this accommodation in the heart of a populous and overcrowded city the rent of a cottage is frequently paid. And on the father's return, when worn with his day's work he comes "home," what is the scene which commonly presents itself ? The wife, loyal and loving as she generally is, has never received an hour's training on home-duties. The little money she has to spend might have gone twice as far as it does, but ignorance, credit, and the influences of the neighbourhood, have made her the prey of the pedlar, the pawnbroker, and the publican. The husband, who should be anxious to fly to his home, is ready to fly from it. The unscoured floor has no carpet, save when the last rag of it does duty as a hearth-rug ; by the rusted fender, which encloses an unswept hearth, stands the inevitable cradle, in which a crying child kicks about the scanty litter of dirty clothes ; from the damp walls droop some common prints, the exaggerated horrors of some sensational periodical ; whilst on the high mantel-shelf stand the hideous monsters of the cheap market, which decorate so many chimney-pieces in our workmen's homes. The one meal he takes at home during the week—his tea—is spread upon a dirty table, without cloth and without tray. Nothing is done to make it look decent, whilst taste is never thought of, and here the family meets once every day, when everything should be done to make the meeting a pleasant and kindly remembered one.

Do you wonder that, from this scene of waste, and dirt, and disorder, the man rushes into the street again, passing by the temperance missionary, who, earnest and zealous as he is, has no amusement to offer for the workman's leisure, and often not even a room in which he may spend a couple of hours comfortably ? Do you wonder that the public house at the corner, bright in its colour, lively in its company, should offer an irresistable charm to the homeless workman ; and do you wonder that the wife, robbed of her husband's society, should, as she enters the grocer's shop—remember, that there, too, with its license—she may buy her glass of oblivion, or dream of the home that, as a girl, she once wished for ?

Now let us turn to the practical and easy remedy for all this. First of all, let the education of our youth of both sexes embrace the fullest knowledge of the laws of life and the duties of home. At the earliest period let the child be taught to regard the body as the shrine of the soul, to be kept unsullied and inviolate. Why should they not be taught the minutest details of the wondrous machine, with its delicate tissues, its powers, and its processes, they are to carry about with them all their lives ? Why should they not learn their first idea of their Maker from that glorious creation which is to give us so much pleasure if well treated, so much pain if neglected or dishonoured. And will not this lesson be carried to the home ? Will the child not soon learn that, even at that age, the little missionary may do somewhat towards Christianising the household, whilst, for itself, its first lesson of self-reliance shall have been learned too ? Then, having been taught the meaning of "the life" that is in him, of the future that is before him, of the faculties and powers entrusted to him, his earliest earnings will have a new significance. Money will not be an "end" but a "means" with him.

Close at hand, if the people of the district are alive to the wants of the age, will be found his penny bank. We have in our Yorkshire Penny Bank 430 branches, with an annual deposit of half a million, where, by far the largest number of depositors are children. And when he gets a little older, the home he, by this time, has learned to wish for, dawns upon him. The building society opens his doors to him and realises the vision. Let us suppose that at 18 years of age he lays by five shillings a week. It is done in the North of England in thousands of instances. At 25 he will have accumulated a little capital of £106 to take the average profits of these societies. This will give him about half enough to build a house for himself, and any society will most cheerfully lend him the £100 more. From 25 to 30 years of age he will—to repay this £100 capital and interest, have 10s. a week to pay, which he may call "rent" if he likes, only that he pays it into the building society. But that is the only rent he ever pays. From 30 years of age for the rest of his life his house is his own, and his wife's. His wife, for I suppose that at 25 or thereabouts, he marries, and that he has chosen for his wife a young woman to whom the world has in the way of education given equal chances. And this is supposing a great deal, for it is not yet the case.

Unpractical as much of the education for boys is, for the girl it is worse. Nobody teaches the boy how to write, or even how to address a letter, or to do any part of his future life-work in warehouse, counting-house, work-room, or shop. But the girl is, as a rule, taught nothing to fit her for the home or the world. She can scarcely make, unaided, a pudding, a shirt, or a bed. She can neither keep her husband's accounts, nor gracefully or neatly conduct her own correspondence.

But I am to suppose that this Conference is to bear fruit, and that the girl shall have some sort of training to fit her not only to be "the servant" of her husband, in which direction we are travelling far enough, but to be his life-companion—understanding somewhat of her husband's work in life—yea, and even sharing in his studies, and preparing for the higher duties of a moral and intellectual motherhood. And the home he is to bring her to, the workman's home, is to cost about £200. The home I sketch may certainly be built for that sum, and, if many are built together, for less. First, for its situation. Not, certainly, in the heart of a crowded town; his early experience has taught the workman what that means; but some half-a-dozen miles from his work, in a clean, bright district, if nothing more, and where the railway gives him a cheap workman's pass. It is to have a little ground about it, a decent plot of grass in front, a small yard behind, where the outbuildings are compactly arranged on the best sanitary principles, at a somewhat higher cost than usual, because what you have to economise here is not money, but health and life. The house should have five rooms, two below, three above. The rooms below should be—a living room behind, a bright kitchen, with covered sink, low mantle-piece, ample cupboarding, a range, which Mr. Buckmaster might approve, an immovable stone fender, a good wood floor, well excavated beneath, a broad window. The front room should be "the Sunday room" (I like the word), where a part of "the Day of Rest" should be spent. A bay-window, very little dearer than the other, should give scope for a window garden, the cottager's conservatory; and who that has looked into these greenhouses of the poor, but must have noticed with what care the pendant bells of the fuschia, or the bright blossoms of the red geranium, have been nursed by those to whom the window garden is so full of pleasant memories of sunnier hours.

I would not have one bit of paint about the place. The honest grain of the wood should tell its own tale. Polished granite, if you like, from Devon, for that one chimney-piece, but for the sideboard, the window mounting, the door, the wall-casing—the beautiful grain of our native woods, which we so often slander by varnished substitutes. Both the rooms on the ground floor should be twelve feet high. And there should be a decently broad entrance passage. Better the parlours a little smaller than the entrance unhealthily contracted. This passage should run from front to back, and form the lungs of the house. Upstairs the workmen is to have three rooms, one in front over the best room, for himself and wife, and two over the kitchen or living-room, to separate his children; and all three rooms should be ten feet high.

And now one word of modest suggestion to the architect. If what is called "Gothic" be the style chosen, let it err on the side of simplicity. Let there be no ornament "stuck on" to give relief. The windows—the eyes of the house—should have eye-brows; the doors, protecting arches for shadow; beyond this there should be nothing that has not a distinct meaning and use.

I do not suppose it necessary here to say anything about what has been so well and wisely enlarged on, in reference to drainage. We kill thousands every year by cheap building, and have at last learned how malaria and typhoid find their victims.

But I have a word or two yet to say about the decorations of the house. I take it for granted that the best room has its piano—the workman's piano. In some of our Yorkshire villages at least every third cottage has one, and I know one village where, in the three hundred and twenty houses, I could count at least one hundred and fifty musical instruments of one kind or other, and all in frequent and skilful requisition; and where, too, the voices are so trained and developed that "The Messiah," or "The Creation" can be rendered with credit and taste.

I should like to say something about curtains, and counterpanes, and carpets. Why should it not be part of the child's education to have his eye taught the harmony of colour? In our Kinder Garten schools this is not only possible but easy. Why should our gaudy carpets, our loud counterpanes, our coarse designs, fall to the lot of the poor? The room they have is so circumscribed, and their means so limited, that the quietest patterns, the chastest designs, and the most harmonious hues should be theirs, for they have them for their lives. No caprice of fashion can be followed by them, and, therefore, would I have the decoration of bed, and window, and hearth, as delicate and dainty as their money could purchase; and a great many very pretty things are cheap enough. A few shillings would replace our white and gold griffins with tasteful statuettes in plaster. Good engravings of our best masters are within reach, and they are far better than florid chromo-lithographs; a half-dozen busts of the workman's friends might be bracketted here and there, and Burns the ploughman, Shakespeare the woolsorter, Stephenson the collier, give him silent counsel.

In one recess his library should stand. I wonder why Smith, or Cassell, or Collins, have not thought of grouping an alternative library for the workman, in which a good History of England, a good summary of our literature, and a full dictionary, should form a part. This would be a permanent decoration for the house, and the reference library for husband, and wife, and children. And these grouped books—if the booksellers could only see their way to it—might range from three to twenty pounds. And the means for all this? It is the very easiest part of the work. With the preliminary culture, with the training of eye, and hand, and head, in our primary schools, would come such a love of what is pure, and sterling, and beautiful, that five and twenty per cent. of the workman's wages would no longer be spent in drink. Fifty "South Kensingtons" would stud the land. In every museum the quarter-hour lecturers would be placed, to give the dry bones life. Our window gardens would lead to our field clubs, and you would, in thus looking to the appointments and appearance of the workman's home, be making of every home a centre of action in which to look for the steady and continuous advancement of the people.

WARMING AND VENTILATION.

By Capt. Douglas Galton, R.E., C.B., Hon. D.C.L., F.R.S.

There is, perhaps, no subject connected with the economy of the dwelling which has so great a range of importance as that of warming and ventilation. It involves health, comfort, and expense. Ventilation is the science which enables us to regulate the purity of the air within our houses, by renewing our supply from the outside; and the problem of ventilation includes a consideration of the degree of purity possessed by the outside air, as well as of methods by which fresh air can be most advantageously admitted into, and vitiated air removed from the house. In its broad sense, therefore, ventilation should determine the site on which the dwelling is placed, as well as its form. It will also be apparent that, since the temperature at which fresh air is admitted influences the mode of admission, as well as the quantity and quality of the air, and its effect upon the individuals submitted to its influence, a consideration of the degree of warmth to be given to the incoming air is necessarily a part of ventilation; the temperature of the air is of especial consequence. Whilst we incessantly require air for the purpose of nourishing us, we also require it for regulating our temperature, or cooling us down.

The quantity of air inhaled and exhaled by an adult, in 24 hours, amounts on an average to about 360 cubic feet, or 2,000 gallons. What we take in and give out during 24 hours, in the shape of solid and liquid food, occupies, on an average, the space of 5½ pints, which is equal to $\frac{1}{3000}$ of the volume of the air passing through our lungs. But this food, and the oxygen of the air which we take in, is necessary for keeping in activity the chemical processes which are bound up with life; and one of the conditions necessary for the proper performance of these processes is a definite temperature.

This uniform temperature of the organs is an essential condition of man's life. The blood of the negro in the torrid zone, at its hottest period, is not one-fifth of a degree warmer than that of the Esquimaux, in the coldest time of the year, in the highest latitude. It is always 99½° Fahr.

The chemical processes going on in man produce and give off, on an average, in 24 hours, about 12,000 caloric units. A caloric unit is that quantity of heat which will suffice to raise 1 lb. avoirdupois of water, 1° Fahr. Thus the heat produced in one day, on an average, by a human being, would suffice to warm 7⅓ gallons from freezing to boiling point. Of course this varies with the individual as well as with the food and muscular exertion. It follows that the heat of the body is continually being lost. It is lost, 1st, by radiation; 2nd, by evaporation; 3rd, by conduction.

The loss by radiation and conduction may be exemplified by considering the cold feeling produced on entering an unoccupied house in cold weather, for as radiation is stronger in proportion to the difference of temperature between adjacent bodies, therefore, when the walls of a room are cold, the effect on the occupants is more sensible. As a further illustration, the rapid conduction of iron makes iron railway carriages so unbearable in winter. When the different parts of the human body are exposed unequally to loss of heat, we often say we feel a draught, and injurious effects, such as catching cold, ensue.

The loss of heat experienced by evaporation will be understood from considering the cooling effect on the human body of wind or air in movement, which increases the evaporation on the surface of the body. It follows that when the air is changed in a confined space, if we are to avoid disturbing the temperature of the space ventilated, it is necessary that the temperature of the inflowing air should be regulated.

The quantity of air required in ventilation is governed by the following considerations:—

In the process of breathing, the air thrown out from the lungs is deteriorated, the oxygen it contained is diminished, the carbonic acid is increased, a quantity of watery vapour is produced, and a considerable amount of suspended matter is set free, consisting of organic matter thrown off from the body, which assumes a more or less active condition of putrefaction.

Nature has provided in the atmosphere unlimited extent and constant means of purification and of movement. The average movement of air out of doors must be understood, in order to have a correct idea of the real difference between being in a room or in the open air. In our temperate climate, the velocity at which air moves amounts on an average at about 10 ft. per second; that is to say, at 7 miles per hour. Imagine a frame of the height and width of a human body, which may be assumed to measure about 6 ft. by 1½ ft., or 9 sq. ft. If this is multiplied by the average velocity of the air, it will be found that in one second 90 cubic ft., in one minute 5,400 cubic ft., in one hour 324,000 cubic ft. of air flow over one person in the open air.

In houses these natural conditions are interfered with; the air is enclosed in confined spaces, which allow it to become saturated with impurities, and render it stagnant. Those dwellings are the most healthy in which the natural conditions of the atmosphere are most perfectly preserved.

Chemistry tells us that at least 200 cubic ft. of air per hour is required by a human being, for the mere purposes of diluting the carbonic acid and water given off from the body to the same standard as they exist in the atmosphere itself.

But this mode of stating the case takes no cognisance of those aerial poisons eliminated from the skin and lungs, and which in stagnant air are perfectly cognisable to the senses, even after the air has been diluted to the extent mentioned. Indeed, the object to be served by ventilation is primarily the dilution and removal of these poisonous exhalations, and if this be secured, the carbonic acid and water will be removed at the same time.

If it were desired to supply in a room a volume of fresh air comparable with that supplied out of doors, it would be necessary to change the air of the room from three to six times in every minute, but this would be a practical impossibility; and even if it were possible, it would entail conditions very disagreeable to the occupants.

It is thus evident that, in considering the condition of air indoors, we have to seek a standard of admissible impurity in the air, rather than a standard of purity of air, comparable with what we have out of doors.

In judging of the amount of impurity which may be allowed in an inhabited air space, the sense of smell, when carefully educated, affords the best indicator of the relative purity and impurity of different kinds of air.

The volume of air which is required to maintain the air of a room at a uniform standard varies with the character of emanations given out by the occupants of the room. For instance, the emanations given out by sick persons, and especially those from bad surgical cases, require for their dilution a greater volume of air than is requisite in the case of healthy persons.

Calculations have been made which show that, theoretically, about 3,000 cubic feet of fresh air per hour per individual should be afforded to preserve the air in a confined space at the required degree of freshness; but, in our climate, a careful practical examination of the condition of rooms in barracks and hospitals, judged of by the test of smell, shows that arrangements which appear to provide for a much less amount than that obtained by theoretical calculation, will keep the air of rooms in a fair condition. These results have pointed to about 1,200 cubic feet of air per hour per individual.

It is very difficult, however, to obtain any accurate measure of the exact quantity of air which enters or passes out of a room. The conditions under which the air flows in and out of a room are so varied. The walls and ceiling themselves allow of a considerable passage of air through them, which is proportioned to the difference between the temperature outside and inside a house, and varies with the materials of which it is constructed. Thus, ordinary bricks are nearly twice as pervious to air as sandstone, and plaster is much more pervious than brick.

If you look at the ceiling, you will see that an old ceiling is blackened where the plaster has nothing over it to check the passage of air, and that where the joists come, and the air has not passed so freely, it is less black. If you break the plaster, you will find that its blackness has arisen from its having acted like a filter, and retained the floating particles of dirt while the air passed through.

Ill-fitting doors and windows allow of the passage of a considerable quantity of air.

In a temperate climate, where the changes of temperature of the outer air are rapid and considerable, these means of producing the outflow of air from, and the inflow of air into, a confined space are in constant operation.

A sleeping-room is very warm at bed-time; a rapid fall of temperature outside occurs, and at once a considerable movement of air takes place. The majority of occupiers of sleeping-rooms in England close their windows at night; they often block up the chimney by a register or otherwise to prevent the blacks falling. They have no special inlet or outlet for changing the air. In the morning the room would no doubt be very close; but if it were not for the continual insensible change arising from the air passing through the walls, doors, and window chinks, &c., the occupants would be asphyxiated. A well-built house unprovided with special means for the inflow of fresh and outflow of vitiated air, is a real source of danger.

For these reasons the form, position, and surroundings of a building are important, because the air thus insensibly coming in, as well as all other air admitted, should be taken from pure sources.

Rooms with a large amount of outside wall space have a better chance of obtaining fresh air than rooms whose walls separate them from other occupied rooms; because the air, filtering in from an occupied room, would necessarily contain more impurities than fresh outside air.

The inflow of air to a room takes place not only from all sides, but also from below.

The air does not cease where the ground begins, but air permeates the ground, and occupies every space not filled by solid matter, or by water Thus, if you build on a dry, gravelly soil, where the interstices between the stones are naturally somewhat large, you practically build over a large stratum of air. This air moves in and out of the soil in proportion to barometric pressure, and with reference to the wind.

The fact of this continual free passage of air in and out of the ground makes it important that the ground we live on should be free from impurities. We might just as well (indeed, probably far better) live over a pig-stye than over a site in which refuse has been buried, or in which sewer water has penetrated, or over a soil filled with decaying organic matter; thus, before building on made ground, its nature should be carefully examined.

In proportion, however, as there is a free movement of air in the soil, so is the process of decay, and, consequently, the removal of decaying matter, more rapid. Dead bodies buried in chalk or rubble will decay rapidly, but in clay, bodies will be surprisingly well kept, and even after a very long time, the features may be identified.

Experiments have demonstrated that there is a considerable quantity of carbonic acid in the ground. The water which comes up from deep springs always contains carbonic acid, with which it is supplied from the ground air. The carbonic acid in ground air is often in sufficient quantity to be highly injurious to life.

These remarks show the immense importance which the soil on which dwellings are placed exercises upon health. In cold or damp weather, when the air in the dwelling is warmer than the air outside, the upward movement of this warmer air will draw in air to supply its place, from the ground on which the dwelling stands. This movement would be prevented if the whole surface under the dwelling were covered with an impervious material; but, as already observed, it is difficult to find a building material impervious to air.

Concrete is the most convenient covering to be placed under a building, but it is not impermeable; the lime in it would absorb the carbonic acid from the ground air for a certain time, until it was all converted into carbonate of lime, and then its beneficial action would be diminished. Asphalte is more impermeable than concrete.

The amount of air from the soil may be checked by raising the floor above the surface of the ground, and affording free circulation of air between the raised floor and the ground. In

Burmah the dwellings are raised on poles. In Italy and France it is usual to build a basement on open arches, which are used for wood or other stores, over which the building is constructed. It is only comparatively recently that the occupation of cellars as habitations has been prohibited in this country. These considerations show the importance of forming a deep area round a house, which should be carried below the level of the basement floor, under which there should always be ventilation to the outer air.

In connection with the purity of air, it is necessary to consider the temperature and the degree of humidity most favourable for health. The dry bulb thermometer ought to read from 63° Fahr. to 65° Fahr., and ought not, if possible, to fall much below 60° Fahr. The wet bulb ought to read 58° Fahr. to 61° Fahr. In any case, the difference between the two thermometers ought not to be less than 4° Fahr., or more than 8° Fahr., although in the open air, in healthy weather, the difference is sometimes as much as 8° or 9°.

Vapour ought not to exceed 4·7 grains per cubic foot at a temperature of 63°, or 5·0 grains at a temperature of 65° Fahr. The limit of humidity to be allowed is 75° per cent. or under.

When the outer air is saturated, as in wet weather, the reduction of the humidity in a room will depend on the increase of temperature of the air admitted.

The capacity of the air for moisture increases enormously with the temperature. Thus, at 50° Fahr. a cubic foot of air is saturated by 4·1 grains; but at 60° Fahr. it requires 5·8 grains. Hence that amount of moisture which would saturate air at 50° Fahr. would give only 71 per cent. at 60° Fahr.

If, therefore, the outer air is at a temperature of 50°, and if the temperature inside the room be maintained at a comfortable standard, say 63° to 65°, the incoming moisture would never cause an excess of humidity.

The ventilation of a room is necessarily governed by the size of the room and the number of the occupants.

The size of an occupied and ventilated room affects the purity of the air in the room only by allowing a longer time to elapse before any given standard vitiation of the air is reached, and by making it more easy to supply fresh air without incommoding the occupants. The degree of impurity in the air of an occupied room ultimately in no way depends on the size of a room, but solely on these two things:—

1. The rate at which emanations from the occupants are produced.

2. The rate at which the air of the room is being replaced by fresh air.

The advantage of large space is—

First, the large room is longer in reaching the state of normal impurity than the small room. For instance, the following table shows the time required to bring air to a definite uniform standard of admissible impurity (viz., 0·2 per 1,000 of CO_2), in different sized rooms:—

One man in	10,000	cubic feet,	3 hours	20	minutes.
„	5,000	„	1 hour	40	„
„	1,000	„		20	„
„	600	„		12	„
„	200	„		4	„
„	50	„		1	„
„	30	„		36	seconds.

Secondly, the inflow and outflow of air necessary to maintain the standard of impurity is less perceptible in a large than in a small room; for the chief difficulty of keeping ventilation in action arises from the draughts it causes. Everyone objects to a current of air which affects him, and desires that if a window is to be opened it shall be situated behind someone else. There is, moreover, in practice, this advantage in the larger rooms, viz., that the larger wall surface and the more numerous windows will allow of a larger insensible ventilation, and thus larger rooms will have an apparently less degree of impurity than small rooms. Although the uniform diffusion of carbonic acid is very rapid in the air of a room, the organic emanations given out do not in practice diffuse themselves either rapidly or uniformly. They hang about in corners where there are obstructions to the flow of air, or near the ceiling. On this account some space between the occupants of a room is desirable. In sleeping rooms and in hospital wards, and in fact in all rooms where the height is not less than 10 or 12 feet, the floor space becomes of more importance than cubic space. For adults in sleeping rooms it is undesirable to have a floor space of less than 50 superficial feet. In hospitals from 90 to 120 superficial feet of floor space is generally afforded; and in fever hospitals, and in surgical wards, much more floor space is frequently desirable.

The ventilation of a room means the removal of a portion of the air in the room, and the supply of a similar quantity of fresh air to take the place of the vitiated air thus removed.

This change of air may be effected in two ways: 1st, by forcing fresh air into the room and allowing this fresh air to displace the air already in the room; or 2nd, by drawing the air out of a room and allowing the fresh air to flow in to fill its place. In some cases a combination of both methods is adopted.

The second plan, viz., the extraction of the air, is that which is simplest and generally adopted. The extraction may be effected by fans or pumping machinery, but the usual system is to depend upon differences of temperature for determining the movement of air. A cubic foot of dry air, at a temperature of 32°, and at the sea level, weighs 566 grains. The pressure of the atmosphere on any surface is about 14·6 lbs. to the square inch.

The molecules of air are but feebly attracted to each other, and small increases of temperature, or slight diminutions of pressure separate the particles from one another, and thus one cubic foot of expanded air weighs less. Similarly, small decreases of temperature bring the particles nearer together and make the cubic foot of cold air heavier than the standard above mentioned. This expansion and contraction is equal for equal increments or decrements of temperature. When the temperature of air and the space it occupies increases, its density, that is its weight per cubic foot, decreases.

It follows that as warmed air expands it ascends, and as cooled air contracts it falls. It also follows that as the warmed air ascends the air around rushes in to fill its place. Everywhere this heating and cooling of the air is going on; the sun's rays, the proximity of a warm body, the vicinity of a cool shaded surface, all cause movements in the currents of air.

In a room, as air is warmed by the bodies of the occupants, it ascends, it comes against the glass of the windows, cools, and falls down. Draughts felt near the windows are not necessarily air coming in from the window, it may simply be the cooled air falling.

It is on this law of the dilatation of air that all the movement of air depends, from the winds and hurricanes to the ventilation of our houses, except where we propel air by fans or other mechanical appliances.

The law which regulates this movement of the air in a confined space, when the temperature is higher than that of the outside air, depends upon the following considerations:—

1. Upon the difference of temperature of the air inside the confined space, as compared with that outside.
2. Upon the area of the aperture through which the air passes.
3. Upon the height of the column of ascending air.

Thus velocity of air in a chimney or flue depends on the height of the flue and temperature of the air as it ascends. Therefore a fire lighted at the bottom of a flue produces a current upwards in the flue. The extraction of air by flues is the plan usually adopted.

The extraction of air by a properly constructed fan, worked by a steam-engine, would be more economical than the flue extraction, especially when the warming of the air, which takes the place of that removed, is taken into account; but the strong recommendation to the chimney is its simplicity and its permanence. It requires comparatively little repair, and no skilled labour to look after it. The convenience of this system causes it to be almost universally adopted. The open fire-place is one example of it, the sunburner is another example; but the system is also applied in every room in which there is an opening at the upper part, out of which the warm air can pass, and an opening below, through which fresh air can flow in.

Thus, an ordinary sash window is an example. If the top sash is lowered and the bottom sash raised, the warmed air passes out of the room at the top, and the cooler outer air flows in below.

The air which is supplied to take the place of the air which is removed should be brought in, in such a manner and at such a temperature as not to cause unpleasant draughts, therefore, in a climate like ours, in winter the air removed must be replaced by warmed air.

There is a marked difference in the comfort of different appliances for warming air. It will be found as a rule that this difference arises from the impurities which they communicate to the air with the heat. Thus, carbonic oxide is formed in a fire when there is not sufficient oxygen supplied to form carbonic acid. Cast iron is pervious to carbonic oxide, it passes through the pores of the iron, and more readily when the iron is hot than when it is cold; carbonic oxide is generated when the supply of air to a fire is insufficient, consequently a cast iron close stove is liable to exercise a pernicious influence on the occupants of a room. Wrought iron is not similarly pervious, and is, therefore a safer material for close stoves than cast iron.

A room without opening to the air, warmed with hot-water pipes, or by means of a German stove, is often found to be unpleasant; but the unpleasantness arises from the want of change of air. Where there is abundant change of air these effects are not perceived. On this account the open fireplace, which extracts from a room an enormous quantity of air, is always preferred where it can be applied; and it may be stated as an axiom that an apparatus for warming, which does not provide at the same time for an adequate renewal of air, is unhealthy.

In order to appreciate the relative effects of different heating apparatus, it is necessary to compare the heat which we obtain from them with the fuel they consume.

The results depend upon the nature of the heat which is applied for warming, as well as upon the material through which the heat is conveyed. For instance, radiant heat, *e.g.*, the rays of heat from an open fire, warm the air they pass through very slightly. The rays pass through the air, and warm the bodies with which they come in contact, and these give out the heat to the air of the room. Iron and copper, on the other hand, absorb the rays of heat from a fire rapidly, and give them out rapidly; thus, more effect would be produced upon the air of a room if an iron screen be placed in front of the fire to intercept its rays than if the rays pass on to the walls, because the iron screen would communicate the heat which it received more rapidly to the air than the walls would.

With hot-water pipes the conductibility for heat of the material of which they are made is of much importance, as is evidenced by the following table of the units of heat transmitted per square foot per hour, through a plate one inch thick, the two surfaces differing in temperature one degree:—

Copper	515
Iron	233
Lead	113
Glass	6·6
Baked clay	4·83

It is thus more economical to use copper or iron as a medium for the transmission of heat to air, than to use clay. But on the other hand, iron parts with its heat rapidly as soon as the heating power ceases to be applied to it; whilst clay continues to give out heat very slowly for a long time, it thus affords a less variable means of warming the air than iron.

The heat in the warmed air admitted to a building is communicated to the walls and floor and ceiling of the building, until they acquire the temperature of the warmed air. As the walls and roof are in contact with the outer air, there is a continual loss of heat, which has to be made up from the warm air which flows in.

The economy with which buildings can be warmed and kept warm depends, therefore, very much upon the material of which they are composed, and of how the materials are arranged. For instance, the walls should be dry; not only is spontaneous change of air through walls impeded if the walls are damp, but damp walls cause a great absorption of heat, from the evaporation of the moisture from their surface. Therefore, new houses are unhealthy.

The simple forms of ventilation rest on the principle of an outlet for the warmed air, and an inlet for fresh air.

The position of the inlet is of material importance, because the question as to whether draughts are felt or not necessarily depends upon that. The sensation of draught is produced when the current of air impinging on the body is at a lower temperature than the body, because it thus abstracts heat by promoting a more rapid evaporation. Therefore, although a draught is more readily experienced from cold air, it would be felt even with warmed air. For this reason it is desirable to admit fresh air, especially cool air, at the upper part of the room, above the heads of the occupants, and to break up the stream by admitting it at numerous inlets. It thus becomes partially warmed by the air already in the room. The Sherringham ventilator is admirable in this respect, in that it is placed near the ceiling, and the incoming air thrown upwards.

If, in addition to the Sherringham ventilator, a flue is carried up from near the ceiling of a room, the air of a room, if warmer than the outer air, will pass up the flue, and its place be supplied with air through the Sherringham ventilator—one will act as an outlet, and the other as an inlet.

Another simple form of ventilator is Watson's ventilator. The ventilation in this case is obtained by a shaft carried up to the outer air from the ceiling level; the shaft is divided into two parts, by means of a vertical diaphragm, and the shaft on one side is carried rather above that on the other; thus an upward current is produced in the longer limb, and the fresh air flows down the shorter limb.

The velocity of air-flow in the up-cast shaft in this case depends upon the difference of length between the long and short limb, which is very small; and therefore, to produce the same effect as in the case of the first arrangement, a larger area is required. This is a very convenient method of ventilation in large halls and churches, when the doors and windows are closed, and when the warming is effected by hot-water pipes or close stoves, or by some means independent of ventilation.

The action of this ventilator is of course completely altered if air is admitted in the lower part of the room, for then an upward current would be determined in both shafts.

Another mode of admitting fresh air is by inlets, on what has been recently called Mr. Tobin's principle. Vertical inlets on this plan, combined with outlets for vitiated air in the upper part of the room, have long been in use; where, however, the extraction shaft is low down in the room, as for instance with an open fireplace, the draught from the vertical inlet passes direct to the outlet flue near the level of the occupants of the room; and this causes an inconvenient draught.

In this climate, in private houses, where changes of temperature are so frequent, it is of great advantage to keep the warming and ventilation of the several dwelling rooms independent of each other; on this account the open fireplace has always held its own as being the most convenient, as well as the most cheerful, means of warming and ventilating a room. The open fireplace is a most powerful engine of ventilation for drawing out the air.

With an open fireplace, a velocity will frequently prevail in the chimney of 10 feet, and in some instances, of 15 feet per second, thus causing, with a flue 14 inches by 9 inches, the removal of from 30,000 to 45,000 cubic feet per hour. But, as a rule, there is no provision whatever made for replacing the air thus removed. It is allowed to find its way into the room as best it can, by crevices in doors and windows, and through the walls. We, therefore, perpetually hear complaints of draughts, of colds, &c. Our open fireplaces merely warm us by direct radiation of the fire. The hotter we make the fire the more heated air do we send up the chimney, and the more cold air do we bring in to supply its place; thus we are roasted on one side and frozen on the other, and at least five-sixths of heat generated by the coal passes up the chimney.

To remedy this, various methods are resorted to. In some cases the hall and staircase are warmed by hot-water pipes or close stoves, with the idea that warmed air will find its way into the rooms.

This arrangement is open to various inconveniences, and indeed dangers, unless ample provision is made for the provision of fresh air. For instance, in a house with a central staircase, in the case of the temperature of the house being greater than that of outside air, the staircase becomes a powerful shaft in which the air moves up with considerable velocity. It is often more powerful than the chimney flue because of its larger size, and thus it is often the cause of smoky chimneys.

But it will frequently happen that the open fires in the rooms which require it to be fed with fresh air, and the warm air shaft of the central staircase, will combine to draw in the air from every available opening. They will draw up the air from the basement, they will draw it, if they can, from the water-closet and sink pipes, unless the water-closets and sinks are in projecting buildings, cut off by lobbies ventilated from the outer air.

For these reasons, it is of importance, not only to provide fresh air to the staircase, but when open fires are used, to make each room, in which there is an open fireplace, dependent on itself for its supply of fresh air. If the temperature of the room is to be kept up to a pleasant heat, this must be warmed air.

Careful experiments have shown that with an ordinary open fireplace, five-sixths of the heat passes up the chimney. The obvious method of obtaining warmed air is to utilise some of this wasted heat.

The way in which an ordinary open fireplace acts to create circulation of air in a room with closed doors and windows, is as follows:—The air is drawn along the floor towards the grate, it is then warmed by the radiating heat of the fire, and part is carried up the chimney with the smoke, whilst the remainder flows upwards near the chimney breast to the ceiling. It passes along the ceiling, and, as it cools in its progress towards the opposite wall, descends to the floor, to be again drawn towards the fireplace. It follows from this, that, with an open fireplace in a room, the best position in which to deliver the fresh air required to take the place of that which has passed up the chimney, is at some convenient point in the chimney breast, between the chimney-piece and the top of the room, for the air thus falls into the upward current, and mixes with the air of the room without perceptible disturbance.

The principle of Galton's ventilating fireplace is derived from these considerations. Fresh air is admitted at the back, where it is warmed by a large heating surface, and then carried by a flue, adjacent to the chimney flue, to the upper part of the room, where it flows into the currents which already exist in the room. The fireplace preserves an equable temperature all over the room, and provides a large amount of fresh warmed air.

The following result of General Morin's experiments on this ventilating fireplace showed that, with the ordinary fireplace, the heat utilised in a room amounted only to 0·125 of the heat given off from fuel, whilst in Galton's ventilating fireplace the heat utilised in room rose to 0·355 of the heat given off from fuel. Therefore, to produce the same degree of warmth in a room, Galton's fireplace requires only one-third of the quantity of coal required by an ordinary fireplace. It may be laid down as an axiom that every fireplace should be furnished with some means of admitting fresh warmed air.

All inlets for fresh air and all outlets for vitiated air should be adapted to being easily cleaned. Dirt soon accumulates, and if the inlet is foul, the air, however pure, will be fouled in its passage into the room. Moreover, the inlet should be at least two feet above the level of the ground, away from any sources of impurity.

In towns, especially in London, the air is rendered so impure by soot and other matters, that any current admitted continuously at one place soon blackens the adjacent walls and ceiling. The only remedy for this is to pass the fresh air to be warmed in the chamber at the back of the fire through a filter of cotton wool, to remove the blacks and other impurities.

In cases where the extraction of air by a chimney flue and an open fire is not considered sufficient, and where one or more other flues have to be adopted, it is advisable that these flues should be placed on the same side of the room as the chimney flue, because if placed opposite to it the currents established by the fire would tend to check the current in the flue.

In Germany, close stoves are generally used. The amount of fuel consumed in the German stove is comparatively very small. The stove is generally filled with fuel at an opening outside the room, and no removal of air takes place by means of the stove. In German rooms, therefore, the purity of the air is frequently left to depend on the spontaneous change of air which can take place through crevices of windows and doors or through the walls.

This absence of ventilation is the cause of the saving of fuel in German stoves. This saving of fuel, however, is at the expense of health. Dr. Böhm has adopted for some years the following system (than whom no one has better studied ventilation) in the Rudolf Hospital at Vienna. He there warms fresh air by means of passages constructed in the fire-clay stoves placed within the ward, and the fresh warmed air passes into the ward from the top of the stove. He provides flues of a large size, and proportioned to the size of the ward, from the level of the ward floor to above the roof; and the difference of temperature between the air in the ward and the outer air, causes a sufficient current in these flues to ventilate adequately the ward. By this means the fresh warmed air, instead of passing off to the upper part of the ward, and thence away by flues, is made to circulate towards the floor of the ward, thus bringing into action the principle by which the open fireplace is useful in ventilation. But this arrangement destroys one element of economy in the German stove, because the heat generated, instead of being left to pass slowly off into an unventilated room, is removed rapidly by the fresh air passed into the ward, and has, therefore, to be renewed at intervals, instead of, according to the usual custom, the stove being left shut up for twenty-four hours to give off its heat slowly. The larger the supply of warmed air, the larger must be the consumption of fuel; and if the heat is to be supplied economically, it must be through a good conducting medium; but the material of the German stove is a bad conductor of heat.

The inventions for warming and ventilation are extremely numerous; but the space allotted to this subject at the Conference on Domestic Economy does not admit of my entering further into the subject. I have only been able in this paper to touch on the fringe of this very large question, and have endeavoured to show the sanitary aspect of the subject, as well as to explain the general principles upon which all the detailed inventions for warming and ventilation must be based if they are to be successful.

MISCELLANEOUS.

TECHNICAL EDUCATION.

The following letter on this subject has been addressed by Mr. T. Twining to the Clerk of the Clothworkers' Company, Mr. Owen Roberts:—

Perryn-house, Twickenham, March 1st, 1877.

Dear Sir,—The following considerations are suggested to me by the conversation we had on Saturday last, respecting the intended City Guilds' Technical University, and the purposes and organisation proposed for it in the programme which you left in my hands.

Assuming the proposed building on the Thames Embankment to include, besides the central university itself, a model technical college, and to have in its proximity a model industrial institute, and considering the number and importance of the special duties that will devolve on the university, I would suggest that its teaching functions should be mainly confined to subjects of the highest grade, corresponding approximately in level to those proposed to candidates for honours at South Kensington, though in their kind they would partake of the utilitarian nature and industrial bearing of everything connected with the intended institution. At the same time attention would be paid to the desirableness of maintaining all those among the subjects taught at Gresham College, that might be made practically conducive to industrial improvement.

The following are a few subjects which I would venture to recommend. Those marked (G.C.) correspond to courses delivered at Gresham College.

1. Established truths in the higher regions of inorganic and organic chemistry. Theory and practice of the most important modern discoveries, or inventions, and of the most successful processes. This subject embraces on the one hand the whole range of the wholesale manufacture of chemicals, whilst, on the other hand, it divides itself into several distinct branches, *e.g.*, the metallic industries, the ceramic and allied industries, textile and allied industries, detection of adulterations, preservation of food, fermentation and industries con-

nected therewith, the products of destructive and of fractional distillations, the important results obtained from the study of homologous serials, the marvellous instances of natural products obtained by chemical mutations, &c.

2. Thermology, and ventilation in connection therewith. Photology, including apparatus for light-houses; the influences of various kinds of light on plants and animals, &c.

3. Magnetism. Electro-telegraphy.

4. (G.C.) Acoustics and music. Students who have acquired at the technical college a good practical knowledge of the various materials used in the manufacture of musical instruments, and of the construction, capabilities, and peculiarities of the instruments in common use, may learn in the university course the acoustic principles and phenomena which underlie the laws of harmony and instrumontation; also the history of musical instruments, from the earliest attempts to the latest and most perfect contrivances. Desiderata in the way of musical instruments, towards which the spirit of improvement should be directed. Phonometric appliances for time, pitch, and power. International pitch. Maritime acoustics. Appliances susceptible of being used as signals, *e.g.*, syrens, steam-trumpets, pyrophone, &c.

5. Dynamics and mechanism up to the highest performances of mathematical ingenuity, combined with mechanical skill. The steam-engine and kindred subjects to form a special branch.

6. (G.C.) Geometry considered in its practical applications to arts and manufactures.

7. (G.C.) Astronomy, meteorology, and physical geography in their bearings on navigation and commerce. The union of these three subjects in a course representing the purely astronomical one of Gresham College, is more natural than may at first appear. To the invaluable means of guidance afforded to navigators by astronomical observations, associate themselves on the one hand the phenomena of magnetic disturbance connected with the condition of the sun's photosphere, and, on the other hand, the laws of tides and ocean currents, forming a transition to meteorology and climatology, and to every branch of physical geography and *erd-kunde* that materially affects the interchange of resources between the various nations of the globe.

8. The science of commerce, including the history of trade from the earliest times, its vicissitudes and their causes, its statistics, and the many considerations above the level of ordinary routine which will be suggested to an enlightened mind by attentive study of the Commercial Museum. (See the works and lectures of Dr. John Yeats.)

9. (G.C.) The law of commerce, home, foreign, and international. (See the works and lectures of Prof. Leone Levi.)

10. (G.C.) Industrial economy, or if this title does not come sufficiently near to that of the Gresham course—the rhetoric of industry. To comprise the fundamental principles on which is based industrial success. The relations of capital and labour. The causes of fluctuation in trade. International exchange in weights, measures, and money. Paper currencies. Banking and Stock Exchange transactions, &c.

11. (G.C.) I am glad to see that it is proposed to consider hygiene as another subject borrowed from the intentions, though not from the exact wording of the Gresham syllabus. Health is so universally a matter of prime necessity, that the knowledge of means for its preservation, based on sound but simple scientific principles, should permeate the whole system of instruction from the lowest grade upwards, and will, doubtless, be comprehensively dealt with at every technical college. Nevertheless, there are certain branches to which a superior and special development should be given at the university, for the benefit of advanced students aspiring to responsible positions as builders, sanitary engineers, officers of health, &c.

To these subjects, jotted down in the order in which they have occurred to me, it might have been necessary to append explanatory remarks, showing how they would fit in with the *modus operandi* proposed in my "Technical Training," were this is not rendered superfluous by the attention with which you have honoured my book. You will at once perceive that detached courses of this description would be mainly addressed to students of already superior attainments, who, having obtained a major certificate in their respective callings, would now become candidates for a diploma of excellence. They would mostly have in prospect lucrative industrial or commercial positions, or aspire to become directors of, or professors at, local technical colleges, and might well be expected to devote for a comparatively short period the whole of their time to the completion of their studies. Consequently, the courses might be delivered in the daytime, as at other universities, and thus the lecture-hall would be available for the holding of public evening lectures on the scientific, artistic, and industrial questions of the day.

As shown at page 424 of "Technical Training," it is on the technical colleges that will devolve the greatest part of the instructional labour, and especially of that aimed at the acquisition of major certificates. The character of the technical teaching I would propose is too well known to you through chapter v. of my book to require further comment. The scientific teaching may approximately be compared as to level with the elementary and advanced stages of the South Kensington curriculum, or with grades 3 and 4 of general scientific foundation ("Technical Training," chapter iv.). It will sometimes be necessary to stoop to teaching grade 2, where there is not an industrial institute at hand to take charge of it. Too much allowance can scarcely be made for the difficulties placed in the way of artisans in general, by the want of attention to their mental culture which has so long prevailed. Due consideration must also be paid to the fact that in the proposed system of utilitarian instruction, the artisan will frequently have to borrow from several sciences the knowledge he has occasion to apply, which knowledge must in each case not be based on one department only of a science, as for instance on the chapter of the non-metallic elements in chemistry, but on a sound eclectic, or rather I might say panoramic, acquaintance with the most essential facts and principles of the whole science. Under these circumstances, it is obvious that whilst the proposed technical colleges will gladly accept assistance from all sides, and seek the cordial co-operation of all institutions that have a kindred bearing, they will not anywise enter into competition with those which in their instruction, examinations, and certificates, take each science on its own merits, and in the unmixed purity of its autonomy.

Descending to the industrial institute, we find it chiefly occupied with grades 1 and 2 of general scientific foundation. Here will be shown how the fundamental elements of practical science may be imparted to the working classes at large in the most cheap, easy, and effective way, so as to serve alike for the improvement of their physical condition and the development of their technical abilities. Indpendently of this, the second grade will give the studious artisan just that amount of intellectual preparation which is necessary for enabling him to use with satisfaction the scientific handbooks prepared with a view to the South Kensington curriculum. He will thus have a fair chance of obtaining certificates that will open to him a still brighter prospect, hitherto reached only by a privileged few—that of succeeding at the technical examinations organised at the Society of Arts, through the praiseworthy exertions of Major Donnelly, and which I am glad to see likely to be transferred to the charge of the City Guilds' Technical University.—Believe me to remain, dear sir, yours very truly,

T. Twining.

To Owen Roberts, Esq., M.A.,
Clerk to the Clothworkers' Company.

PHILADELPHIA EXHIBITION REPORTS.[*]

Motors and Transmitters, Hydraulic Apparatus, &c.

The following are the classes treated of by Mr. Barlow in this report:—"Water Wheels, Water Engines, Hydraulic Rams, Windmills, &c.," "Apparatus for the Transmission of Power," "Shafting, Belting, Cables, &c.," "Hydraulic Jacks, Presses, Elevators, &c.," and "Pumps and Apparatus for Lifting and Moving Fluids." In the first class, Mr. Barlow noticed an extensive display of turbines, which seem to have superseded water wheels and other water motors. There were also some ingenious contrivances for applying small amounts of hydraulic power. In the second class, leather belting occupied a prominent position, from the extensive use made of it in the States as a transmitter. The Belgian hair machine belting is also noticed. Wire rope also was extensively shown, and there were some driving chains working over cogged chain wheels, and constructed so as to be detachable for lengthening or shortening, which attracted notice. In the shafting, the shafts made by a process of cold rolling afforded the greatest novelty. These are first rolled hot, then treated with acid to remove scale and oxide, and finally subjected to cold rolling in cast steel rollers. In the elevator class, a curious safety device was noticed. The lifting chain is a strong flat-linked endless chain, arranged so that it can only move in the direction of its length. If the chain breaks, the lower part below the carriage, being unable to move laterally in its groove, becomes a rigid support to the carriage. Among the pumps were some Pulsometers and vacuum engines. The former are characterised as being cheap in construction and repair, but wasteful in steam from condensation. As the latter are intended to be worked by exhaust steam from other engines, all the work they do is so much utilisation of waste power. Other pumps, hydraulic rams, &c., are also noticed.

Looking at the exhibits of the whole group, Mr. Barlow was struck by the great fertility of invention displayed in America, and the excellent workmanship. American machinery seems somewhat lighter than English, and therefore less steady and free from vibration. "The aim at improvement takes two different directions; one being that of obtaining simplicity and cheapness of construction, putting the cost of working as of secondary importance. The other being the endeavour to obtain high perfection in the details and great economy of working, treating the cost of construction as of less importance. The one, in fact, being aimed at cases where engines and machinery are employed for temporary purposes, the other directed to those cases where continuous working is the object." The Machinery Hall, as a whole, gave "a high opinion of the mechanical skill of the Americans."

ANILINE DYES.

There has been at various times much discussion on what may be termed the sanitary aspect of the aniline dyes. Although it may be at first difficult to see in what way the colour of an article of costume can possibly affect health, yet the relation of the one to the other is not so remote as might be anticipated. Socks, stockings, and gloves are worn next the skin, and poisonous matters may thus be brought into the system; even the very wear and tear of ordinary articles of costume, in the event of the colour not being of a very firmly adherent nature, results in a portion of colouring matter being liberated in the form of a fine dust, and thus inhaled by the lungs. In France stringent measures have had to be adopted to prevent the artificial colouration of cheap wines with "fuchsine." Recent experiments have now beyond doubt established that aniline dyes, at least, the reds and blues, are in their pure condition comparatively inert, and that the ill effects which have been sometimes attributed to the use of these dyes are traceable, not to the pure colouring matters themselves, but to traces of arsenic which they contained, and which arose from inefficient purification subsequent to manufacture. Enterprising scientists may always be found who are willing to become martyrs, for science or for notoriety, and the present inquiry has had its self-sacrificing hero in the form of Herr Seidler, of Riga, who administered to himself three-quarters of a grain of aniline red every morning, for a period of five weeks, without any ill effects. When it is pointed out that a single grain of aniline red is said to be sufficient to impart a good pink colour to fifteen gallons of alcohol, it would be necessary to drink an enormous quantity of artificially-coloured wine in order to equal a single morning performance of Herr Seidler. So far the question is practically settled, the only remaining difficulty being our inability to ascertain whether pure or impure colouring material has been used in any purchased article; and it will therefore be better, as a simple matter of precaution, to be on our guard against the indiscriminate use of aniline dyes for colouring purposes.—*Medical Examiner.*

MODEL BYE-LAWS ISSUED BY THE LOCAL GOVERNMENT BOARD.

This work, for the use of sanitary authorities, has been often earnestly desired in the discussions on Health and Sewage in the Conferences of the Society, and has at last been performed officially by the Government. The bye-laws are issued in following separate parts:—

I.

For Cleansing of Footways and Pavements.
Removal of House Refuse.
Cleansing of Earth-closets, Privies, Ashpits, and Cesspools.

II.

Prevention of Nuisances arising from Snow, Filth, Dust, Ashes, and Rubbish.
Prevention of the Keeping of Animals on any premises so as to be injurious to health.

III.

Common Lodging-houses.

IV.

New Streets and Buildings.

V.

Markets.

VI.

Slaughter-houses.

VII.

Hackney Carriages.

VIII.

Public Bathing.

IX.

Public Baths and Washouses and open Bathing Places.
Duties of the Officers and Servants.

Every householder in the United Kingdom should possess a copy of these bye-laws—which it may be expected will be printed together in a volume. It is to be hoped that the householders of the metropolis will be furnished by the Home Secretary with a similar manual as soon as possible.

GENERAL NOTES.

The Liernur Sewage System.—According to reports recently received from Holland, the Commission of Advice to the Common Council of Amsterdam having recommended the extension of this system to an area equal in extent to one half the town, the population of which is 300,000, the council have, without a division, voted the first instalment of the extension. The length in mains will be about two miles, at the estimated cost to the municipality of about 90,000 florins.

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[*] Continued from p. 880.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,293. Vol. XXV.

FRIDAY, AUGUST 31, 1877.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

GROSVENOR HOUSE.

The Duke of Westminster is desirous that designers, artisans, and the like, employed in any branch of Art applied to productive industry, should have the opportunity of inspecting Grosvenor House, with its Works of Art, daily, including Sundays, during the month of September, from 2 p.m. to 6 p.m. He regrets that, for want of room, he cannot extend the admission beyond the persons specified.

A number of tickets of admission have been placed in the hands of the Secretary of the Society, for distribution among persons answering to the above description.

Such persons can obtain tickets on application at the Society's house, by bringing with them a paper containing their names, addresses, and occupations.

Each ticket admits a party of four.

There will be no admission on wet afternoons.

DOMESTIC ECONOMY CONGRESS.

The following papers were among those brought before the Congress at Birmingham :—

THE WORK OF THE LADIES' SANITARY ASSOCIATION.

By Miss Rose Adams.

It has been suggested that the history of the efforts of the Ladies' Sanitary Association to popularise sanitary knowledge, and to develop and encourage the study of domestic economy during the last twenty years, would prove of some interest to the present Congress. To condense, however, the experience of the last twenty years in any branch of work is no light task, and can, in the limited space allowed, be at best but a cursory glance. The leading features of work, the most successful means used, and the most salient results can alone be touched upon.

1. In 1857, a few earnest women, impressed with the sense of the wide-spread ignorance concerning the laws of health, and believing by far the greater part of the debility, disease, and premature mortality in this country resulted from preventible causes, determined to make an effort to mitigate these evils. Twenty years ago, associations and societies did not crop up so readily as they spring into existence now. A conference on domestic economy had not been thought of, nor would it have been possible to enlist the sympathy of men and women in a subject about which so few knew anything, practically or theoretically. The sphere of domestic economy existed then in "Magnall's Questions," "Pinnock's Catechism," the "Guide to Knowledge," and among a limited number of practical housewives.

2. Health was a subject not recognised in schools; the study of the laws relating to this science is even now conspicuous by its absence in many, and was very little regarded by the general public. Since 1832, we may be sure that the nation has thought more of washing and setting its house in order than it had ever done before. The first extension of public interest on the subject of health must of course be attributed to the labours and writings of scientific men, medical and non-medical. The great discoveries of the last century as to the constitution of air and water afforded a standard of purity for those two prime elements in human health and disease hitherto unattainable. Little by little, as the writings of the scientific class filtered into public and private libraries, the attention of thoughtful men and women became more and more drawn towards inevitable deductions. There were many men who were in the advanced rank of sanitarians who realised the help that women might be able to render in popularising and extending sanitary knowledge, and these stretched out a friendly hand when the scheme of the Ladies' Sanitary Association was proposed. But it was very uphill work before the little books now exhibited at this Congress became the household words with many that they are at present. One smiles now, but only a few years ago it was the prevailing belief that it was flying in the face of Providence to assert that suffering might, could, and should be prevented. The little tracts appeared. "The Worth of Fresh Air," "The Use of Pure Water," "The Value of Good Food," "How to Nurse the Sick," "The Health of Mothers," "How to Clothe and Manage a Baby," "The Power of Soap and Water," &c., had to be given away freely at first, in order to obtain a hearing for any of the subjects enlarged upon in these little pamphlets.

3. With an average yearly receipt of £350, the association has, since 1857, published 70 tracts, the titles of which tell their own tale; and these have served the purpose of that much-quoted "thin end of the wedge," so needful to be inserted when any new idea has to be presented, or evil to be attacked. It has been, of course, interesting and cheering to the women who have striven to distribute them widely, to hear what good little pioneers they have proved in neighbourhoods where health regulations were utterly neglected, and where learned works would neither have been welcomed nor comprehended. Edited by scientific men, but written in simple, homely language, so "that those who run may read," the publications of the association have had a circulation of nearly two millions. Many have been translated into several languages. Through their distribution efforts have been made to form sanitary associations in other countries.

They are welcomed at hospitals, working men's clubs, lending libraries, mothers' meetings, and schools. Clergy of all denominations, Scripture-readers, City missionaries, Sisters of Mercy, Bible-women, sanitary missionaries, distribute them gladly, especially the Colporteurs' Society.

4. These unpretentious little books, too, have in their time influenced public opinion, and flagrant breaches of health laws have been rectified, and some fashionable vices have retired before them. For example, the paper on "Overwork" served to prepare the way for the beneficial action of the "Early Closing Association." "The Dance of Death" was very successful in calling attention to the use of arsenic in the preparation of ball dresses, flowers, and wall papers. "Dress and its Cost," pleaded somewhat successfully for the overtasked seamstresses, working very long hours in ill-ventilated rooms, and the present effort on behalf of shop-women, who suffer so much by the prolonged hours of standing behind counters, is procuring relief steadily, although so slowly.

5. The delivery of practical lectures on health, sanitary improvements, and domestic economy, formed a principal feature in the crusade against dirt, disease and unthrift undertaken by the association. More than 70 courses of lectures have been delivered, having for subjects, physiology, public health, gymnastics, chemistry, cooking, nursing. The first lectures to ladies on physiology and anatomy applied to health and education were given by Professor Marshall, at the request of the committee. Since then lessons have been arranged in all parts of London and delivered in all kinds of places. "Lessons on Health" have now become a recognised institution, although at first they excited prejudice and suspicion. In the Home and Colonial and British and Foreign Schools, Ling's system of educational gymnastics was most successfully introduced, and Dr. Roth's efforts to promote physical education are well known. Drawing-room meetings, then as now, formed a convenient and attractive means of spreading a knowledge of those grand laws which claim from every philanthropist intelligent practical consideration.

6. The formation of branch associations in the provinces early engaged the attention of the committee. These have worked well according to their means and opportunities, and have achieved good results in many parts of the country. Day nurseries have been opened, houses cleaned, cleansing materials lent, clothing clubs formed, and out of one branch arose a company for building suitable dwellings for the poor. After the lapse of years, in most cases, these branch associations have subsided into humbler organisations, owing to their work having been recognised as important, and having been taken up by Town Councils, Boards of Health, parochial authorities, &c., as the area of sanitary operations grew larger. A refining influence by the culture and care of flowers has been widely spread, through the efforts made by the association in promoting window-gardening, flower shows, &c.

7. The establishment of the Destitute Children's Dinner Society arose from the endeavour of the committee to provide dinners for the little street children in Chelsea.

8. The sufferings of the poor children living in the close, crowded alleys and courts of London were a cause of distress to the association. Hence, park parties were arranged, that is, guides were paid to take out, in parties of fifties, some of the poorest children in London from the ragged schools, mews, &c. Music, toys, teas, dinners, even clothes where the need was great, were provided, and in this way 298,629 little ones have been sent out into the public parks for fresh air and recreation during the last 17 summers. The association, from careful observation, is enabled to state that these "park parties" have been productive of beneficial results. There is scope for the influence of those ladies who have time and inclination to spread a knowledge of Kindergarten games, in the supervision and direction of children in their playtime.

9. With the view of assisting in the formation of habits of personal and household cleanliness, from the branches of the Association have been lent baths, washing-tubs, pails, brooms and brushes, disinfectants, cooking utensils, and nursing appliances, while at the office of the Association were kept, for many years, patterns of garments of all descriptions, made and unmade. These were given or lent, and the various text-books on domestic economy, as they appeared, were adopted, lent through the library, and kept for sale and distribution. Also, when models and diagrams were not so commonly to be seen as they are now, the Association kept, for purposes of illustration and instruction, models of filters, drain-traps, ventilators, invalid cooking and nursing appliances, &c. All these things were needed to make sanitary necessities and improvements known, for it is only within the last six years that sanitary exhibitions have been arranged.

10. It has been part of the work of the Association to appeal to public bodies for the amelioration of the suffering, the redress of grievances, the removal of abuses, and for the promotion of general education in relation to public and private hygiène. Continuous efforts have been made to obtain the recognition of the necessity for instruction in domestic economy being faithfully and thoroughly imparted to all classes of children. It has been possible to exercise influence through many of the members of the Association, a number of whom have materially assisted in the advancement and enlightenment of public opinion on this point. In many quarters, the Association has been successful in introducing into schools valuable text-books and manuals treating of domestic economy. Messrs. Jarrold, of London and Norwich, who have aided the Association in various ways, have only recently published one of the most readable, attractive, and voluminous volumes on this important branch of a woman's education, entitled "Our Home Work."

11. Feeling convinced that, unless the good seed be sown in childhood it is often never sown at all, the committtee have attempted in the last little tract, "Our Schools and Public Health," to draw the attention of all engaged in training the young to the vital importance of teaching physiology and the laws of health, *i.e.*, how to live.

12. By the gift of prizes for window gardening, cooking, needlework, swimming, gymnastics, &c., it has been the privilege of the Association to assist

useful movements from time to time, and to form a bond of union between many, working in various ways, in different countries, under widely different circumstances, yet all linked together by the one common hope and intent with which this Congress meets, viz., by God's blessing to make possible, and to secure happier, purer, more intelligently-managed homes for England, and a healthier, more temperate, truer manhood and womanhood for her sons and daughters.

THE OBJECT AND WORK OF THE NATIONAL TRAINING SCHOOL FOR COOKERY.

By Mrs. Charles Clarke, the Lady Superintendent.

> The number of inhabitants who may be supported in any country, upon its internal produce, depends about as much upon the art of cookery as upon that of agriculture, but if cookery be of so much importance it certainly deserves to be studied with the greatest care. Cookery and agriculture are acts of civilised nations. Savages understand neither of them.—Count Rumford's Works, vol. 1.

1. The establishment of the National Training School for Cookery is due to her Majesty's Commissioners for the Exhibition of 1851. An international exhibition of the industries and products connected with food took place in 1874, and the Commissioners resolved that lectures illustrating cookery should be given in connexion therewith. These lectures were given by Mr. Buckmaster, with practical demonstrations by a staff of cooks, and attracted so much public attention, that in the following year a general committee was formed, and subscriptions raised for starting a National Training School for Cookery. The Commissioners agreed to grant the use of a building rent free, the Duke of Westminster consented to act as president, and the Hon. F. Leveson Gower, M.P., accepted the duties of Chairman of the Executive Committee of Management.

2. The principal object in founding the school was the training of teachers, who should impart instruction, as far as it was possible in public elementary schools, as a branch of national education. It was hoped that such teachers would be those who are trained in the numerous training colleges for female students, established throughout the United Kingdom. Up to this time, Whitelands Training College is the only one which has sent teachers to be trained, in view of teaching cookery in elementary schools. The Rev. Newton Price, of Watford, has also sent pupil teachers from his school, to be trained in artisan cookery only, and they may in time become teachers in elementary schools. The School Board of London now employs two teachers holding diplomas of cookery from the National Training School. The Worshipful Company of Cooks have selected 12 girls from the ward schools of the City of London, and sent them to South Kensington to pass through a course of instruction in practical artisan cookery, lasting over eight weeks.

3. Bristol, Dundee, Edinburgh, Glasgow, Liverpool, Milford, Derby, Newcastle-on-Tyne, Sheffield, Stockton, Stonehouse, Wolverhampton, Winchester, Darlington, and other towns have sent ladies to be trained as teachers of cookery, and schools of cookery are established in those towns, the instruction being given by teachers holding diplomas obtained from South Kensington. Classes of cookery have been taught by teachers sent from the National Training School, for periods varying from four weeks to six months, in Oxford, Leamington, Birmingham, Shrewsbury, Cheltenham, Plymouth, Leeds, Newcastle, Leek, Macclesfield, Nottingham, Sevenoaks, and several other places. Many ladies have gone through the school by paying their own fees, or on the votes of the subscribers, and having obtained diplomas, have been in some cases taken on as staff teachers, and are employed in teaching, sometimes in the school itself, and sometimes in towns requiring classes for limited periods, also in teaching cookery in parish schools in London and the suburbs, while others have obtained engagements in some of the provincial towns, or have held classes in various localities on their own responsibility at remunerative fees. The Society of Arts has given ten free scholarships for ladies wishing to be trained as teachers at the National Training School for Cookery; these were competed for in the spring of last year, and also of this year.

4. Cookery is a new subject of public instruction, and as such can only be developed gradually. This school had to be organised from the very beginning; the building arrangements, the description of utensils needful, the preparation of recipes, the modes of demonstration, the system of practice, had to be worked out, and there then remained the special course of instruction for teachers in training to be considered, the art of training, the time necessary for it, the utmost economy of cost in doing it, and the extent to which it should be carried. It has required both care and patience to do what has been done up to this time. The National Training School has cost in money a capital of nearly £1,000, which has been almost wholly subscribed by residents in the metropolis, and much valuable volunteer work has been given by friends of the school. This sum is exclusive of any rental for the building.

5. Since the Training School arrived at a sufficient state of organisation to receive teachers for training, *i.e.*, in October, 1875, there have been 64 who have taken diplomas; 36 have taken a first-class diploma, 26 a second-class diploma, and two only a third-class diploma. By degrees the standard is likely to be raised.

6. The original object of the school has been kept steadily in view, namely, the training of teachers; it has, however, of necessity deviated from this object to raise the needful funds, by teaching those who do not engage to become teachers, but rather wish to learn what good and economical cookery is for their own home use. No mere training school of any kind can be made wholly self-supporting, and this School of Cookery, like training schools for other subjects, must have some sort of endowment to fall back upon, if it is to devote its full attention to its first function of training teachers only. It is greatly to be hoped that, sooner or later, the Education Department will recognise it, and encourage the training colleges to send their students to go through the classes of the School for Cookery, and earn its diploma for competency.

7. The time may come when there will be such an extensive demand for teachers—when the cost of training them will be sufficiently paid for—as to justify the establishment of more than one Training School for Cookery. A proper training

school, even with the experience gained from the National Training School, cannot be quickly formed.

8. An application has been made from an important local school, proposing that the National Training School should give diplomas upon instruction received in local schools, to be tested by paper examinations only, and without affording to the examiners of the National Training School any evidence of the personal ability of the cook, either as a cook or a teacher. The National Training School desires heartily to co-operate with all local efforts, but the form in which this proposal was made did not commend itself to the judgment of the Executive Committee. What it may be possible and advisable to do in the direction suggested would seem to be a good subject for discussion at this Conference, more especially as the course of training for teachers at South Kensington will, in all probability be greatly extended and improved, on the re-opening of the National Training School in October.

9. The Executive Committee of the school have pointed out in their last report the inconsiderate action of a few towns, which have tried to induce some of the staff teachers of the school to leave it, and accept short engagements at high fees, thinking by that means to secure the services of the individual teacher whom they fancy. Fortunately in no case has this attempt succeeded, and eventually this mistake will cure itself, but in the meantime the attempt to introduce a good national system is discredited by it. It is much to be desired that towns requiring teachers, either for short or permanent engagements, should apply to the National Training School direct, for information as to the capabilities of the teachers for the post to be filled; the diploma can only show the ability in cooking and the capacity for imparting knowledge; no insight into individual character and general suitability can be obtained from a cookery diploma. In several instances previous application to the Training School, for information as to the general suitability and terms to be made, would have prevented disappointment and failure to local committees, and unjust fault-finding with the National Training School.

THE ART OF PREPARING FOOD; ITS PLACE IN GENERAL EDUCATION.

By Miss Guthrie Wright,

Hon. Sec. of the Edinburgh School of Cookery.

Few movements have met with such rapid and general approbation, and comparative success, as that initiated some years ago by Sir Henry Cole, of the South Kensington Museum, for the systematic teaching of cookery. Public classes, emanating from several centres, have been conducted in a large number of places. Edinburgh was early in the field, and its school, although only commenced in 1875, has already supplied, with great success, classes to thirty-seven towns and villages, in one of which (Newcastle) the numbers attending the artisan class averaged about 900, and elsewhere 500, 600, and 700.

It may be worth remarking that many of the warmest supporters of the higher education of women are among the most forward to promote these classes, inasmuch as few women are not called on, at some period of their lives, to discharge duties for the proper performance of which such knowledge is essential.

The experience of schools of cookery, so far as the public classes are concerned, is that the attendance diminishes as the novelty wears off. Advantage should, therefore, be taken of the present novelty and popularity of the subject to introduce some scheme by which this branch of education may be made permanent in the ordinary school curriculum. This object can, in my opinion, be best attained by a united endeavour to make the teaching of cookery and domestic management an essential component part of the education of girls of all classes. It should be taught in every girls' school as a part of the ordinary curriculum, and by a specially qualified teacher. If we are to succeed in making this branch of education universal, I consider it essential that it should be taught in the school in which the other ordinary branches are conducted.

The regulations lately made by the Education Department of the Privy Council relative to the teaching of the subject of "Food and its preparation," will ensure its introduction into Board schools, and it is earnestly to be hoped that other elementary schools for the working-classes will be induced to follow so good an example. As a special paper and a discussion are allotted to the subject of the teaching of cookery in these elementary schools—which is at once the most difficult and the most important part of our work, I shall not attempt to discuss it here, but would invite attention to the importance of teaching cookery and domestic management in ladies' schools.

If it is the duty of man, usually the bread-winner to devote time and energy to the learning of his trade or profession, surely it is equally the duty of woman, the bread-dispenser, to bestow time and energy in learning her part of this natural division of labour. It is much to be regretted that women are not generally taught the principles of political economy, in several departments of which they are actually, though often ignorantly, important agents. It can hardly be estimated what the saving to the nation would be in money, in food, in health, and even in life, if a thorough and systematic knowledge of the utilisation of food material were disseminated among women of all classes, rich as well as poor.

Something like the following may be suggested as a method of giving the kind of instruction that I advocate.

A thoroughly qualified teacher should be engaged to give a regular course of lessons or lectures on the preparation of food with practical demonstrations. These lessons should include, not only the actual preparation of certain dishes, but instruction in the principles of cookery, the proper methods of cleaning cooking utensils, the uses, qualities, combinations, and seasons of the various kinds of food. The dishes, with diagrams and experiments, should practically be texts and illustrations of the principles of physiology, natural history, and elementary chemistry. The pupils should be required to take notes and to undergo examination in this as in their other studies. The lessons might be given either in the kitchen, with the ordinary range, or in a class-room with a temporary gas-stove introduced for the purpose. The latter plan has been successfully adopted in three large schools in Edinburgh.

In addition to these lessons, the girls should in rotation learn the practical management of a house, under the lady superintendent of the boarding school, or, if they attend day schools, under their mothers at home. By alloting a limited time each morning, they would gradually become acquainted with the average necessities of the household in all its details. It is to be regretted that mothers, well qualified to instruct, show often so little patience in training their daughters, preferring to do rapidly themselves what is required, rather than waste time (as they erroneously term it) by having it more slowly done by those whom it is their duty, and ought to be their pleasure, to instruct. If, in addition, the pupils had a course of practice lessons in which they themselves prepared the dishes, conducted either in the ordinary school or in the public school of cookery, they would begin life with a very fair knowledge of domestic matters.

It is to the force of public opinion that we must look to bring about so valuable an addition to the education of girls of all classes; and, if this Congress stamps the proposal with approval, and the public press follows it up, an important step will be gained.

While thus instruction in the preparation of food should constitute an essential part of the education of every girl, opportunities should be afforded by the schools of cookery for special instruction for men. On two occasions, teachers have already been called upon to give lessons on camp cookery to soldiers; and, in one village in Scotland, the evening class of artisan cookery was chiefly composed of ploughmen from neighbouring bothies. This shows that the demand for such teaching has already begun. It is a question whether it would not be advisable to encourage the attendance of elder boys at cookery classes in elementary schools. But, without doubt, our schools of cookery should be prepared to give lessons in the preparation of food to soldiers, sailors, and intending colonists, with the apparatus and food material likely to be respectively at their disposal. To this I would add that, in university towns, provision should be made for teaching sick-room cookery to medical students. Further, it is important that teachers of cookery should be able to furnish information regarding the dietary and cooking apparatus suitable for hospitals and other public institutions.

If the foregoing remarks are accepted as indicating the probable future sphere of work of cookery schools, it is evident that only highly-qualified women are suited to undertake the work of teaching cookery. A very small proportion of those who have hitherto presented themselves for training are fitted for the profession they have undertaken; and it is only by offering liberal salaries, and giving a good position to teachers of cookery, that we can expect to induce the right class of women to come forward.

Then, the training of teachers must be made much more thorough than at present. Some of those who have already been trained have, by additional study, additional practice in cookery, and experience in teaching, become excellent teachers, but this is by no means the rule. Much longer practice, both in cookery and in teaching, should be given during training, and special arrangements should be made for training teachers in elocution, physiology, the natural history of foods, and in elementary chemistry. It is difficult to see how training schools, unless well endowed, can provide first-rate instruction in these subjects; but perhaps we might fairly expect from the Science and Art Department practical assistance in this matter, and also in the compilation and selection of the text-books necessary for our schools. It is satisfactory to find that several schools have already made arrangements to give improved training.

To meet, as far as possible, the difficulty of obtaining properly qualified teachers to conduct Board school classes in country districts, the Edinburgh School of Cookery intends, in autumn, to invite the co-operation of the other central and branch schools in Scotland, in applying to the Education Department for a slight alteration in the next Scotch Code, viz., that, instead of the teaching of cookery in Board schools being limited, as at present, to two hours a week, it should be permissible, where there is no resident teacher of cookery, to give three or four hours, that is, two lessons a week. This would enable central schools to send a teacher to conduct Board classes at a moderate charge in two neighbouring towns or villages during the same period, and her spare time might be occupied either with classes in other schools or with public teaching, according to circumstances. In this way, the central schools would be enabled to provide for the wants of a very large part of the country.

Although much initiatory work has already been accomplished by schools of cookery, I believe that their most permanent work is only now beginning, and that in this, as in all other branches of education, it is to teaching the young that our efforts must chiefly be directed.

ON THE PRACTICAL TEACHING OF DOMESTIC ECONOMY IN ELEMENTARY SCHOOLS.

By Mrs. Fenwick,
Hon. Secretary of the Leeds School of Cookery.

It has of late years come to be generally acknowledged that, in providing for the public education of girls in our elementary schools, it is very desirable that some scheme should be adopted, whereby a certain amount of training would be secured to them, in those domestic arts and duties upon which the comfort of home life so much depends.

The ignorance of women of the working class in matters relating to household management is constantly being forced upon our attention, and it is not too much to say that a great deal of the vice and wretchedness, of which our police reports furnish daily instances, owes its origin to this cause.

It must, therefore, be a matter of rejoicing to all interested in the social condition of the people, to find that public attention has at length been drawn to this important question; but, while all are agreed as to the wisdom of adding domestic economy to the list of subjects for instruction to girls, the difficulties attending the development of this kind of teaching present a formidable obstacle to its adoption.

Having for a length of time been connected with the organisation of classes in Leeds, where large numbers of children from the Board schools have been under instruction, it has devolved upon me, and the ladies with whom I am associated, to consider how these difficulties may be overcome, and such a training rendered efficient and of practical value to the class for whose benefit it is intended.

I do not wish it to be supposed that the plan we have adopted is by any means faultless. It is, of course, to a great extent experimental, as all work in this direction must be for some time to come. Until a few years ago, such teaching was, as we are all aware, unknown in England, and everywhere new ground had to be broken, difficulties overcome, and experience gained, by the pioneers in the work, of which their successors will reap the benefit.

I think we owe a debt of gratitude to the spirited management at South Kensington, who, while they were themselves fighting with the difficulties of a new position, yet found time and inclination to assist, with their advice and suggestions, schools which, like our own, were then struggling into existence.

I have a lively recollection of the kind way in which I was received some five years ago by Sir Henry Cole, when I went, at the request of my own committee, to get some insight into the system adopted at the National Training School. Lady Baker was then at the head of things gastronomic, surrounded by a halo of noble cooks, and the information she was good enough to afford me proved afterwards of much value. Since that time a great deal of good work has been done, and schools of cookery have sprung up in various parts of the country. Nothing, however, has been carried out on a general plan, and the need for a recognised and uniform system of teaching is strongly felt.

As one of the objects of the promoters of this Congress is to hear the opinions of others on this special subject, and to discuss the merits or demerits of the various schemes which may be proposed, I venture to hope that a brief account of the training classes at present being organised for teachers at the Leeds school, and the plan we adopt in the conduct of lessons to children, may not be without interest.

On the principle that what is worth doing at all is worth doing well, I venture the proposition that no system of teaching cookery can be entirely satisfactory, unless the lessons are of a thoroughly practical kind, and I am further of opinion that lessons in the other subjects mentioned in the 4th Schedule in the two first stages of domestic economy should be taught, as far as possible, by means of simple experiments and the use of objects or models.

I am aware that such a system would in no way lessen the difficulties already experienced in giving lessons to large numbers of children, and the expense is also rather greater than when demonstration lessons are chiefly relied upon; but if it be conceded that this kind of instruction to our girls has become a necessity, and that the knowledge thus to be obtained is quite as important to the wife of the working man as any other part of her education, I think those who have the welfare of the people at heart will agree in feeling that if this training be undertaken at all, it should be thoroughly done, without reference to either the cost or the difficulties to be overcome in first arrangements.

After carefully noticing the results of different systems of teaching in our own and other schools, I cannot but feel that lessons by demonstration are of very little value as a means of instructing young girls. We all know how difficult it is for even a clever teacher to keep up the attention of children for any length of time, and it is not to be supposed that lessons in domestic economy of one hour and a half's duration can be rendered more attractive to the infant mind than other subjects, or that thirty or forty girls placed together on a platform could sit still during that time without feeling restless and wearied. An intelligent instructress, anxious to do her duty, will doubtless be able to relieve the monotony of the lesson, in a great measure, by the comments she makes, and the questions she may require answered; it is also possible to allow two or more of the girls to assist the teachers as kitchen maids, while their companions on the platform criticise their proceedings, and correct any mistakes that may be made; but the effort required on the part of the instructress to sustain the attention of her pupils is a tax upon her ingenuity and strength which can never be long continued.

Another reason why demonstration lessons can never be entirely satisfactory is, because their success depends entirely upon the ability and physical powers of the teacher. I have myself been present on occasions when the lessons proved utter failures, from the lack of sufficient energy in the instructress to maintain order and attention among her pupils.

In the case of practical lessons (which are frequently preceded by a demonstration), there is a constant change and variety in the work; the children, to the number of 16 or 20, stand round their teacher, and first hear her explanation of what is going to be done, she then apportions to each the quantities of material required for the dish to be made, while she herself makes up another portion in their presence. When this part of the lesson is over, the cleaning begins, followed by instruction in any other domestic matters which may be down for the work of the day. Thus a constant change is kept up, the time passes quickly and pleasantly, and the lesson closes to the regret of the pupils. Written "reproductions" of the work done are required each week and are sent in to the teacher for correction.

It is doubtless understood by all who have studied the new Code, with the idea of obtaining the Government grant, that the sum of four shillings per head, offered since the 31st of last March, for instruction in cookery to girls, is not to be obtained unless this subject be taught in conjunction with others included under the head of domestic economy; thus, for example, in the first year the instruction is to include "Food and its Preparation, Clothing and Materials."

It is evident that teachers, competent to give practical instruction in these subjects, must be specially trained for the work, and, as the demand for their services is likely, for a length of time, to be far greater than the supply, the committee which I have the honour to represent has decided to open classes for the training of teachers in cookery, and other branches of domestic economy, as soon as the necessary arrangements can be made. By this means, it is hoped that a thoroughly intelligent and efficient class of teachers will be formed, capable of undertaking the whole instruction included under the head of "Domestic Economy," in the fourth schedule of "Specific Subjects," to be found in the new Code of Regulations for 1877.

In the first stage, or year, of this instruction the teaching is limited, as I have already said, to the consideration of "Food and its Preparation. Clothing and Materials."

In order to give our teachers a clear and comprehensive view of the whole subject, it is intended to form a small, but complete and classified, food collection, which will illustrate all the chief types of food, and their components, required for the maintenance and nourishment of the human body in a state of health and vigour. By reference to the printed prospectus of this training, it will be seen that courses of lectures are to be delivered to the students on elementary physiology, the chemistry of food, and domestic economy.

It may perhaps excite some surprise that the first-named of these subjects, "Physiology," should be insisted upon; but when it is remembered how entirely the health and strength of the human frame are dependent upon the foods which sustain it, and how greatly the amount of nourishment to be derived from food depends upon its intelligent preparation, I think it will be understood that a knowledge of the structure of the body, and of the materials required to build up and repair the daily waste which is going on within it, is of essential importance in the intelligent teaching of cookery.

The scientific instruction supplied by these lectures will be supplemented by courses of practical lessons in several grades of cookery, given by the trained instructresses on the staff of the Leeds school.

For the purpose of making the instruction required under the head of "Clothing and Materials" as complete as possible, sets of samples of the different kinds and qualities of linens, cottons, woollens, unions, and other fabrics will be provided; the peculiarities of the various makes described; the adulterations used in their manufacture, and the means by which these may be detected, explained.

Information will also be given on the subject of clothing, relating to the choice of suitable materials for summer and winter wear, the necessity of providing against the changes of temperature experienced in our variable climate, and other things bearing upon the same subjects.

The next stage of domestic economy for which we have to provide, in the training of teachers, refers entirely to "The Dwelling, warming, cleaning, and ventilation, washing materials, and their use."

It will at once be seen that very little practical instruction is possible in this stage, excepting that which will be given in cleaning and respecting washing materials. Cleaning, as every one knows, is one of the first things in which girls are instructed in all schools of cookery which deserve the name.

As regards washing materials and their use, soaps and washing-powders, blues, starches, &c., of various kinds and qualities, will be provided, and their effects upon clothing demonstrated by practical experiments. The chemical action of the salts and other ingredients used in their composition will be explained and commented upon, and advice given as to their judicious use.

The different modes of warming and ventilating a dwelling must, in a measure, be explained theoretically, though, whenever possible, simple experiments will be used to illustrate the meaning of the lecturer, and add force to his remarks.

In the third and last stage of this subject, that relating to health, the management of a sick room, cottage income, expenditure, and savings, the lessons must necessarily be theoretic; and I dare say, if the truth were known, those of us who are occupied in considering how these things may best be explained, are not a little relieved by the thought that years have yet to elapse before we need trouble ourselves much about it. Before that time, no doubt, some ingenious person will have appeared on the stage for our benefit with a nice little book, containing all we want to know.

I have now explained, as briefly as I can, what we believe to be necessary, in the way of training, to form an intelligent class of teachers for this new field of work.

The next point to consider is, where they are to come from.

The class of domestic servants is certainly not the one from which we can hope to recruit our staff of teachers.

In the first place, the amount of study required in order to pass the examinations presents a serious obstacle in the way of an uneducated person; but a far more weighty objection against the employment of such persons, is to be found in the lack of that educational culture and refinement which exercise so salutary an influence in the intercourse between pupils and their teachers, and for the absence of which nothing can compensate. In the case of classes where ladies only are the pupils, and cooking the only thing to be taught, I grant that "cooks," properly so called, do exceedingly well, and, perhaps, even better than a higher class of instructress; but when the children of the working people are to be taught, by all means employ the educated teachers. For the same reason we find ladies chosen for the work of district nursing among the poor, for the refining influence which they bring to bear in those houses, to the comfort of which they minister. There exists, however, a body of educated women in our midst, working early and late for small salaries, for whom I think this new field of labour ought to possess attractions. I refer to the largely overstocked class of uncertificated governesses, who have now so hard a struggle for existence. The position of these ladies at the present day is one deserving our true sympathy. For the most part they were educated at a time, and that not very distant, when a thin coating of knowledge, obtained generally at some respectable ladies' "seminary," was considered sufficient for any woman of ordinary aspirations. Happily, that relic of the "good old times" has passed away never to return, but with the advent of a higher and more enlightened system of education for women, to which the establishment of Mrs. Grey's public day schools gave the first impetus. The work which provided a modest income for our reduced gentlewoman is well nigh gone, and ladies not possessing a diploma or certificate as teachers find it difficult to obtain work of any kind. It is not, therefore, unreasonable to suppose that the new field of work opening out in the direction of cookery, and other branches of domestic economy, will be taken up by many of these ladies to whom it offers a legitimate and suitable means of livelihood.

THE NORTHERN UNION OF TRAINING SCHOOLS OF COOKERY.

With Remarks on Combining Practice with Theory in Cookery Lessons for Elementary Schools.

By Mrs. Rowland Williams
(President of the "Northern Union.")

The advantage of uniting practice with theory in cookery lessons for schools is sufficiently great, to make the best method of overcoming the difficulties in the way of doing so, a subject worthy the consideration of those who are interested in the improvement of the homes of the working classes.

Practical experience of teaching cookery to the poor goes to show that reformation, to be radical, must begin with the young, rather than with those whose stereotyped habits make them, as a rule, unwilling to accept new ideas; and though there have been many honourable exceptions to this, and artisan cookery demonstrations for adults have in some places been eminently successful, and most useful in awakening an interest in the matter, we do not think them altogether satisfactory in their results. The attendance is too irregular, and the interest not sufficiently lasting; some excusing themselves by saying they know well enough to cook all that they can afford to buy, and others resenting any suggestions savouring of economy and taking trouble.

It is, therefore, to the schools, whether board, voluntary, industrial, or others, that we look for the carrying out of a more systematic and thorough course of training in the principles and practice of good household cookery, which shall fit the women of Great Britain to become more practical housewives and better domestic servants. And in the recognition by Government of cookery as a branch of education in the public elementary schools, we see a favourable omen of a better state of things in the future.

The subject requires to be carefully and thoughtfully dealt with. Some of the committees of the schools belonging to the "Northern Union of Training Schools of Cookery" have given much consideration to it, and it is certainly one which falls within the scope of the work proposed by the union.

I will give a brief account of the origin of the "Northern Union of Cookery Schools," before venturing to make a few suggestions as to the combining of practice and theory.

As the demand for teachers of cookery increased, and schools of cookery began to multiply, it was found to be desirable that there should be some uniformity of method in the training adopted in the different schools, with a recognised standard according to which certificates and diplomas might be conferred, for only in this way could efficient teaching in the various schools of cookery be secured.

With a view to this end, as well as to that of helping to supply the great demand which had suddenly arisen for properly qualified teachers, the Union of Schools of Cookery was formed. Liverpool took the initiative, and was joined by the Yorkshire schools and those of Edinburgh and Glasgow.* Delegates from the committees of these schools met in Liverpool last autumn to organise the scheme which came into operation in January, and according to which a systematic course of instruction is adopted alike in all the schools joining the union. Certificates and diplomas are given according to a uniform standard. The business of the union is carried on by a committee formed of delegates from the committees of the different schools. The theoretical examinations are conducted by means of written papers, which are sent to a lady examiner, appointed by the committee, for adjudication; the practice examinations being conducted under the superintendence of the committee of each school. But while uniformity of method is adopted throughout the Northern Union schools with regard to the training, and to the giving of certificates and diplomas, each school is left free to meet as it sees best the special requirements of different localities, which are found to vary greatly.

That teachers trained in the Northern Union schools should be thoroughly efficient, and well grounded both in theory and practice, is the great aim of the united schools. Their teachers are expected to acquire a knowledge of such of the leading facts of physiology and chemistry as are most obviously connected with the science of cookery, in order that they may be able to impart the same to their pupils, in such a manner as will help to enforce the practice lessons; all learners, whether adults or children learning to do things much more efficiently when the "reason why" is well explained.

How well-fitted to enlarge a child's mind a cookery lesson may become, if the teacher can explain to her class why food is required, the digestive and circulating process by which it becomes assimilated to the body, the necessity that it should be of sufficient variety, so that all that is necessary to the support of life may be supplied, one article of food containing the nutriment in which another is deficient; if as she takes up each ingredient she can tell the children all about it, whence it comes if it be a natural product, or how made if an artificial one, and what its especial use in the preparation of which it forms a part; for example, if in using condiments and spices, she not only says, "here we add a pinch of salt," or, "here we put in a little spice," but prefaces this by an explanation of the use of condiments and spices, tells how they act as a tonic to the nervous system, stimulating healthfully the digestive organs, and acting as a preventitive to the cravings for alcohol, may not cookery lessons so taught prove as useful for enlarging the minds of the pupils as any that can be given, invaluable, in fact, in their bearing on practical life.

But, strongly as we advocate theoretical lessons, we would still more strongly insist on practical ones, and by this I mean lessons in which the children are taught to do the work themselves; and I lay special stress upon this, from having lately seen a table of lessons to be given in a Board school, which, under the head of "Domestic Economy," included a syllabus of what appeared to be a very complete course of lessons in cookery, to be given by the teachers; but, upon inquiring how the teachers were to be qualified for giving the lessons, I was told, that domestic economy, as to be taught under the new arrangements, would not include any lessons of a practical kind in cookery; but, I venture to ask, is it possible that children could learn adequately how to roast, boil and broil, to stew, fry and make hashes, to cook vegetables, dress fish, make pies, puddings, bread and cake, all of which, and much more, was included in the list, merely by theory? And while the knowledge to be gained from primers is most valuable, I do not think it possible to urge too strongly that the practice lesson should follow, and that, if practical and theoretical teaching cannot both be had, we had far better have the practical.

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* Manchester, Bolton, Leamington, and Cambridge, have now joined the Union of Training Schools, and Southport and Warrington have been affiliated to the Liverpool Training School.

But why may they not be combined? Let only the necessity be once acknowledged, and the way of accomplishing it will certainly be worked out, and:—

1. Might not Government insist that the lessons in the elementary schools should not only be theoretical and acquired from books, not only be lessons by demonstration merely, but practice-lessons; for unless this is enforced, the Government requirements may appear to be met by teaching the children from books only, a sort of teaching which, besides being unsatisfactory in itself, will be misleading to the public, who will suppose that, under the new regulations in domestic economy, the children are being thoroughly trained, whereas they may only be learning by rote a set of questions and answers, the after application of which by them to practical life may be very doubtful. It appears to me that theoretical lessons in cookery, if given by themselves, are quite inefficient; that lessons by demonstration (though exceedingly useful, and we hear from many quarters of most satisfactory results) are also inadequate, and chiefly to be used in breaking up new ground, and as introductory to the practice lessons; and that the latter, in which the pupils themselves do the work in the presence of the teacher, who explains as much of the theory as possible, are alone really satisfactory.

2. Practical and theoretical teaching being combined, a system of examination should be set on foot to test the results. Examiners with due knowledge of the subject should be appointed. It is work which seems especially suited to women who have themselves taken a certificate in one of the training schools of cookery, and who will know what the work in the practice class ought to be, with the head-knowledge which should accompany it.

The question then arises:—How is practical teaching to be provided for the schools? One of two plans might be adopted, either (*a*) the children might be taught by certificated teachers of artisan cookery from the training schools of cookery, at some centre appointed by the managers of the schools, as has already been done with regard to demonstration lessons, in London and other places; or else (*b*) the mistresses of the elementary schools might be required to hold a school of cookery diploma, showing competency for teaching artisan cookery in their own schools. But it seems a doubtful question whether school teachers have time to add practical cookery to the lessons on their time-table; and we should think it could only be possible if the pupil-teachers were also required to hold certificates of qualification to assist in the work.

What we especially deprecate in reference to the teaching of cookery in the schools is, that any one should be accepted as a teacher unless holding a teacher's certificate or diploma, and it should clearly be understood that the ordinary certificate does not qualify for teaching. A teacher requires a longer course of training than an ordinary pupil, and we earnestly desire the co-operation of School Boards and other managers of schools in this matter, and trust that, in the interests of the community, they will not employ half-trained teachers, which would be the means of bringing the matter into great disrepute. In Glasgow, a considerable number of Board school teachers have received training in the School of Cookery, and have been teaching through the winter, but without taking certificates, and the hon. sec. of the Glasgow school writes that the result of the Committee's experience is that the day teachers thus trained can never prove efficient teachers of cookery; they have neither time, money, nor, in many instances, inclination to thoroughly qualify themselves, and the instruction given in the Board schools, instead of being the best, is in every respect inferior to that given by the teachers of the School of Cookery.

And this testimony corroborates our own feeling that the work would be best accomplished by employing the trained teachers from the schools of cookery. Might not each large school have a class-room, fitted up with necessary appliances, which might serve as a centre for the schools in the immediate neighbourhood? Or might not the different schools in a neighbourhood be used as a centre alternately?

That a large number of children may receive practical instruction at a small charge, has already been proved in some of the schools of the Northern Union. At Leeds, 180 per week have for some time received practical cooking lessons at the rate of 6d. per head, and the honorary secretary, who has had much experience in the matter, states that the attention of children cannot be kept up during demonstration lessons, and that the difficulties in the way of lessons in practice are by no means insuperable.

In Liverpool, also, a class of 50 children, in one of the Board schools, has for the last six months been taught by the teachers from the Liverpool Training School. The lessons have combined practice with demonstration, six children being taken in turns to cook, in the presence of the rest of the class, the dishes they have previously seen the teacher prepare.

In the artisan kitchen in the Liverpool school, a practice class is held of girls from an industrial school, 18 attending at a time, and showing great interest in the lessons. They are divided into three sets, with a teacher to each set. One child in each division is told off to do the necessary cleaning, while the others cook, in rotation, meat, vegetables, and puddings. After each set has had three different lessons on each of these subjects, the lessons are changed to fish, bread, and pastry, and sick room cookery. A reward, under the title of a scholarship, is offered to the girl who does best of a course of lessons in household cookery in the higher school.

The chief difficulty, after all, in introducing lessons in cookery practice into the elementary schools appears to be the question of money; but the Government grant for domestic economy would help a little, and we should like to urge that this be divided, and 2s. be given as a distinct grant for passing in cookery, instead of, as at present, being joined to the grant for clothing. And, if a knowledge of cookery is henceforth to be considered as much a part of a girl's education as sewing has hitherto been, it would seem that the fees for properly trained teachers ought to be considered a part of the necessary expenses of the school, and arranged for accordingly; and we should recommend that the Boards should leave the teaching of cookery in the hands of the training schools of cookery, but if they object to this, another suggestion would be that they might have trained teachers (holding diplomas as teachers artisan of cookery) for themselves, who should go from one school to another, teaching cookery only.

But, in conclusion, we would urge that the machinery having been set on foot with considerable care, trouble, and expense in the training schools of cookery, we think the Council on Education, and the managers of schools generally, may very well avail themselves of the teachers trained, or of the training provided for teachers at South Kensington, and in the schools in connection with the Northern Union of Training Schools of Cookery.

Mrs. Clarke having referred to an application, made indeed more than a year ago to South Kensington, on the subject of their giving diplomas to schools throughout the country, I will explain a little more fully the nature of the application and its results.

A cookery school in one of our large towns could not but be much straitened in its work and influence if it had not the power of giving diplomas to its pupils if they wished to become teachers. No sooner had we established our school in Liverpool, than we became practically aware of this. But we thought combination desirable, and did not care for independent action. We saw the work had to be done, and we wished it done in the best way we could devise. We thought it would be better for the community at large if some scheme could be formed whereby all schools of cookery, as they arose, might have a common centre, from whence plans for the general working of all the schools might emanate, examinations be organised, and certificates and diplomas conferred. South Kensington appeared a ready-formed centre; and we, together with the Yorkshire schools, applied formally to the authorities, asking if they would adopt a plan something like that adopted by Oxford and Cambridge (in the higher branches of knowledge), of holding local examinations in the different towns, and giving certificates throughout the country; but they replied that the organisation of the National Training School of Cookery was not sufficiently organised to enable [the committee to give effect to the suggestion.

We were therefore compelled to form our own scheme; and accordingly we invited delegates from the Yorkshire, Edinburgh, and Glasgow schools to meet in Liverpool and consider the matter.

SEVERAL YEARS' EXPERIENCE IN SCHOOLS OF COOKERY.

By R. C. Browne Clayton, M.A., Oxford.

Having for many years devoted my attention to the social improvement of the lower classes—especially in habits of temperance—I gladly welcomed the movement now so general, which proposes to add the subject of cooking to the industry training of young women and girls; thus giving a useful and practical direction to their future lives. Whether in a higher or lower degree, this training will remain imprinted on their minds, when most of the literary branches of science will have escaped—I may say evaporated from their memories.

I had the advantage of attending Mr. Buckmaster's interesting lectures on cookery, which so exactly met the views I had entertained, that I opened on my estate in Ireland, I believe, the first school of the kind. It has been in operation, at intervals, for three years, and is, I may say, perfectly successful. A large kitchen, dining-hall, and dormitory for three girls (coming from a distance), have been erected, and about twelve pupils have been taken from neighbouring parishes, recommended by the clergy. These having been instructed in cooking, baking, and washing, have either taken places or giving the benefit of their instruction to their own homes. This work has been followed up during the winter by giving some provisions to them in turn, that they may cook at home what they have learnt at school.

In England the work is now developing rapidly. South Kensington being established as a Training School for Cookery, numerous schools are now in communication with it, employing as teachers those recommended as having taken a first-class diploma. I would strongly urge that in those schools where demonstrations and the higher branches of practical cookery are taught, those only from South Kensington should be employed. The advantage is, that if one teacher did not suit the committee, another would be supplied forthwith. Another class of schools, such as those in small towns or villages, would not require a teacher of the same attainments; and here I would suggest to the Committee of South Kensington that there should be two classes of teachers—one for the higher branches of cooking, and another with a second-class diploma, to be recommended for invalid and artisan cooking, adapted to elementary schools. The class of schools that I am most interested in are those in which the first principles of cooking are taught—the A B C of the art. In the teaching of girls from the age of 10 or 14, more will be done than by lectures to the artisans, who in few instances follow up the precepts they have had explained to them. I have found that giving small prizes to girls for cooking at home, has had a wonderful effect in inducing parents to second the teaching in the school.

There are two points on which I would lay much stress: first, a close calculation of the expenditure; and, second, a properly-arranged programme of each day's proceedings. In the former lies the true economy, and in the latter the proper working of the kitchen. The plan adopted in the Torquay school suited admirably, and is as follows:—The programme of work was fixed the previous day, by taking the South Kensington recipes to be worked on the next day, and making a list of the quantities laid down. That settled, an order was given to the tradesmen to send in the necessary provisions by nine o'clock next morning. These were placed in a part of the kitchen called the shop, to which each girl went for the materials she wanted—according to the recipe she had to work upon—giving a ticket, placed on a file, as payment, weighing and measuring all taken. At the close these tickets were always found to correspond with the delivery from the tradesmen. This simple plan has been of great use in many ways. I have not heard of its being adopted in any other school. I give in a sheet of the day's account, which more clearly explains my meaning.

On my estate at Adlington, in Lancashire, there is a school of 700 boys and girls, in which I have adopted a plan which has proved of great benefit: a kitchen being fitted in one of the class rooms, with a full supply of utensils, dinner is served daily to 80 children coming from a distance, who bring their own provisions with them; these are cooked or warmed up by two of the girls. This simple plan gives instruction in many ways, especially good behaviour at meals, and is highly appreciated by the parents. I should be glad if such a plan were adopted in all large schools, where children come from a distance, in winter time.

The school at Leamington has been in all respects thoroughly successful, and I would draw attention to it in having one feature peculiar to itself—a home for those girls who come from a distance. This, being carefully superintended by the ladies of the committee, is made most comfortable for them, and thus being resident on the premises they enter thoroughly into the work as in a family. They pay a small sum per week for their board and lodging, accommodation being found for eight. This is a most desirable branch of the school to establish where it is possible to do so. The practice lessons for ladies and cooks have been conducted with great success. Demonstration lessons have been well attended, and a registry office is established in connection with it. Great progress has been made in the instruction of school children, 67 scholars coming from the different schools, each paying one penny a lesson for learning practically to cook. A lady of the committee writes:—

"We thought the best way of testing their powers was to have a little exhibition of a cold lunch and tea in Whit-week. That the children might come and cook it all themselves, not a single thing was cooked by anyone else. As our room was a small one, we chose 26 girls—some from each school—their ages ranging from 9 to 14. A happier or more industrious set of little cooks I never before met together. The children laid the cloth, garnished the dishes, spread the luncheon of beef-steak pies, rolled veal braised, salmon, salad, mackerel in vinegar, custard pudding, corn flour blancmange, two rhubarb tarts, buns, gingerbread, neatly-cut sandwiches, bread and butter with cheese inside. We begged our visitors to taste as many things as they liked; all was pronounced excellent, especially the pastry. No butter or eggs were allowed, dripping only being used, as we wanted it to be a specimen of cottage cookery. The children afterwards sat down to tea; in number 67. Buns, gingerbread, scones, and bread being all made by the children the previous day; they were excellent, and did great credit to the instructress—Miss Elles—and was most gratifying to all, especially when but a few months ago I saw these same children totally ignorant of any kind of cookery. One of our little cooks, nine years old, had to stand on a footstool to reach the table to cook, but we generally wish to have older girls. We have had some nice girls in our kitchen from a private family in Wales."

This school is, I consider, a model of management in all respects.

The school at Leek has also been very successful in its management. Without any donation or guarantee fund, at the close of the first course, £40 was placed to its credit at the bank. All the rules and arrangements seem admirably adapted to the end in view, making the school self-supporting and efficient in every way.

In closing my remarks, I would add that the true road to improvement lies in teaching the rising generation of girls, who, when grown up, may impart the knowledge they have learnt in schools to their own homes. Artisans of riper years, though much interested in the demonstration lectures, have little time to follow up what they have had explained to them. Something, however, may be done by offering prizes, as in the Torquay school, based upon the South Kensington recipes. This work, however, mainly depends on the ladies of families giving their earnest attention to promoting schools of cookery, and by attending the practice classes themselves. They will thus be better able to manage their own households, secure home comforts and home happiness, and escape the troubles of a young married lady, humorously described by Tom Hood, on giving her first dinner party:—

"How shall I get through it,
I never can do it,
I am quite looking to it,
To sink by and bye;
I would I were dead now,
Or up in my bed now,
To cover my head now,
And have a good cry."

ELLACOMBE COOKING SCHOOL, 3RD MARCH, 1877.

Names.—Louisa Essery, Mary Jane Shepherd, Emily Huson, Ellen Westlake, Mary Mortimer, Maria Higgins, Elizabeth Bullied, Amelia Davy, Mary Lane, Elizabeth Barclay.

Provisions (*cost*).—Meat, 2½ lbs., 1s. 8d.; potatoes, 9½d.; carrots, 1d.; onions, 2 lbs., 1d.; herbs, 1d.; dripping, 15 oz., 7½d.; sugar, 1 lb., 2d.; raisins, 1 lb., 5d.; eggs, 3, 3½d.; treacle, ¼lb., 1½d,; suet, ¼lb., 2d.; split peas, 1 qrt., 3½d.; milk, 1 qrt., 4d.; flour, 5 lbs., 11d.; bones, 4d.; bacon, ½ lb., 4d.; baking powder, 3d.; cocoa, ½ oz., ½d.; carraway seeds; rice, 1d.; cooked meat, 2 lbs., 1s. 5d. Total, 8s. 6d.

Meals (*served*).—Pea soup, mutton pies, hash, potatoe cake, toad in the hole, stew drop cakes, buns, cocoa mould, rissoles, treacle pudding, rice pudding, bread pudding. Fourteen dinners.

Given away or sold.—Some of hash, liver and bacon, soup, two extra dishes of toad-in-the-hole, given away; five mutton pies sent into the cook shop, price 2d. each.

MISCELLANEOUS.

ADULT INSTRUCTION THROUGH PUBLIC MUSEUMS (*Subsidised by Parliament*).

The following results, giving important information bearing on public education, are obtained as correctly as possible, from inquiry and Parliamentary returns, in the hope that they may hereafter be officially collected and published periodically, like the Registrar-General's returns. The number of visitors for the month of June and July, 1877, are stated. When they are counted by sight the letter "S" is used, when by turnstile the "M":—

Institutions.	Amounts voted in 1876.	Number of Visitors in June.	Number of Visitors in July.	How counted.	Observations.
	£				
1. British Museum	108,947	50,757	58,594	S	Return refused. Open Mondays, Wednesdays, Fridays, and Saturdays. Closed, except to students, on Tuesdays and Thursdays. (1)
2. National Gallery, Charing-cross	6,898	112,365	88,602	S	Open Mondays, Tuesdays, Wednesdays, and Saturdays. Closed on Thursdays and Fridays. Open from 10 to 6. (2)
3. Kew Gardens and Museum	22,622	..	95,746	S	Open on Sundays and week days. (3)
4. South Kensington Museum	39,058	153,873	82,303	M	Open morning and evening till 10, on Mondays, Tuesdays, & Saturdays. Students' days—Wednesday, Thursday, & Friday, 6d. entrance. Open from 10 till Sunset.
5. Bethnal-green Museum	7,200	36,674	43,665	M	Ditto. (5)
6. National Portrait Gallery, South Kensington	2,000	..	..	M	Return refused. Open daily except Sundays. (6)
7. School of Mines and Mining Record Office, Geological Museum, Jermyn-street	8,947	2,387	3,298	M	Open daily, except Sundays and Fridays, and in the evenings till 10 of Monday, Tuesday, and Saturday. (7)
8. Patent Office Museum, South Kensington	..	..	16,700	M	Open daily, except Sundays. (8)
9. Edinburgh National Gallery	2,100	9,891	19.622	M	(9)
10. Edinburgh Museum of Antiquities	..	10,417	23,327	M	(10)
11. Edinburgh Museum of Science and Art	10,320	25,879	51,519	M	Open daily (10 a.m. to 4 p.m.) except Sundays, and Friday and Saturday evenings (6 to 9). Students' days—Monday, Tuesday, & Thursday; admission 6d.; other days, admission free. (11)
12. Edinburgh Botanic Gardens	1,750	15,020	14,851	M	(12)
13. Dublin Museum of Natural History	1,742	7,521	7,390	M	Open daily, & in the evening. (13)
14. Glasnevin Botanical Gardens and Museum	2,224	34,109	29,373	M	Open daily, including Sundays. (14)
15. National Gallery of Ireland	2,339	7,650	8,224	M	(15)
16. Museum of Royal Irish Academy, Dublin	300	..	..	M	(16)
17. Zoological Gardens, Dublin	500	11,942	13,581	M	Open daily, including Sundays. Number of visitors in July, 15,281. (17)
18. Tower of London	1,590	..	..	S	Open daily, except Sundays. (18)
19. Royal Naval College, including Greenwich Painted Hall	38,051	26,158	44,297	S	Open daily, including Sundays. (19)
20. Royal Naval Museum, Greenwich	1,055	6,746	7,970	S	Open daily, except Fridays and Saturdays. (20)
21. India Museum, South Kensington	..	..	2,727	M	Paid for by Indian Government. Open on Mondays, Tuesdays, Fridays, and Saturdays, 1d. admission; on Wednesday and Thursday, 6d. admission. (21)
22. Hampton Court Palace	7,475	..	53,755	..	Open on Sundays, and on week days except Fridays. (22)

(2) Open 17 days, 10 to 6 o'clock, in June. Seven months, 1,038,140. The numbers are the visitors on public days only.
(4) Number of visitors during May, 101,635. (5) Number of visitors for May, 63,381.
(9) (10) No information as to opening. (11) Total number of visitors during year 1876, 350,656. (12) (16) No information as to opening.
(22) As far back as 1855 returns of the number of visitors were made to Parliament and printed, but this practice, for the present at least, has been suspended. The statistics published by the Board of Trade every three years give returns.

TRADING CAPABILITIES OF THE COUNTRY TRAVERSED BY THE YUNNAN MISSION.

The Mission left Yunnan-fu on the 26th of March, and the same day arrived at the district city of Ganningchow, a broken-down, small town, having scarcely any house standing—a limited, ragged population. It is situated in a valley, and being formerly of importance on account of the salt wells in its vicinity, it was provided with a wall during the reign of the Ming Emperor Hungwu (1368-99). On the 28th the Mission reached the district city of Lu-fung, situated, as usual, in a valley. It first became of importance in the reign of the Emperor Kublai Khan, at the end of the thirteenth century, but it is now in ruins, having very few inhabitants. The country passed through was quite waste; the hills were covered with long grass, sprinkled with scent fir, with Chinese pines growing in favoured localities. There were no traces of either sheep or cattle on these hills, and no cultivation, except at the bottom of the valleys. A considerable quantity of salt was met with coming from Wu-ting-fu, bound for the provincial capital, together with, in smaller quantities, jossticks nyas grass, figs, potash, and rhubarb, brought from the Burmese frontiers by members of the Shan tribes.

On the 31st the Mission reached Kuang-t'ung-hsien, built in the reign of Emperor Hungwu, of the Ming dynasty, situated in a valley, and more populous than most of the places previously passed through. The valley was well filled with cottages, but a great proportion of the paddy land was not broken up. The country traversed was, as usual, mountainous. The northern sides were often well wooded with pines, &c., but there was little cultivation, although no deficiency of water. There was little traffic observed except Burmese cotton. On the 1st April the Mission reached Chu-hsiung-fu, a walled city built in the reign of the Ming Emperor, Hungwu, and a little more than two miles in circumference. The general aspect of the country passed through was beautiful and impressive, while the houses were of a better description, having tiled roofs, &c. A considerable part of the paddy land was still not broken up, but there were fine winter crops of white poppy, wheat, peas, beans, &c. This was the first place where the oak shrub was observed on the hills; though common enough in Northern China and Manchuria, is rare here, as well as any other shrub capable of affording food for game in the winter. This city formerly contained a comparatively large and wealthy population who lived in the salt trade, there being fine wells in the neighbourhood. Also silver mines were once worked here. On the 11th the Mission reached Ta-li-fu, after crossing a stream conveying the surplus waters of the Tali Lake, called Erh-hai, to the Lantsan or the Kong or Camboy River. By the side of this stream stands the lower pass of Ta-li. It is protected in front by the lake and river, which has worn a deep channel through the range. Like most Chinese cities, it is square, and is about four miles in circumference. It formerly possessed extensive suburbs, and before the rebellion the eight miles from Hsia Kuan were described as one uninterrupted street. The eastern or lower side of the city is almost wholly laid out in irrigated fields and gardens, having a fine winter crop of poppies, garden produce, &c. The western half, though somewhat ruinous, is tolerably well filled with a ragged population, and is, the officials said, the seat of the plague, as a preservative against which the inhabitants partake freely of snow brought down for that purpose from the mountains. The Mission were fortunate enough to arrive while the famous yearly fair was going on, which years ago was attended by Lamas from Thibet, aborigines from Wei-ri, Burmese, Cochin Chinese, and, in short, people from all the adjacent countries, and from eleven out of the eighteen Chinese provinces. They brought Burmese goods, such as jade and other precious stones, pearls, musk, deer horns, and the like, in exchange for raw and manufactured silk, satin, copper and other metals. The only foreign goods seen in the fair were Turkey reds, said to be brought from the Yangtze and from Canton, some gauze said to come from Burmah, and wax matches of European manufacture. There was a large supply of local medicines, &c.; also a large quantity of native-made cotton cloth. The rhubarb is said to be found in the neighbourhood of Li-Kiang fu, in the north of the province. The rest of the goods were merely the ordinary articles of Chinese domestic consumption. In fact, the authorities stated that, owing to the disturbed condition of the country, the fair was merely nominal, the people simply taking the goods out of their shops and exhibiting them in stalls outside the west gate.

On the 26th the Mission reached the prefectural city of Yunchang-fu, the commercial rival of Ta-li-fu, and now in even a still more battered condition. It is situated in a plain, about three miles and upwards in breadth, and said to be eighteen miles in length. The town is built at the base of a range of mountains called Taipanshan, and is very old, having been furnished with a mud wall, A.D. 744. At the end of the fourteenth century it was surrounded by the present brick wall, inclosing a hill which formerly commanded the town. It is about four miles in circumference, being upwards of a mile in length towards the mountains, and three-fourths of a mile in breadth. Like other Yunnan cities, the suburbs were entirely destroyed. The plain was only partly cultivated, but well irrigated; one vast reservoir measuring at least 400 yards by 200 yards. There was scarcely any trade going on here; a few shirtings and a little Russian cloth found their way from Yunnan-fu, but the great trade of the place was opium. Formerly, the city carried on a large trade in indigo, paper, wax, glue, cotton cloth, tung oil, manufactured silk, bamboo cloth, articles made of deer-skin, chess-men—sent all over the Empire—and gauze, manufactured by "white barbarians." The mulberry and nan-mu trees grew in this department, and excellent tea was produced in the adjacent Meng-tung mountains. On the 3rd inst. the Mission, after an almost sheer descent of 2,000 feet, reached the valley and city of T'eng-yueh-chow (Momein). This locality has been recently visited and carefully described by Major Sladen and his party. The city, though very thinly populated, must, from its position, rapidly recover itself, and has probably done a great many things since its first appearance in history during the Chow dynasty (B.C. 1122-1235). The shops were comparatively well supplied with foreign goods from Bhamo, consisting chiefly of shirtings, broad-cloth, camlets, Dutch camlets, and lingells.

From Momen to Manwyne was the only level road traversed by the Mission since it commenced the land journey in the beginning of February, It was far more thickly populated and better cultivated than any part of the province passed through after reaching Chan-tung. The Shan village of Nantien, whose late commandant was the notorious Li Chan-Kuo, was formerly famous for the manufacture of silk, which was sent as a tribute to the Court. After leaving Manwyne, the Mission, passed over the Kakhyen hills, and on the 21st arrived at Bhamo.

SANITARY STATE OF BIRMINGHAM.

A correspondent sends to the *Builder* the following note on the sanitary condition of Birmingham:—"It was a happy thought to initiate a public movement in favour of 'Economy' at Birmingham. In the last generation Manchester had a mission to preach Free Trade, and nobly did its work, received the due reward of success, and became Conservative. It would appear as if the next city which has a mission is to be our great Midland town, the home of Radicalism, enterprise, hot restless energy, hard speaking and public spirit Domestic Economy means the prevention of waste a home, and 'waste' is an awful word, abhorrent to the Birmingham mind—wasted time, energies, influence, life, and even money is nothing compared to waste in material, and if economy in this only can be brought about by any Congress sitting anywhere, great good will result. While this particular Congress was sitting in Birmingham, any of its members might have seen, as the writer did in the district between Aston and Lozells, parties of young men and youths grubbing among the discarded heaps of rubbish for material treated formerly as waste, but now valued because scarce, and consequently dear. Nor in this particular was Birmingham fruitful in lessons to members of a Congress devoted to the promotion of happiness and comfort in the home. A more appropriate or a sadder centre for the commencement of a mission could not well have been better devised. The centre town in the kingdom, the most enterprising, energetic, and wealthy in the metal trades, with beautiful suburbs—yet such a centre presents some of the most cruel contrasts to be found in our civilisation. In no other city in the Empire would be found the same squalor and filth—the same hard-featured, toil and sin-battered women—and the same number of wretched, neglected children. The root of the evil is in the home-life the poor and labouring classes live. The cupidity of landlords has caused the streets to be intersected with narrow alleys, in which houses are back to back, or built with back walls in which no windows appear, ventilation being thus impossible. But it is in the drainage of the town that the saddest hindrances to home comfort and decency are to be found. Houses innumerable exist without water-closets, or with one closet to a row of houses—the soil falling into an open space tainting the air. What would members of the Congress think of rooms being erected over these cesspools, in which only a bare flooring separates the abode of father, mother, and family from the foul mass beneath. Nor is this all, for in some cases the boiler of the factory, the home of the artisan, and the cesspool are in such close proximity, that it is not an uncommon fact for the latter to be such a seething, heated mass, as to bring an indignant tenant before the owner of the boiler (and it was used in a sewing-machine business), with a complaint that 'he was boiling his filth.' Under such circumstances, decency, modesty, and health find sore discouragements, and selfishness, coarseness, and sickness find full play."

CARDINGTON TRAINING SCHOOL FOR GIRLS.

This school is the only one of the kind in the county of Bedford, and as an experience of seventeen years has now been gained, it is thought that a statement of the method pursued, the expense incurred, and the results, may be to some persons suggestive and serviceable.

If a girl goes out to service without special training she generally begins at low wages, in an inferior situation, but from this school girls have obtained at once a good start in life, in superior families, at wages of about ten pounds per year.

Girls are admitted to the school between the ages of eight and seventeen. Instruction in the elementary branches of education, reading, writing, and arithmetic, and in the Bible and formularies of the Established Church is given as in the parochial school. Plain needlework is also taught, and the elder boys are instructed in the use of a sewing machine. To this instruction is added the special training in the work of a cook, a housemaid, a laundress, and sometimes of a dairy-maid, the elder girls taking weekly turns to act in these capacities.

Practice in all ordinary kinds of cooking is obtained in the following ways:—1st. Soup and other articles of food are frequently prepared for sick persons; 2nd. A dinner in winter and a meat tea in summer, with a varying bill of fare, is given to the whole school once a-week.

Application is now (July, 1877) being made to the Education Department for the recognition of the school as a "certified efficient school" within the meaning of the Elementary Education Act, 1876.

The buildings consist of an ample school-room, furnished with a Hasell's cooking range, a mistress' house, a dairy, a pantry, and a scullery.

When any girl of the age of 16 or 17 years, after conducting herself well, goes out to service, to a place approved of by the managers, she receives part of an outfit of clothing. All the girls of this age (14 in number) who have hitherto gone out to service from the school in this way, have obtained good places, and have given satisfaction in them. Those who have gone out to service before the age of 16 years (47 in number) have obtained better places than they could otherwise have expected.

The chief employment of women and girls in this village is lace making, and it is adopted into the work of the school. A teacher is engaged to superintend the girls so employed. This arrangement is found to leave the girls time enough for the other school work, and it leaves the mistress more free to attend to the domestic training.

The entire training in all its branches (except the instruction in lace making) is carried on by one competent, trained, but not certificated mistress, who has also had some experience in domestic service.

The total expenses of the school at present are about seventy pounds a-year. The number of girls is limited to thirty, but this is found to be more than can be supplied by the population of Cardington proper, which by the last census was 545. It may be remarked, however, that in a large parish a school of double the number could probably be maintained at proportionally small extra cost. The cost would also be diminished if the industrial part were an annex to the parochial school, instead of being, as this is, a separate establishment.

To any person proposing to found a similar institution the patrons will gladly give further particulars on application being made personally, or by letter, to the Mistress of the Girls Training School, Cardington, near Bedford.

GENERAL NOTES.

Sale of Casts of the Venus de Milo, &c.—It is announced in a Paris journal that the directors of the Louvre have had executed moulds of a great number of the most celebrated works of art in the sculpture galleries of the museum, such as the Venus de Milo and the Victoire de Samothrace, and that after being exhibited to the public the casts will be sold to the provincial museums, artists, or amateurs. It is stated that the exhibition will take place in the present month, in that which was formerly the Salle des Etats in the Louvre. It has been stated that foreign Governments had ceased to allow of casts being taken for certain museums, having discovered that moulding could not be effected without some injury to the original. It is not the first time that the Venus de Milo has been moulded, and perhaps after all the casts spoken of may be from old moulds.

Musical Conservatoires.—The *Academy* quotes from the *Revue et Gazette Musicale*, which gives the following particulars concerning the dates of establishment of various musical "conservatoires":—The most ancient of these is stated to be the Musical College at Palermo, founded in 1747. The next in order of dates are: the Conservatoire of Paris (1795), the Liceo of Bologna (1798), the Conservatoire of Naples (1806), Milan (1808), Prague (1810), Parma (1825), Madrid (1831), Brussels (1832), Leipzig (1843), Berlin (1850), Cologne (1850), the Musical Institute of Florence (founded 1860, opened 1862), the Conservatoires of St. Petersburg (1862), and Moscow (1866). Conservatoires, or schools, have been more recently founded at Vienna, Warsaw, Buenos Ayres, and Rome; and the Liceo Marcello, at Venice, is still in course of formation.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,294. Vol. XXV.

FRIDAY, SEPTEMBER 7, 1877.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

DOMESTIC ECONOMY CONGRESS.

The following papers were among those brought before the Congress at Birmingham :—

COOKERY IN PUBLIC ELEMENTARY SCHOOLS; THE DIFFICULTIES STATED AND DISCUSSED.

By Rev. Newton Price.

In a recent Blue-book of the Education Department, an inspector of schools writes as follows:—"The introduction of cookery and domestic economy into school work for girls is excellent in theory, but will be found very difficult in practice. I have long tried to solve the problem of teaching children cooking, but have always been unable to get over these difficulties—Who is to teach it? Where are you to teach it? Who is to pay for it? Are you to teach all the bigger girls, or only a limited number?" (Report of Education Department, 1875-6, Mr. Colt Williams' report, p. 445.)

Here is another statement of difficulties. "Though your plan is quite feasible in a town such as this or Watford, or even a large country village, I do not see how it could be carried out in ordinary country schools, where as much as managers can do is to make both ends meet. To teach girls to cook you must have a proper grate—I do not mean a close range—that is, such a grate as is to be found in cottages; this is not generally the kind of grate found in schools. Secondly, you cannot teach cooking in the school itself, for the lesson in cookery would, of course, be given in the two hours of secular instruction. In many places there is not a house attached to the school, and where there is, I much question whether the teacher would give up the privacy of her house. Thirdly, the instructress is a great difficulty; most teachers' wives, or mistresses themselves, can cook after a fashion, but I much doubt their ability to teach cookery on system to children, even supposing place and material to be found them."

I make these quotations because I think they state very fairly, between them, the difficulties which lie in the way of teaching cookery in our public elementary schools.

In discussing these difficulties, I shall take it for granted that they reach their highest pitch in country schools. For, whatever the difficulties of town schools may be, those of country schools are greater. Country managers look enviously at the good luck of town managers, who are supposed to have an inexhaustible exchequer, and to be able to have what they want for the mere willing it. The rate is the thing which helps them over all difficulties. But the country schools maintain an unequal struggle for existence. The liberality of subscribers does not grow with the ever-growing expenses. Hence it will generally be found that the financial difficulty is the chief hindrance to the introduction of cookery. To the question, Why is not cookery taught? the usual answer is, We cannot afford it. As the system with which I am connected was framed, though not from necessity, to meet the financial difficulty and to conduct a useful experiment, I propose to enter into the details, keeping in view the requirements of this paper. It will appear, I hope, that I am dealing with the difficulties in a practical manner—in other words, that I am not showing how they may be overcome, but how they have been overcome.

The managers of the Watford-heath School, impressed with the importance of introducing cookery into the school course, communicated with the proprietor, who at once offered to build a kitchen in the playground. At their request it was built in a plain style, and furnished with an ordinary cottage range. The cost was probably about £100, furniture included[*]. As there may be rich men inclined to confer this boon upon their district, and as I have been frequently asked for particulars, I annex a description drawn up by Mr. W. H. Syme, A.R.I.B.A., of Watford:—

> "The kitchen, a plain brick-built and slated structure, measures 16 ft. square inside, and has an open roof, affording an average height of 12 feet. On the side by which we enter is a table or dresser 11 feet in length, with a large window immediately over it. On the right hand of the room is a stone sink 5 feet long by 2 feet wide, amply lighted by a second large window, and provided with a lead pump for the supply of rain-water, Against the wall, on the opposite side, stands a roomy cupboard, the lower portion of which, with a door 4 feet 8 inches high, is fitted with shelves for the disposal of wood, knives, forks, spoons, and crockery. The upper compartment, used as a store closet, has a perforated zinc panel at each side, and a door 1 foot 9 inches high similarly ventilated. The remaining side of the apartment is occupied by a 42-inch open range, with boiler and 14 inch oven. A clock surmounts the stone chimney-piece, and in the recess on either side of the fireplace is fitted up a tier of shelves for plates and dishes, the lower shelf being sufficiently wide to be otherwise useful. The floor is laid with 6 inch tiles; but as, in winter, this has been found to draw the heat from the children's feet, narrow strips of wood, nailed to ledges, have been placed in front of the sink, and around the clean deal table which occupies the centre of the kitchen."

The teaching is given by a pupil-teacher who has been trained at South Kensington. To assist the movement by providing teachers and to reward the most diligent, one person is sent up each year to Kensington to be instructed in artisan cookery.

The instruction in cookery, which is altogether distinct from the lessons in domestic economy, is divided into three grades corresponding with the upper standards of the school, thus:—

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[*] This is less than I stated in a former account.

Standard IV. (average age, 11), Cleaning.
" V. (" 12), Cooking.
" VI. (" 13), Marketing and cooking.

About 80 lessons in cookery are given in the course of a year, at the rate of two in each week, omitting the weeks immediately before and after the holidays, inspection time, &c. The days are Thursday and Friday, and the time, morning. Consecutive days are taken, that the work may be done more economically, and the morning is chosen that the food may be prepared for an ordinary dinner. The time for dinner is half-past 12, when about eight persons sit down to the meal—the teacher, the cooks, the cleaners, and as many more as are required to furnish the table with guests. Each child who dines pays 2d. The teacher, in addition to her salary as one of the school staff, receives at the rate of 1s. for each cookery lesson, with the proviso that whatever the dinners cost above 3d. a head will be deducted from this payment.

The average number of girls in Standard V. is taken to be ten, and one-half take kitchen duty alternately, so that each girl in this standard receives one lesson a week, and about 40 lessons in the year.

Not more than five girls are allowed to receive instruction from the same person at the same time, and each of them has something to do. As the school is small (average number, 92), the Fifth Standard is not likely to contain more than ten girls, so that no embarrassment results from this rule; but, in a larger school, one or two of the best girls in Standard VI. might be employed in instructing the juniors, under the teacher's direction. Two purposes would be served by this plan; for, when you know a little of a subject, there is no way like teaching to enable you to learn more. Another plan would be to make a selection of girls for the kitchen by merit. Whatever is done, I think a larger number than five cannot be taught together practically. The lecture system does not suit children, and I have concluded, as the result of some experience, that it is not very effective or popular with grown-up people, except a chosen few, who seem to be born with a faculty for receiving information in this way.

It may be noticed, in passing, that the Education Department allows only 20 of these lessons to be counted as attendance at school—a hardship, surely, though a small one.

The cleaning after dinner, still under superintendence, but out of school hours, is done by girls of Standard IV. told off by turns for this work. Each of them is supposed to receive 20 lessons in cleaning in the course of the year.

The arrangements for Standard VI. are not so easily detailed. Much depends on circumstances, as the number in this standard is found to vary much; but the endeavour is to give each girl 20 extra lessons in cooking and some experience in marketing. By the time a girl reaches the Sixth Standard she has most likely gained a certificate for cleaning and another for cooking. She is then in a position, with the consent of the teacher, to undertake a "trial dinner;" that is, a dinner of soup, meat, and sweets, selected from the school course of dishes by the ladies who are to be the judges. The materials are given to the candidate, and she is left to prepare the dinner without aid or hints. If the judges are satisfied, they sign a certificate to that effect, and henceforth the girl is considered to be on the staff of the kitchen. She assists in preparing dinners and suppers for the Workmen's Club, the Youths' Guild, &c., work for which she is paid, and which gives practice without cost to the kitchen.

In order to stimulate method and regularity, and to assist the managers in supervising, a strict account of the dinners is entered in the kitchen journal, of which a page (filled in) is given at the end of this paper.

I come now to the cost. The following is an exact account of the expenses for 1876:—

	£	s.	d.
1. Loss on food (784 rations)......	2	16	3½
2. Coals........................	1	0	0
3. Fee to Kensington Training School	3	3	0
4. Teacher's fees.................	3	5	0
5. Receipts and printing..........	0	17	9
6. Aprons, &c....................	0	16	5
	11	18	5½
7. Extra furniture..............	3	10	11
	15	9	4½

Item 7 is for furniture which was not required only desired. As to items 3 and 4, it is not, of course, necessary to train a teacher every year, nor is it necessary to pay for the lessons, as the work is done in school hours. The loss on food (item 1) is trifling, but even this might be made to disappear, as we could find plenty of customers for our dinners at 3d. a head instead of 2d. With this tariff, we should actually make a profit which would go to meet the other expenses. By a turn of the screw, the kitchen could be made self-supporting when once started. But as it is, the loss on food is less than £3 a year. and the ordinary expenses less than £12.

While on this subject, I am anxious to quote a valuable suggestion in the *Times* as to the utilisation of doles. It comes to me second-hand through the *Woman's Gazette*, from which I make the extract:—

> "The bread doles would furnish the necessary capital to start the village centres, and the full value of the food cooked might be given as a charity to the present recipients of the dry bread. For example, the returns already noted show that upwards of £100 16s. 9d. is given away in Kenilworth, chiefly, if not wholly, in bread. This amount would go largely to support a school, which would be further aided by the fees paid by the learners of all ages. The adult poor might be taught as well as the children, and many a young lady in Kenilworth might be able to get a practical knowledge of cookery that would be useful all her life. Again, at the adjacent picturesque old town of Coventry, where there is an admirable germ of a domestic economy school in the Blue-coat School for Girls, and doles amounting to £415 12s. 6d., a school of cookery with branches might be established to the great comfort of its 40,000 inhabitants. It might fairly be predicted that the old crone who now hobbles to church to get a sixpenny or ninepenny loaf would be much more cheered by a giblet pie or a shepherd's pie, or some fried rissoles of meat, or sausage rolls of Australian mince-meat, or a quart of Irish stew, or some curried tripe, or a Cornish pasty, or a pig's fry, which is called 'poor man's goose,' or a quart of 'pot-au-feu,' or 'a mackerel or herring baked with bread-crumbs and herbs,' or a plum-pudding

at Christmas. Any one of these could be provided for the cost of a ninepenny loaf, and some for a sixpenny one, as we learn from the recipes of the National Training School for Cookery.

"If Lord Sandon would look into this subject, he would find that there is a fund exceeding £110,000 per annum throughout England and Wales now devoted to doles, which might help to promote good cookery among the poor and help to compete with habits of drunkenness."

I submit that I have shown, by an example, how, in connection with a small village school, a kitchen may be maintained, if not on the basis of self-support, at all events for a trifling sum which surely would not be hard to get in any parish in England.

Not long ago a lady's lamentation reached me. It was over her experimental school kitchen, which had failed from its great cost. I found the aim had been to train servants to minister to the rich man's fanciful appetite, and not simply to teach the future managers of our poor homes the importance of method, cleanliness, ingenuity, and economy. It is not expensive to carry out the latter modest course, but I am afraid the other, when tried in schools, will be found both expensive and fruitless.

Now for the question, Where is the teaching to be carried on? Even though there may be no chance of getting a kitchen built, it is not yet time to give up. Everything belongs to those who are in earnest. In some cases, the teacher's house could be secured; in others, the village reading or club-room, which is not, as a rule used in the day-time. These failing, I should be disposed to try negociations for the cottage of a solitary impecunious widow, who, for a small consideration would gladly adjourn into the cottage of a neighbouring gossip, or abdicate in favour of the teacher for two or three hours a week.

The next question is, who is to teach it? I am afraid you cannot assign this work to your head-teacher without injuring the general work of the school. The best plan in my opinion is to employ an assistant mistress or a pupil-teacher. With this latter arrangement, however, you will have frequent changes. I may be wrong, but I have an opinion that, as a rule, a visiting teacher seldom has the influence of a regular school teacher. In all cases, the head-teacher should have the superintendence and be held responsible that the work may be treated as a part of the school routine and not as something outside of it.

Whatever arrangement is made, the teacher, I suppose, will have to be trained. The cost of going through the artisan kitchen at Kensington is 3 guineas or 4 guineas, if the extra lesssons in teaching are taken. I am assuming that there is no hardship in expecting the teacher's friends to bear the expense of maintenance, as her value is increased and additional payments are immediately earned in the case I have given, at any rate. The girls sent up from Watford-heath have been able to stay with friends.*

But now we come to a serious difficulty. Watford-heath is near London, but what about schools in distant parts? To make this movement general there must be a network of schools of cookery over the land. I cannot stay to treat of this subject fully. It is a pity it has not been made the burden of a distinct paper. The large towns are, perhaps, supplied, but towns below, say 20,000, are unable to maintain separate schools. Could not those in the same district combine, say in threes, and have temporary, flying schools set up for a year in each town with the same teacher and *batterie de cuisine?* By a system of day and night classes, as in the schools of art, and with payment from the Education Department for every teacher and pupil-teacher passing satisfactorily, such schools would, I believe, support themselves. It would, however, be important to stipulate that they should not be closed in the ordinary school holiday-time, as the manner of the school at Kensington is.

I come now to speak of the principal hindrance which the managers of the Watford-heath School kitchen have had to face. It sprang, not from want of funds, or from want of a room, or from want of a teacher, or from the suspiciousness of the parents, or the unwillingness of the children, but from the strenuous opposition offered by her Majesty's inspector. Nothing that could be done by him was left undone. Our time-table was rejected. We were told our grant was in danger. We were dealt with separately, with the view of dividing us, and thus conquering. Had the proposal been to teach Syriac, the opposition would, possibly, have been less violent. It could not have been more so. However—

"Persecution drove us into fame."

We were obliged to appeal to the Department, which ratified the sanction they had previously given to our experiment, a sanction which was ignored by the inspector. The press took our case up, and we were safe. At the next visit of the inspector, our cooking operations were simply passed by without observation or inquiry. Under other circumstances we might, perhaps, have hoped for friendly interest; but, as it was, we were deeply thankful to escape notice, and to be allowed to do good by stealth, as it were.

I may safely add that there is nothing in the state of the general education of our school to justify this tone. None of our cooks have ever failed in any subject of examination. Both managers and teachers agree in thinking that their general intelligence has been much improved by the lessons in cooking. I am happy here to quote another inspector:—"Children who have little beyond the dull routine of reading, writing, and arithmetic, must grow unutterably weary of them. The stimulus given to their faculties by having a new object of interest produces a more healthy and vigorous condition, and enables them to accomplish more in the standard subjects with less waste of power." (Report of Education Department, 1875-6. Mr. Howard's Report, p. 320.)

My object in making this statement is not to parade a grievance, but to show that if practical education is to be carried on well, we need friendly, sympathetic, intelligent inspection. We do not want inspectors, who have persuaded themselves that Oxford lore, or as much of it as can be got in, is the thing for our elementary schools. I am far from saying that all our inspectors are bent on thus perverting the elementary education of the country, but here is one case, at all events. Managers when urged to introduce cooking into their schools allege as a difficulty, fear of the inspector, and fear of loss in the grant. It is the same with needlework. The schools are afraid to take it up as an extra subject, for the same reason. I seek in vain to reconcile this opposition to practical education with the declarations of Lord Sandon, which have won for him the confidence of the country.

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* In the debate in the House of Commons on 10th July, Lord Sandon stated that he was informed that the cost of training a teacher would be about £35. Surely this information comes from an unfriendly source. Even if maintenance has to be found, the expense would not be more than from six to nine guineas, with or without travelling expenses.

We evidently want special inspectors, interested in practical education and able to see that it is carried out. I am glad to see that this subject is to be handled in Section C. by Mr. MacCarthy.

I am not one fond of calling for Government interference; but, reverting to the difficulty in getting teachers—which, after all, is the main difficulty — it strikes me there are several subjects under the fostering care of the Science and Art Department which are of less importance to the country than this. Why cannot we have examinations in cookery on the same principle? Without a large supply of teachers, it is mere play. But give us this, and the moral aspect of the country would shortly be changed.

Let it be understood that this is not an endeavour to afford gratification to the lovers of good living. It is based on a desire to spread contentment and domestic comfort, to cheer the lives and purify the tastes of those who spend day after day in a dreary round of monotonous labour. It is an economical and temperance movement. "The adjustment (says C. Kingsley) of the elements of food in the right proportions is almost the most important element in insuring temperance." Had as large an army of teachers of cookery been in the field as of teetotal lecturers, and for as long a time; had schools of cookery been in operation as long as teetotal societies, we should perhaps by this time have seen the publicans parading our streets in the same destitute condition as will be the lot of the doctors, if *Mr. Punch* is right, in Dr. Richardson's City of Health; or, better still, driven to take up their legal but forgotten trade of licensed victuallers.

And, not only is this appeal for support made to the friends of temperance, but we claim the sympathy of the advocates of women's rights. We hope that a better acquaintance with domestic duties will make woman in humble life more valued and more valuable. We hope she will be helped to acquire and maintain that true though unseen ascendancy in the household without which no home is well-regulated, moral, or happy, and to conform to the ancient type of perfect womanhood set forth in the writings of the wise man: "The heart of her husband doth safely trust in her, so that he shall have no need of spoil. She will do him good and not evil all the days of her life. She seeketh wool and flax, and worketh willingly with her hands. She looketh well to the ways of her household, and eateth not the bread of idleness. Her children rise up and call her blessed; her husband also, and he praiseth her. Many daughters have done virtuously, but thou excellest them all."

WATFORD-HEATH KITCHEN, 1877.

Description of Dinner, names of persons dining, and work done.

Thursday, June 28th.—Sheep's head, haricots, gooseberry pie. M. Phillips (in charge). S. Bates (pie), G. Freeman (head), M. Battams (beef tea, haricots), E. Morgan (cleaning), P. Gates (cleaning), L. Field. (cleaning), Miss Williams.

Friday, June 29th.—Cornish pasties, haricots, rhubarb pie. M. Phillips (in charge). G. Freeman (pasties), E. Cooper (pie), A. Hill (haricots), A. Ashby (cleaning), E. Morgan (cleaning), A. Pepper (cleaning), Miss E. Savill. Total No., 16; payments, 2s. 4d.

Cost of Food.—Brought forward (stock in hand), 3s. 2¼d.; meat (sheep's head), 9d; milk, 3d.; bread, 2d.; flour, 4d.; haricots, 2d.; potatoes, 2d.; onions, ½d.; gooseberries, 6d.; rhubarb, 3d.; sugar, 3d.; barley, ½d.; total, 6s. 1¼d.; deduct amount carried forward, 3s. 2¼d.; total, 2s. 11d.; cost per head under 2¼d.

Memoranda for Treasurer.—Gifts valued at 3d. included above; beef tea for Mrs. Paul—cost 9½d.—not included above. To be charged to Sick Poor Fund.

Examined, J. E. W.; M. Phillips, teacher.

WATFORD-HEATH ELEMENTARY SCHOOL KITCHEN.—CERTIFICATE OF MERIT.

Fourth Standard.— , of the fourth
standard, attended* lessons in cleaning
in the year 18 .

Fifth Standard.—The above-named received†
lessons in the year 18 ,
also prepared and served, without aid, a plain dinner, to
the satisfaction of the undersigned, this day of
, 18 .

Sixth Standard.—The above-named received‡
additional lessons in cooking, and assisted in the
purchase of food for the kitchen in the year 18 .

A full certificate, with prize, is awarded to the above-named.

The above form and certificate can be had at the *Labour News* office, 15, Russell-street, Covent-garden.

ERRORS IN DIET.

By Dr. Wilson,

Medical Officer of Health.

It has been estimated by a physician of great eminence that at least 30 per cent. of the patients who consult the doctor owe their ailments to errors in diet, and a tolerably large proportion of them come from the upper and well-to-do clasees. But, as a rule, they are very troublesome patients to treat, for the mind of the dyspeptic is notoriously fickle and uncertain. He will catch at any nostrum which professes to give relief, and drink any amount of nauseous waters, rather than change his mode of living, although he is assured, and may himself have a very shrewd suspicion, that this is the real cause of all his troubles. If he is put under a regimen which he considers too strict, he will have few scruples in changing his medical adviser, and thus he frequently becomes the ready dupe of the arrant quack, who will buoy him up for a time with false hopes, and afterwards trade upon his fears. Although it is true that disorders of digestion are not all attributable to errors in diet, it is no less true that the great majority of them are, either directly or indirectly, traceable to this cause — indirectly often when they are inherited, and directly, for example, from overfeeding, over-stimulation, a badly regulated dietary, meals eaten hurriedly and at irregular hours, insufficiency of food, and articles of food of very indifferent quality.

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* Not less than 20.
† Not less than 40.
‡ Not less than 20.

But in addition to what are vaguely called disorders of digestion, there is a crowd of other ailments and diseases which may be all placed in the same category, as regards cause and effect. Look, for instance, at the enormous waste of infant life, and the enfeebled constitutions of those that survive, which are due to ignorance or culpable neglect in the feeding of young children. Or, look again at the wide-spread evils of intemperance and over stimulation in steadily and surely undermining the healthy action of almost every organ of the body, and the long train of diseases which follow that smaller habitual excess in eating and drinking so common amongst the upper and middle ranks of society. Livers are constantly going out of order amongst the men, and bilious headaches, to say nothing of worse ailments, spoil the temper and the good looks of the women. After a protracted period of immunity, the sedentary man who is fond of a good dinner and a glass of old port, and who boasts of his moderation, is astonished with an attack of gout, and forthwith blames his ancestry. Very possibly his ancestors may have had a good deal to do with it, but he is slow to admit that a little more care on his own part might have prevented all the excruciating pangs to which he has now become a victim. Indeed, it generally requires more than one attack to convince him that, as errors in eating and drinking have been the exciting cause of the mischief, so a careful and more abstemious dietary affords the only chance of a real and permanent cure. Full of good resolves when he is in the clutches of his enemy, he cannot help gratifying some of his old appetites and habits when the attack is over, at first, it may be with no small amount of misgiving, but after a time with less stint and fewer scruples, bearing out the truth of that well-known rhyme—

> "When the devil was sick, the devil a saint would be;
> When the devil got well, the devil a saint was he."

But I need not multiply instances; let me, rather, in passing, venture to make a suggestion. In these days of Conferences and Social Science Congresses, I can conceive of few gatherings which would attract a larger share of interest, and be productive of greater good as regards what we should eat and drink, than a conference of persons who have suffered from gout, and who, by careful living, have prevented subsequent attacks. There might be another section, composed of those who have been victims to dyspepsia, disordered livers, or bilious attacks; but in both sections the discussions should be charactised by frank and open confession of the modes of living before the disorder set in, and what changes were made in the diet, to effect a cure or ward off a relapse. No doubt there would be a good many conflicting views expressed, especially as regards the efficacy of drugs, but I feel confident that there would be a general concurrence of opinion that errors in diet have a much larger share in the production of disease than people are inclined to believe, and carefulness a much wider influence in its prevention and cure.

This, however, by the way. Let me now endeavour to point out very briefly some of the leading facts and principles which should guide us in matters of diet, and in doing so I shall avoid as far as possible entering upon any discussion of the numerous and important chemical and physiological researches which have been made in this direction, though I shall freely avail myself of whatever practical deductions can be usefully drawn from them. In the first place, then, I need hardly say, that whether food be animal or vegetable, it is essential that the diet should contain certain classes of ingredients, namely, those which are required to build up the fabric of the body and repair waste, and those which are necessary for the support of animal heat and the evolution of force, as exemplified in various bodily movements, and in our capacity for work. Now, these ingredients or constituents of food, as they have been called, have been divided into the following classes:—the nitrogenous, or flesh-formers; the fatty and saccharine, or body-warmers and force-producers; and the watery and saline, or inorganic substances. The nitrogenous substances nourish the muscles, brain, nerves, and bone; the fatty and saccharine constituents make up the fatty or adipose tissue, which is interspersed throughout all parts of the body, and are directly subservient to the maintenance of animal heat and the production of animal force; while the watery and saline constituents are essential to the solution and conveyance of the food to different parts of the system, and to the consolidation of the tissues. As examples of the nitrogenous class, we have albumen, which makes up a large part of the lean or fleshy portions of animal food, and which is also contained, though in much smaller quantities, in vegetables; casein, which is found in milk and cheese; and gluten, which is contained in varying quantities in wheaten flour, oatmeal, barley-meal, and the like. As examples of the fatty constituents, we have the fat, which is interspersed more or less freely throughout all animal food, butter, and animal and vegetable oils; while the saccharine constituents are derived from the starch contained in potatoes, the various cereals, tapioca, arrowroot, and other vegetable products.

That a well-arranged diet should contain all these several classes of constituents is alike taught by experience and proved by experiment, and science has also decided with tolerable accuracy, not only what proportion each should bear to the other, but what should be the actual quantities allowed under the various influences of age, sex, and work. The articles of food themselves may be varied almost indefinitely; indeed, variety is a great desideratum in diet, but the proportions and amounts of the several constituents, under certain uniform conditions, cannot be widely departed from without incurring injurious results. As to quantity, an adult may be considered to be taking sufficient for the ordinary requirements of healthy activity if he eats in 24 hours the equivalents of 1 lb. of meat and 2 lbs. of bread. The English soldier on home service receives $\frac{3}{4}$ lb. of meat and 1 lb. bread daily, and he buys about $\frac{1}{2}$ lb. additional bread and 1 lb. of other vegetable food. Such a diet is amply sufficient for any adult under ordinary circumstances of light employment; but should extra demands be made upon mind or body, the diet must be increased, or the health will suffer. Active labourers, such as artisans or agricultural labourers, consume about a fifth more nitrogenous food, and twice as much fat, as those engaged in light employment, while the saccharine constituents are not augmented. Navvies, on the other hand, and those who are employed at hard work, while they require more food, generally err in taking too much animal food and neglecting vegetable food, for it is now well-known that the raising of the muscular powers to the full extent of their usefulness may be effected by vegetable food, quite as well as by increasing the more stimulating and more expensive animal nutriment. With a fair allowance of milk, plenty of oatmeal porridge and oatmeal cakes, potatoes, and other vegetables, a Scotch labourer will do as hard a day's work as any English navvy, and yet take very little butcher-meat from one week's end to the other. Such a diet is as nutritious, more healthy, and much cheaper in country districts, than a diet in which animal food is partaken of twice and often thrice daily, and to a working man cheapness is a great desideratum.

But, then, on the other hand, there are vast numbers amongst the working-classes who do not obtain a sufficiency of nitrogenous food. They subsist almost exclusively on bread, potatoes, and other starchy foods, and they are easily recognisable by their pale looks, attenuated forms, and weak and flabby muscles. More especially is this species of chronic starvation common amongst the wives of the poorer classes, and women employed as seamstresses, and there can be little doubt it is to their insufficient diet that the craving for tea at all hours of the day is in great measure due. Much more nutriment would be obtained, and much mischief avoided, if cocoa were more freely used, for I need hardly say that over-indulgence in tea-drinking induces a long train of dyspeptic symptoms, accompanied by great excitability of the nervous system, which are as painful as they are unfortunately common.

Having thus far endeavoured to indicate roughly the importance of a right distribution of the different classes of food-constituents, let me now submit a few hints of a practical kind, in respect to diet as influenced by age. And first, I would direct attention to the feeding of infants. Few people have any adequate conception of the enormous waste of infant life which results from diseases induced by the insufficient, improper, and careless feeding of infants. The statistics of the Registrar-General inform us that, out of every 1,000 children born, 150 die before they reach the age of one year, and I do not think it is making too high an estimate, if I say that one-third of these deaths are attributable to what may be called starvation-induced ailments. Assuming, further, that the number of children born annually in the United Kingdom amounts to one million—and that is very near the mark—there is thus an annual sacrifice of at least 50,000 infant lives.

Leaving these figures to speak for themselves, I think there are few who would be ready to dispute that the proper food for a new-born infant is the mother's milk; and, in order that this may be sufficiently nutritious, it is necessary that the mother herself should be in fairly good health, and be very careful as regards her diet. Cow's milk, fresh and unskimmed, should, if possible, be partaken of freely every day; and, in respect to solid food, there should be a liberal allowance of animal food, cooked in various ways, so as not to cloy the appetite, and plenty of farinaceous food and vegetables. With the exception of a little light wine, beer, or stout—and even these might be advantageously dispensed with in most cases—the less a nursing mother takes of stimulants the better, and she should especially avoid over-indulgence in the use of tea. As regards the infant, after the first few days, it should be suckled from six to nine times daily, and, as far as possible, at regular intervals, after which a gradual reduction may be begun, until, before weaning, the number of meals should not exceed four. The time for weaning—generally, about the age of nine months—should be determined partly by the growth of the teeth, presuming, of course, that the mother's health is not suffering in the meanwhile. Whenever the first group of teeth appear, which usually happens about the sixth or seventh month, the mother may begin to diminish the number of suckling times; and when the second group appear in the upper front gums, the supply may be cut off altogether. If the state of the mother's health prevents her from nursing her child, it may be reared on fresh cow's milk, or goat's milk, or condensed milk. The advantage of using goat's milk, when it can be procured, is that, even in towns, the animal may be brought to the house, and the freshness and genuineness of the milk are thus put beyond question. When cow's milk is used, it should at first be mixed with half its bulk of pure, soft, tepid water, and sweetened with a little sugar or sugar of milk, and a grain or two of phosphate of lime should also be supplied with it daily. Condensed milk will not require sweetening, but it should be sufficiently diluted to resemble milk and water. Although it is not liable to undergo the rapid changes to which cow's milk is exposed in warm weather, it is not so suitable as fresh unskimmed milk for constant use, but it may very often be advantageously used during the summer and autumn months. I say nothing regarding wet-nursing, because I am strongly of opinion that, should the mother be unfit to nurse her child herself, a trial ought first to be made, under the supervision of the medical attendant, of artificial feeding, and the numbers of healthy infants who are reared in this way shows that, with proper care, a wet-nurse need only be employed in very exceptional instances. But great care must be exercised, especially as regards the quality of the milk, its quantity, the times of feeding, its proper preparation, and the observance of the most rigorous cleanliness. Indeed, one of the chief objections to the use of the feeding-bottle depends upon the fact that the bottle and flexible tube are not kept sufficiently clean, so that fermentive changes are set up in the milk, and the infant sickens, and very often succumbs to diarrhœa. It frequently happens, too, that the water which is used to dilute the milk is not sufficiently pure, and it is a wise precaution always to boil the water if it be derived from a surface well.

Up to six months old, then, the food of the infant should consist of milk, and, if possible, it should not be supplemented by or mixed with farinaceous foods, such as arrow-root, sago-flour, and the like. The quantity required, whether it be from the breast or consist of cow's milk, has been ascertained to be a quarter of a pint on the second day, two-thirds of a pint on the third day, about a whole pint on the fourth day, and this quantity is gradually increased, until when the child is six months old, not less than two pints are wanted. Unfortunately, however, when the mother herself is underfed, or when amongst the poorer classes the child is artificially reared, nothing like this quantity is obtained, and the feeding-bottle is charged with all sorts of messes which do not in themselves contain sufficient nutriment, and which the child cannot digest. The consequence is that the child begins to waste away, and whether diarrhœa or other form of disease sets in, the actual cause of death is gradual starvation. The reason why farinaceous foods are unsuited to a young infant is simply this, that an abundant secretion from the salivary glands is essential to the proper digestion of foods of this description, and these glands do not begin to secrete freely until the child is about six months old. After this period the diet may be supplemented, but at first only in a tentative way, by various articles, such as a little broth or beef tea, tapioca, arrowroot, corn-flour, baked flour, and the like. All these and others should have their turn, but, meanwhile, the child should be carefully watched, so that any article which is found to disagree should be discontinued. And here it is necessary to allude to the dangers of weaning the child too early, not the least among which is the liability to suffer from rickets. The child may look thriving enough, but the bones are not sufficiently nourished, and the mischief is not suspected until the limbs become distorted when it begins to move about. It is in order to prevent this mischief that physicians recommend the addition of a little sugar of milk, and a grain or two of phosphate of lime, daily, to be mixed with the milk when the child is artificially fed; so long as it is well nursed at the breast, the mother's milk supplies a sufficiency of the saline as well as the other constituents of food.

After the child is weaned, and up to the eighteenth or twentieth month, when the eye-teeth are cut, milk should still continue to form a considerable portion of the diet, and indeed, during childhood, it may be laid down as a rule that it cannot wholly be dispensed with without detriment to health. Dr. Ferguson, a factory surgeon, who has devoted a large share of attention to this subject, has ascertained from careful measurements of numerous factory children, that, between 13 and 14 years, they grow nearly four times as fast on milk for breakfast and supper as on tea and coffee, a fact which proves incontestably that milk is essential to the healthy nutrition of the young. If tea or coffee is given, they should be given sparingly and largely diluted with milk, and stimulants, except for medicinal purposes, should be prohibited altogether. For breakfast and supper, no more wholesome and nutritious dish can be given than well-cooked oatmeal porridge or gruel, with milk, and bread and butter. Animal food should only be given at the mid-day meal, but at first only in small quantities, and served in soups, broths, or stews, together with mashed potatoes and other vegetables, and followed by a liberal allowance of some farinaceous pudding. Good cooking will make up largely for variety in diet; at the same time, it should be remembered that variety can always be secured without increase of cost, at the most homely nursery tables. Above all, there should be no stinting, because, with very rare exceptions indeed, the natural instinct of a healthy child is a safeguard against gluttony. It is only when the period of puberty is approached, or between that and the period of full growth, that over-eating is likely to be indulged in; and, as any tendencies in this direction can be readily detected, they should be as rigidly checked.

But, it may be asked, what about the crowds of very young children who have to be left behind in the impoverished home when the mothers go to work? Many, no doubt, will languish and die, but many might be saved by philanthropic effort, in the establishment of *crèches*, or nurseries, where they could be fed and tended during the day at a trifling cost. This, however, is a phase of the subject into which I cannot enter, for, when sufficiency of food cannot be provided, it is mockery to talk of dietetic rules or errors. Let me rather allude to instances, common enough, in which, though sufficiency is guaranteed and expected, it is scandalously denied, and in doing so I need only refer to numbers of private boarding-schools, mostly of a cheap kind, where the dietary may be characterised as a bare subsistence dietary. Although one can appreciate the desire of parents of limited means to obtain a good education for their children at a moderate cost, they should make it a rule, before sending a child to any boarding school, to visit the school and see the pupils, and then they could readily judge by their appearance as to whether they were well fed or not. There is no doubt whatever that numbers of pupils have to suffer in after life from weakened constitutions, not to speak of more immediate ailments, from the scantiness of food supplied at the schools to which they have been sent; while on the other hand, there are many pupils who, though well-fed at school, ruin their digestion and become the victims of over-indulgence in after-life, by gorging themselves with sweet-stuffs so long as they have pocket-money to spend. It need hardly be said that excesses in this direction should invariably be discountenanced, and treated as habits which have a low and vitiating tendency, and that undue greediness should be met with censure and reproach.

During the period of youth the diet should be as liberal as for adult age and active employment, inasmuch as bodily growth and the activity of in youth have both to be provided for. It is at this stage that lads sent out into the world are apt to suffer from the neglect of a mid-day meal. Owing to the exigencies of business, they take little or nothing during the day, and gorge themselves when the day's work is over, so that, by-and-bye, the digestion becomes spoiled for the breakfast next morning. Indeed, this is a dietetic error which prevails largely in the commercial community. Breakfast and dinner are rightly regarded as the principal meals, the one before and the other after the business of the day is over, but between the two luncheon should never be neglected or partaken of in a hap-hazard sort of way, but the lighter it is the better. If animal food is partaken of at breakfast and dinner, it may be dispensed with at luncheon, and farinaceous foods, vegetables, and fruits should form the staple of the mid-day meal.

But, in all walks of life, one great essential in healthy diet is regularity of meals. For the active out-door labourer and artisan, an early breakfast before work, a mid-day dinner with an interval of rest, and supper after the day's work is over, has long been proved by experience, to be the most conducive to health. For the business man, a later breakfast, a mid-day luncheon, and a late dinner after the day's work is over, is the best arrangement. For literary men, who write more in the evening than during the day, an early dinner and a light supper will be found to be the most advantageous for steady work. Idlers, to enjoy life, if they possibly can, should dine early if they intend to spend the evening at theatres and the like; but, if they accept dinner invitations freely, they should be very careful not to eat too much at the mid-day meal. The breakfast hour should be determined, in great measure, by the hour of rising, but, in any case, food should be partaken of before the material business of the day is commenced. Those who like to take a constitutional before breakfast, would find their appetite whetted, and their walk made all the more enjoyable, if they took a little milk, or *café-au-lait*, with bread or biscuit, before starting. Work done before breakfast is always irksome and fatiguing, and, on that account, is very likely to be badly done; and hence, teachers or parents should never exact lessons before the first meal of the day. The last meal, whether dinner or supper, should be sufficiently late for the whole not to be absorbed before retiring to rest. If dinner is the last meal, a cup of tea or coffee with a thin slice of bread and butter during the course of the evening will be found to be very refreshing, but for those who dine early, either what is known as a high tea, or a plain but substantial supper, becomes necessary. To a person in health, three meals a day ought to be quite sufficient, and the stomach ought to be educated to take enough at them to supply his bodily wants. The practice of constantly taking "something" is sure to bring on indigestion, and especially the habit, which of late years has become so fashionable, of indulging freely in the afternoon tea. If too long a period intervenes between dinner and luncheon, the latter should be moved onwards; at any rate it is much safer to be satisfied with some fruit, an ice, or a biscuit than that ladies should continue to "imitate their washerwomen" in lavish afternoon tea-drinking.

And now as to general rules. The three daily meals should be taken at regular hours, and these should be determined mainly by the nature of one's business or occupation. While the appetite should be satisfied, the stomach should never be filled so as to induce the feeling of uneasy repletion. The food itself should never be hastily swallowed, and solid food should be carefully masticated. No active bodily or mental exercise should be indulged in immediately after a meal. The diet best suited for the great majority of people in this country is a mixed diet, but persons leading an idle life, or pursuing a sedentary occupation, should be careful not to eat too much animal food.

As regards stimulants, the evidence of scientific opinion appears to be largely in favour of total abstinence for persons who are in sound health, and especially for children and young people. At the same time it cannot be doubted that vast numbers of people pass through life in the apparent enjoyment of sound health who are accustomed to take a certain amount of alcohol daily. As to the actual amount which can be partaken of without any apparent detriment, it would appear, from numerous careful experiments, and more especially those conducted by the late lamented Dr. Parkes, that 1½ fluid ounces pure alcohol is the limit of moderation. This is equivalent to about 2½ pints of weak table beer, or 1½ pints of stronger ales and porters, or three-quarters of a pint of light French clarets or Burgundies, or 7½ fluid ounces of port or sherry, or 3 fluid ounces of spirits. That this quantity is exceeded by the great majority of so-called moderate drinkers, I think there can be little doubt, but there is as little doubt that this habitual excess, even though slight, becomes sooner or later a fruitful source of recurring pains and discomfort, if not of actual disease. In the prime of manhood, the effects may be slight, inappreciable, and transitory; but, by-and-bye, distinct warnings are not wanting that if health is to be enjoyed to the full stimulants should be used but sparingly, and with the greatest caution.

HOUSE DRAINS IN RELATION TO HEALTH.

By Dr. Alfred Hill.

Any system of domestic economy which omits the question of the purity of air of the dwelling, and more particularly of that species of impurity which is derived from excrementitious matters, must be pronounced seriously imperfect. Indifference, but more particularly the ignorance which begets it, with regard to this matter, brings sickness and sorrow into many homes, and leads to the sacrifice annually of many thousands of lives. It is a deep conviction of the importance of this subject to the comfort, health, and even existence of the domestic circle that has prompted me to contribute a few remarks upon it to the members of this Congress of Domestic Economy.

Every subject on the programme of this Congress is more or less intimately connected with the promotion and maintenance of health, and to none is it more important to pay attention than that of this paper. It is so difficult to excite attention to intangible objects like the atmosphere or the air of a drain, particularly when it is invisible and often not easily perceived by any of the senses. The present occasion, bringing together as it does so many intelligent thinkers and zealous workers in the field of sanitary science, appears to me a specially favourable opportunity for calling attention to this question, and so making it a starting point, a centre from which the subject may radiate and become one of those embraced by the physiological and sanitary teaching in schools and other educational institutions.

A house drain may be defined as a tubular channel, communicating at its one end, either directly or indirectly, with the waste and soil pipes of the house, and at the other end with the sewer; and, as these three portions really form one commonly unbroken system, it is necessary, in considering the question of house drains in relation to health, to include each portion of this triple arrangement.

The introduction of this subject is justified by the very marked effect drain air can and does exert on health, and the little regard that is paid to this fact by the majority of persons. Medical men, sanitarians, and a few others instructed in hygiene here and there, are all of our great population who ever give a thought to this question, or take a step in regard to it; yet there can be no doubt that that terrible disease typhoid fever, diphtheria, and other zymotics are caused by, and propagated through the medium of, drain air. My own observations of the state of drains in this town prove to demonstration how drain air and certain forms of disease stand to each other in the relation of cause and effect, and in this respect my experience only confirms that of other observers. At the present day, indeed, probably few persons could be found to dispute this statement. The general question may be considered under three heads:—

1. Absence or deficiency of drains.
2. Defective drains.
3. Properly constructed drains.

1. *Absence or Deficiency of Drains.*—A reference to the Report of the Inspections of the Medical Officers of the Local Government Board in 1875 shows that, in a considerable number of the 27 inspections made in towns, and some hospitals and asylums, in different parts of England and Wales, which were the seat of typhoid fever, diphtheria, general zymotic diseases, low type diseases, and a high rate of mortality—in some cases increasing year by year—drains were entirely absent.

The effects of sewer or drain air, or of the gases emanating from surface impurities of excrementitious origin on health, vary according to circumstances. Such air may be so diluted by good ventilation as to be perfectly harmless; often it possesses no disagreeable odour, and is found to cause no inconvenience to persons who spend a great part of their lives in sewers. At other times, where there is an absence of proper ventilation, the air of the same sewers will be found highly offensive, and will suddenly asphyxiate and kill. But the more usual condition of sewer or drain air is one between these two extremes, and inhalation of such ordinary non-infected sewer air for any length of time produces a variety of symptoms, from *malaise* and debility to disturbance of the digestive organs and low fever. It is believed also to aggravate many diseases which owe their origin to other causes, and to impress upon them a low type. When specifically infected by the poisons of typhoid, &c., it has the property of communicating these diseases.

The absence or deficiency of drains and sewers implies the collection of filth on the surface of the ground, or in cesspools, or in dumb wells, or all three. Persons living in houses so circumstanced have frequently been known to suffer from typhoid fever and similar diseases. It might be suggested that probably polluted well water acted as the true cause in these cases, knowing as we do how readily the disease is propagated through the agency of water, but this objection is disposed of by the fact that the introduction of proper drains and sewers has immediately been followed by a disappearance of the disease. The town of Calstock affords a good illustration of the view here stated. Before it was drained, it was subject to constant visitations of typhoid, but after it had been drained, the visitations ceased. Where excrementitious matters are mixed with the soil, as in agricultural operations or in the earth-closet, they are rendered harmless, but where they are permitted to lie on the surface, more particularly in confined situations, they appear to impart to the surrounding atmosphere a quality resembling that of the dumb well, or a sewer, in which cases the absence of drains has the effect of inducing diseases similar to those caused by the breathing of drain or sewer air.

That sewer or drain air is capable of producing illness has been proved in a thousand instances. I well remember a case in my own practice some years ago, where a man, assisting in the opening of a choked drain, was suddenly attacked with vomiting, diarrhœa, colic, and subsequent low fever; and it is easy to understand that the more gradual introduction of such gases into rooms, even if much diluted, will produce symptoms of a milder type. Hence the danger of—

2. *Defective Drains.*—Defects of drainage in towns are more numerous as would be expected than cases of non-drainage, the result being, however, much the same as regards the effect on health. If any doubt existed on the matter, it would be set at rest by an occurrence in my own house some years ago. On returning home about six o'clock one evening I perceived the house to be full of what I had no doubt, from its odour, was sewer-gas. A sink for washing glasses, &c., in the pantry proved to be the point of entrance, and the current of incoming air was so strong that it extinguished a candle held above the orifice of the drain pipe, which proved not to be trapped. There was no evidence that the sewer air coming in was infected, for it produced no specific disease, but, like common sewer-gas, it produced nausea and vomiting in several members of the household. The defects may be of various kinds; the drain may be unventilated, or insufficiently or inefficiently ventilated; it may not admit of flushing; or there may be imperfect trapping, or no traps at all, at sink and other openings near to or in the house; or there may be an accidental leakage through the soil pipe in the house. The serious effect of even very dilute sewer-gas and similar emanations on personal health would scarcely be credited except it had been witnessed. In illustration of this I will state to you another case as it occurred in my own house about three years ago.

In order to save the housemaid the trouble of carrying the bedroom slops downstairs, I had set up in the bath-room a sink for their more ready disposal. The pipe from this sink, which was trapped, was only about 3 ft. long, passing through the wall and opening in the outer air freely into a larger descending pipe, which itself terminated above the ground over one end of an open channel which ran about 8 ft. or 9 ft. to a trapped drain. With these breaks of continuity, and other safeguards, no gas from the yard drain could possibly find its way into the bath-room; there was, however, a weak, but unsuspected, link in the chain, and it was this, the overflow pipe of the bath was made to communicate with the 3 ft. pipe from the slop sink, at about 2 ft. before its termination. In about ten days after the arrangement had been in operation, the person who slept in the room adjoining the bath-room was seized with a very mild yet persistent form of diarrhœa; the servants, also, near the bath-room followed next, and in a day or two every person in the house, except one, suffered in the same way. What seemed remarkable, but is very natural, is that the intestinal disturbance was always greatest in the morning, *i.e.*, after every one had been exposed to the action of the gas all night in the shut-up house. The attacks being so general in their incidence, so persistent in their character, and intensifying with time, I felt sure that some common cause was operating, although I had no suspicion of its precise nature. I knew all the drains were carefully trapped, that no drain passed under the foundation, that there was no water-closet in the house, and no nuisance of any kind was perceptible.

It never occurred to my mind to suspect the short waste pipe which conveyed away the bedroom slops, till one morning, sitting thinking about the matter, I determined to go and examine it. There was nothing to be detected in the sink itself, but on placing my nose close to the overflow pipe in the end of the bath, which I have already said communicated with the sink pipe, I detected the faintest possible urinous odour. The whole matter was now intelligible; the very slight quantity of organic matter adhering to the sides of the sink waste pipe, after use for only about a fortnight, was undergoing gradual decomposition, the gaseous products of which were borne imperceptibly into the interior of the house, by a gentle current generated by the warmer temperature existing there. I immediately stopped the bath waste pipe with a cork, and, as if by magic, the diarrhœa ceased the same day.

If a minute quantity of gas, the result of the decomposition of what may be called healthy organic matter, enormously diluted with atmospheric air, can produce such results as I have described, it is easy to understand what may be the effect of a larger quantity, less diluted, of a similar gas; and if we further reflect on the nature of the cholera and typhoid poisons, as far as we are acquainted with them, we shall have no difficulty in understanding one of the conditions of propagation of these and similar diseases, and realising the still more serious effects which may be produced by their inhalation.

In the discharge of my official duties, the fact of the connection between gaseous emanations and sickness is daily forcing itself on my attention. In most cases of zymotic disease into which I inquire, I find defects which may account for them. To give a few illustrations, I examine a respectable house where there has been a case of diphtheria; it is new, clean, well ventilated, supplied with good water, and is apparently everything that could be desired; but the kitchen sink is in direct communication with the sewer, and the sink being furnished with a moveable bell-trap, which, when in place, is of little use, but is often not in place, there is a frequent entrance of foul air, not only from the drain belonging to this particular house, but from the common sewer, the receptacle of all the drains in the neighbourhood, and of the specific poison of these drains, if they happen to contain any; and on emergency, one learns that frequently a disagreeable smell is perceived in the kitchen.

The same history, with modifications, attaches to nearly all the cases investigated. At one time there is, or has been, a leakage from the soil pipe of the water-closet which has saturated the ceiling and walls; at another there is an entrapped or imperfectly trapped drain, close to the back door; at another there are traps, but they are of an useless kind, either broken or dry, literally "traps for the unwary;" in another the disease, be it diphtheria or typhoid, is in a house with a wet reeking ashpit only a few feet from the door and window, or with a similar ashpit placed against the side of the house, the liquid contents of it soaking into the walls and cellar, and so making the house damp as well as impure. In other cases the sewers, during times of flood, in low situations, discharge their contents into cellars, and such a property will constitute for a time a constant habitat of typhoid fever. These latter conditions are very common in courts, and it is most remarkable that out of a dozen or more houses in a court, the one where there has been zymotic illness is that particular house which is most exposed to the insanitary conditions named. Either want of drainage, or imperfect drainage, drains entirely external to the house, or connected with its interior, may then exert a serious effect on the health; but it is more particularly the question of drains perfectly constructed and properly connected with houses, upon which I wish now to make some remarks. Premising that the private drains are properly connected with the public sewer, a description of the drawings upon the wall will explain the sort of arrangement necessary to protect the occupants of a house from the ill-effects of sewer or drain air.

The first drawing shows the disposition of overflow and waste pipes; they are quite distinct from the soil pipe, and they are, as far as possible, outside the house. The water-cistern, if one exist, is not in direct communication with the waste-pipe, and all the pipes discharge either upon or near a grated trap, and so are effectually cut off from the interior of the drain, the gas of which might otherwise enter the house, or contaminate water supplied from the cistern. The bath is further protected by a plug and syphon bend, and the sink by a bell trap, which must be non-removable. It would be an advantage to protect sink-pipes further by a syphon bend, since an in-current of air would occur if the bell trap should by any chance become displaced. Such an in-current is charged with impurities collected on the sides of the pipe itself,, which, besides being offensive, are, doubtless, dangerous.

The second sketch represents the mode of arrangement of water-closet soil pipes, by which sewer or drain air is prevented gaining access to the interior of the house through the water-closet. To begin at the distant end of the system, the sewer in the street is to be properly ventilated by a sufficient number of openings at the surface of the ground, by which undue pressure upon drain traps is prevented, and the first danger of the entrance of sewer-gas into the house is obviated. These sewer ventilators are provided by the Corporation.

The next point in the arrangement is situated on the house premises, and consists of a syphon-bend of a peculiar disposition and pitch, and a ventilator with moveable grating, to admit of easy flushing and removal of obstructions should they occur. The entrance of sewer-air into the closet is still further opposed by the syphon trap connected with the soil pan. Danger of absorption of injurious gases, or of pressure of sewer-gas upon the water-valve or the soil pan in the closet, is further obviated by the connection of the wide soil pipe, which, it is to be observed, is outside the house with the ventilator, and the ventilating cowl or mere opening at its upper extremity. In order to prevent the admission of impure air into the house from the closet itself, the closet should constitute a projection from the body of the house, and between them there should be a lobby, admitting of cross ventilation by means of a window on each side. This arrangement is best seen in the plan.

The third sketch shows the arrangement of waste and soil pipes outside the house, and, by the dotted lines, their relation to the bath-room and water-closet.

The question of properly draining houses and premises is one of such extreme importance to health, that where, on inspection, it is found necessary to either construct or reconstruct drains, I am of opinion that it is not sufficient to merely require of the owner that the work should be done, but that it should be done under the direction and supervision of a competent and responsible officer of the sanitary authorities.

The peculiar dip and arrangement of the pipe were, I believe, originally suggested by Dr. Buchanan, in his Report on an Epidemic of Enteric Fever at Croydon, in 1875; they are a great improvement on the common mode of trapping drains. With the abolition of bell traps, avoidance of traps under dwelling-houses, and the adoption of such an arrangement of overflow, waste, and soil pipes as I have described, there is little cause to fear the entrance of injurious gases, and there can be little doubt that its adoption generally would have the effect of diminishing, to an enormous extent the occurrence and fatality of low type and preventible zymotic diseases.

MISCELLANEOUS.

INDUSTRIAL CHEMISTRY.*

By Professor Abel, F.R.S.

The subject which my predecessor, in the honourable position of President of this Section made the chief topic of his interesting and instructive address, affords excellent illustrations of the operation of purely scientific research in creating and developing important branches of industry. Mr. Perkin, whose name has from the very commencement of the history of coal-tar colours been identified with their discovery and their scientific and technical history, referred to several series of researches, each one of which formed a link in a chain of discoveries in organic chemistry of the highest value, as establishing, illustrating, or extending important chemical theories, but at the time, and for long afterwards, of value purely from a scientific point of view. These researches, undertaken and pursued by ardent and philosophical investigators under more or less formidable difficulties, and solely in the interests of science, resulted in the discovery of certain organic bodies which were produced originally only on a very small scale and at a great cost, but which, after the lapse of years, have been readily manufactured from abundant sources, and have constituted important elements in the development of the industry of artificial colouring matters. In fact this industry, which owes its origin to the discovery of mauve by Mr. Perkin about twenty years ago, and which is second to no branch of chemical industry in regard to the rapidity of its development and its influence upon other important branches of manufacture, affords more copious illustrations than any other of the immediate influence of pure science upon industrial progress. It, therefore, affords a topic which the chemist may well be excused for continually recurring to, with an interest bordering on enthusiasm, when illustrating the material advantages which accrue to communities from the promotion of scientific training and the encouragement of chemical research.

The iron and steel industry presents a great contrast to that of the artificial colours in regard to the extent of influence which the labours of purely scientific investigators have exerted upon its development. The efforts of scientific men to unravel such problems as, for instance, the true chemical constitution of steel, or the precise differences between the various combinations known as cast iron, and the conditions which determine their individual production or conversion from one to another, have hitherto been attended by results not at all proportionate to the patient experimental investigation of which from time to time they have been made the subject. Thus, the protracted experiments and discussion carried on by Frémy and Caron, some years back, with reference to the dependence of the characteristics of steel upon the existence in it of nitrogen, cannot be said to have led to results of a more conclusive or even definite nature regarding the conditions which regulate the production, composition, and properties of steel than those arrived at by previous distinguished experimenters; and the same must be said, with respect to cast-iron, of such experiments as those carried on for several years by Matthiessen (in which I also took some part) under the auspices of the Association, with the view to eliminate many existing points of doubt regarding the chemical constitution of cast-iron, by preparing chemically pure iron, and studying its combination with carbon and other elements occurring in cast iron.

The prosecution of purely scientific investigations may therefore of itself fail to bear direct fruit in regard to the development of new metallurgic achievements, or even to the elucidation of the comparatively complicated and numerous reactions which occur in furnaces, either simultaneously or in rapid and difficultly controllable succession, between materials composed of a variety of constituents in variable proportions. There can, however, be no question regarding the important benefits which have accrued from the application of chemical knowledge to the study and the perfection of furnace-operations, by those who happily combine that knowledge with practical experience, and with the power of putting to the test of actual practice the results of reasoning upon an intelligent observation of the phenomena exhibited in such operations, and upon the data which chemical analysis has furnished. In the hands of such men, the scientific results arrived at by Karsten, Berthier, Bunsen, Scheerer, Percy, and other eminent investigators acquire new value, and by them the fruits of the labours of the patient toiler at analytical processes meets with that appreciation which their solid and permanently valuable work does not always command at the hands of their numerous brother-workers in chemical science, who follow the far more attractive paths of organic research.

Naturally, the brilliant results achieved from time to time by investigators in organic chemistry, the rapidity with which, by those results, theories are established or extended, types founded, their offspring multiplied, and their connexion with other families traced and developed, impart to organic research a charm peculiarly its own. This, and the general ease with which new results are obtained by the pursuit of methods of research comparatively simple in their nature and few in kind, have for many years not only secured to organic chemistry an overwhelming majority of workers; they also appear to have a tendency to lead the younger labourers in the field of organic research to under-estimate the value and importance, in reference to the advancement of science, of the labours of the plodding investigator of analysis. Yet no higher example can be furnished of the patient pursuit of scientific work, purely for its own sake, than that of the deviser or improver of analytical processes, who, undeterred by failure upon failure, indefatigably pursues his laborious work, probing to its foundation each possible source of error, carefully comparing the results he obtains with those furnished by other methods of analysis, and patiently accumulating experimental data till they suffice fully to establish the value and trustworthiness of the process which he then publishes for the benefit of his fellow-workers in science. Truly, the results of such labours do not stand in unfavourable contrast, from whatever light they may be viewed, to those of the investigator of organic chemistry. It is not to be denied that the labourer at organic research may, so far as the analytical work which should fall to his share in the course of his investigations is concerned, be tempted to reduce this the least attractive portion of his work to within the smallest possible limits, and having, for example, by a boiling-point determination or a single analytical operation of the simplest kind, such as the examination of a platinum-salt, obtained a numerical result approximating to that which his theory demands, may hasten on to the further development of his airy structure, possibly not without risk to its stability. Unquestionably there are instances of frequent occurrence, in the pursuit of a particular line of organic research, in which more is not required than the identification of a particular product by some such simple means as above indicated. It is certain, moreover, that the labours of the organic investigator also not unfrequently afford bright examples of indomitable perseverance under formidable difficulties; and this alone should constitute a strong bond of union between the worker in organic research and his brother-worker in analytical chemistry, if one did not already exist in the active interest which each, if a true lover of science, must take in the work of the other.

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* Address to the Chemical Section of the British Association, Plymouth, August 16, 1877.

It has been remarked by one of the most distinguished investigators, and, at the same time, one of the most brilliant lecturers and successful teachers of our time, that the contrivance of a new and good lecture experiment may rank in importance with the preparation of a new organic compound; and it may certainly be said with equal truth that the elaboration of a new and good method of analysis may rank in importance with a good research in organic chemistry, in reference both to the part it plays in the advancement of science and to its influence upon industrial progress.

An excellent illustration of this is afforded by reference to the Proceedings of the British Association when it met in this town thirty-six years ago. In a letter to Dr. Playfair, Liebig, who took a very active part in the proceedings of the Association in the earlier years of its existence, reports that Doctors Will and Varrentrapp have devised an excellent method for determining the amount of nitrogen in organic bodies, "very exact and easily performed." He then describes in a few lines the process so well known to chemists, which not only has been, and continues to be, invaluable to those engaged in organic research, but which, as may be testified by such researches as those of Lawes and Gilbert, has borne a most important and indispensable part in the advancement of agricultural chemistry. It is, I believe, but an expression of the unanimous conviction of chemists to say the achievements in analytical chemistry of such men as Berzelius, Heinrich Rose, and Fresenius take equal rank with the brilliant researches and theoretical expositions of such chemists as Liebig, Laurent, Gerhardt, and Berthelot, and that, of all the important contributions to the development of organic chemistry which we owe to Liebig, there is none which has exerted so great an influence on the progress of this branch of chemical science as his beautifully simple method of organic elementary analysis.

Reverting to the industry of iron and steel, which, in regard to some of its most important branches, cannot fail to be a subject of special interest in Plymouth and Devonport, it is not difficult to demonstrate that the labours of the analytical chemist have exercised, and continue to exert, an important influence on the very considerable advance which has in recent years been made, and still proceeds, towards securing complete control over the quality and character of the products obtained. The epoch is well within the recollection of chemists of my generation when the British ironmaster first awoke to the benefits which might accrue to him from an application of the labours of the analytical chemist in connexion with iron-smelting. When the last great stride was made in the manufacture of cast-iron, by the introduction of the hot blast, the iron-smelter was naturally led to seek profit, to the fullest extent, with respect both to the great increase in the rate of production of pig-iron attainable thereby, and to the economy achievable in regard to the proportions and characters of the materials employed in the production of pig-iron. But after a time, the great falling off in the quantity of a large proportion of the products of the blast-furnace, and the difficulties experienced in the production of malleable iron of even very moderate quality, given by the first International Exhibition in 1851, directed the attention of our more enlightened ironmasters to the likelihood of their deriving important aid from chemical science, and more especially from the investigations of the analytical chemist.

Among the earliest to realise the importance of trustworthy and detailed information regarding the composition of the iron ores of the country was Mr. S. H. Blackwell, who, in presenting to the Royal School of Mines a very extensive and interesting series of British ores, which he had collected with great labour and expense for exhibition in 1851, placed at the disposal of Dr. Percy the requisite funds for engaging the services of competent analysts (Messrs. J. Spiller and A. H. Dick), who, under his direction and with subsequent pecuniary aid from himself and from Government funds, carried out a very careful and complete examination of this series, the results of which have been of great value for purposes of reference to those actively interested in the iron industry. It was, however, the first connexion of Messrs. Nicholson, and Dr. D. S. Price, and of Mr. E. Riley, with two of the most important iron-works of this country, about a quarter of a century ago (*i.e.*, at the time when the above investigation was commenced), that marked, I believe, the commencement of systematic endeavours to apply the results of analytical research to the improvement and regulation of the quality of the products of our iron-works.

It is, perhaps, but natural that the primary object sought by application of the knowledge of the analytical chemist should have been to eliminate or reduce the existing elements of uncertainty, in obtaining the most abundant yield of pig-iron capable of conversion into railway bar, sufficiently good to meet the minimum standard of quality, and to reduce still further the cost of production of such bar-iron by utilising materials concerning the composition of which (richness in iron, &c.) the iron-smelter was completely in the dark. The information accumulated by the analyst respecting the composition of the ores, fuel, and fluxes available at the works, and the composition of pig-iron and slags (or cinders) produced under varied conditions, in regard to materials employed and to the proportions of ore, fuel, and flux used in the blast-furnace, could not, however, exist long without exerting a marked beneficial influence upon the quality of the iron produced, and generally upon the iron industry of the country.

Percy's invaluable work of reference on metallurgy furnishes abundant evidence of the scientifically interesting, as well as practically useful, nature of the results obtained at that time by the chemists above named, and others, working under Dr. Percy, with respect both to the elaboration of important analytical processes (in which direction Mr. Riley has continued to the present day to do valuable work), and to the elucidation of the reactions occurring in the processes of reduction and refining of the metal. It is needless to dwell upon the fact that the aid of the analyst has now long since become absolutely indispensable to the iron and steel manufacture; but I may perhaps be allowed briefly to refer to one or two recent illustrations of the indispensable part which analyticical research has played, and continues to play ,in the extension of our knowledge of the chemical reactions involved in the production of cast and wrought iron and of steel, and of the influences which the chief associates of iron in its mercantile forms exert upon its physical characters.

Among the many valuable communications made to that most important body, the Iron and Steel Institute of Great Britain, by men who combine great practical knowledge and experience in iron and steel manufacture with high attainments in mechanical science, and such knowledge of chemical science as ensures a full appreciation of its value at their hands, one of the most interesting and suggestive to the chemist is that on the separation of carbon, sulphur, silicon, and phosphorus in the refining and puddling-furnace, and in the Bessemer converter, contributed to the Transactions of the Institute's recent meeting by Mr. Lowthian Bell, whose valuable investigations in connexion with the iron industry are as interesting to the chemist as they are useful to the manufacturer. Mr. Bell has brought together the results of an extensive series of practical experiments on the treatment of different kinds of pig-iron, of known composition in the finery, the puddling-furnace, and the Bessemer converter, and by comparing the results of analytical investigation of the products of those experimental operations with each other and with those of the materials operated upon, he has obtained valuable confirmation of the views already held by metallurgic chemists regarding the succession in which carbon, silicon, sulphur, and phosphorus are attacked when pig metal is submitted to the above purifying process, and the extent to which these foreign associates of iron are abstracted, or resist removal, by the more or less thorough application of those several modes of treatment. He has also thrown new light on the reason why the most difficultly assailable impurity, phosphorus, obstinately resists all attempts to effect even a slight diminution in its amount by application of the Bessemer treatment. The earnestness with which Mr. Bell wages war against this enemy of the ironmaster, in one of its most favourite haunts, the Cleveland district, not simply with the old British pluck which acknowledges not defeat, but systematically on scientific principles, calling to his aid all the resources which the continual advances in applied mechanical and chemical research place within his reach, cannot fail to contribute importantly, if it does not of itself directly lead, to the complete subjection of this most intractable of the associates to which iron becomes linked in the blast-furnace. Indications have lately not been wanting that the existence of phosphorus in very notable proportions in iron may not of necessity be inimical to its conversion into steel of good quality; and it may be that this element, which is now turned to useful account to impart particular characteristics to the alloys of copper and tin, is even destined to play a distinctly useful part in connection with the production of steel possessed of particular characters, valuable for some special purposes.

In the great development which steel manufacture has received within the last few years, one most prominent feature has been the production with precision, upon a large scale, of steel of desired characteristics, in regard to hardness, &c., by first adding to fluid cast-iron of known composition, the requisite proportion of a rich iron ore (with or without the addition of scrap iron) to effect a reduction of the carbon to the desired amount, concurrent with a refining of the metal by the oxidising action of the ore, and then giving to the resulting steel the desired special qualities by the addition of suitable proportions of iron compounds of known composition, rich in manganese and carbon (spiegeleisen and the similar product called ferro-manganese). The germ of this system of producing steel-varieties of predetermined characteristics exists in crucible processes like that of Uchatius, which have been in more or less extensive use for many years past; but it is to such invaluable arrangements as are most prominently represented in the Siemens-Martin furnace, wherein several tons of metal may be fused and maintained at a very high temperature, with as little liability to change from causes not under control as if the operation were conducted in a crucible, that we are indebted for the very great expansion which the direct application of the analytical chemist's labours to the development of the steel industry is now receiving.

The production of steel upon the open hearth, to the elaboration of which Dr. C. W. Siemens has so largely contributed, since he first established the process at Llandore in 1868, has, in fact, become assimilated in simplicity of character and precision of results to a laboratory operation, and may be justly regarded as a triumph of the successful application of chemical principles, and of the power of guidance and control afforded by utilising analytical research, to the attainment of prescribed results upon a stupendous scale with an accuracy approaching that which the experienced chemical operator secures in the laboratory upon a small scale, under conditions which he can completely control. The production of steel by a large number of small separate operations in pots has now become supplanted with great advantage by the Siemens-Martin system of working at some of our largest establishments at Sheffield; this system has also secured a footing at highly renowned Continental works, which are formidable competitors with us in the manufacture of steel, such as those of Essen, Creusot, and Térrenoire. It is especially interesting to notice that, in the hands of those who on the Continent, at least equally with ourselves, have learned to combine the results of practical experience with the teachings of chemical science, the facilities now existing for dealing in a single receptacle with large masses of fluid steel have greatly facilitated the application of chemical means to the production of solid masses of considerable size, thereby reducing, if not altogether dispensing with, the necessity for submitting large steel castings to costly mechanical operations, with the object of closing up cavities caused by the escape of occluded gas as the liquid metal cools. The success in this direction which appears to have attended the addition of silicon, in combination with iron and manganese, to the steel before casting, in preventing the formation of so-called blow-holes, and in contributing at the same time to the production of the particular character of steel required, bids fair to be of special importance in connection with the application of steel to the production of projectiles for use against armour plates, as affording ready and comparatively very economical means of ensuring the production of perfectly sound castings, which, in compactness of structure will, it is asserted, compete successfully with carefully forged castings, and even with the magnificent material which Whitworth produces by submitting the fluid metal to powerful pressure.

The part which silicon plays, by its comparatively high susceptibility to oxidation, in promoting the production of sound steel castings is readily intelligible; but the functions of the manganese compounds, which are an indispensable adjunct to the Bessemer process, and the application of which has become an integral part of the steel manufacture, are still far from being thoroughly understood; and there is ample scope for chemical research, in co-operation with practical experiment, in the further study of the influence not only of manganese in the production and upon the properties of steel, but also of elements such as titanium, tungsten, and boron, and of chromium, which exists, associated in considerable quantities with iron, in a very abundant Tasmanian ore, to which prominent attention has lately been directed. The achievements of the mechanical engineer have so facilitated the handling and perfected the means of production and the mechanical treatment of malleable iron and of steel, that the full advantage may now be reaped of any improvement of a chemical nature which may be effected in the production of those materials; and it must be a source of pride to the chemist to observe with what success the teachings of his science are being applied by practical men of the present day in the construction of furnaces capable of withstanding the high temperatures required for the production and working of iron and steel in large masses, and in combining the perfect consumption, and consequent great economy, of fuel with the attainment of those high temperatures, and with a thorough control over the character of the gaseous agents to which the fluid metal is exposed in the furnace. I need not quote the names of those men who have already rendered themselves prominent by their services in this particular direction, but may refer, in special illustration of the results achieved by purely practical men, to the success in applying very simple furnace-arrangements to the attainment of the above results which has recently attended the labours of Mr. William Price, a principal foreman in the Royal Gun Factories at Woolwich.

A few of the experiments made in the early days of the application of armouring to ships and forts appeared to demonstrate, on the one hand, that steel was quite incapable of competing with malleable iron, of even very moderate quality, as a material for armour plates, and, on the other hand, that the penetrative power of projectiles made of chilled iron, upon the Palliser system, could not be surpassed, or even attained, with any degree of certainty, by projectiles of steel, produced at comparatively very great cost. But some recent results obtained on the Continent, and especially in the course of the important experiments instituted by the Italian Government at Spezzia, have afforded decisive indications that steel, the application of which to the construction of ordnance has since that time been very greatly extended, may now be looked to hopefully as capable of affording greater protection against the enormous projectiles of the present day than can be secured by proportionately large additions to the stupendous iron-armouring of the most modern ironclads, and also as applicable, at a cost very moderate when compared with that of ten years ago, to the production of projectiles of large dimensions, superior in point of penetrative power, and of uniformity in this respect, to those of chilled iron, the difficulties in the production of which are very greatly increased by the formidable increase which has lately been made in their size. Promising results have also quite recently been obtained at Shoeburyness with a new system of applying steel in conjunction with malleable iron, by which a perfect union of masses of the two materials at one of their surfaces is effected by the aid of heat.

The superiority of soft and very homogeneous steel over wrought iron of the best quality, in regard to lightness combined with strength and toughness, is leading to its very advantageous employment in the construction of a particular class of vessels for the navy; and the perfect confidence which can be placed in the uniformity, in structure and strength, of steel of such character as is produced by the Whitworth system of manufacture, has greatly facilitated the production of air-chambers of small weight, but capable of being quite safely charged with sufficient air, under a pressure of 1,000 lb. on the square inch, to carry the Whitehead torpedo through water to the distance of a thousand yards in little more than a minute and a half.

Thus the results of the recent development of the steel-industry, to which the labours of the chemist have not unimportantly contributed, give promise of exerting a great influence upon the resources of nations for defence and attack. Although the necessity for the continual expansion of such resources cannot but be deeply deplored, there can be no doubt that the problems which it presents, and the special requirements to which it gives rise, must operate, and perhaps as importantly as the demands created by peaceful industries and commercial enterprise, in encouraging the metallurgist, the chemist, and the engineer to continue their combined work in following up the successes, to the achievement of which the results of scientific research have greatly though indirectly contributed.

If it were necessary to add to the illustrations which Mr. Perkin gave in his address last year of the practical fruits of research in organic chemistry, I might be tempted to dilate upon the important results which have, especially during the last ten years, grown out of the discovery and study of the products of the action of nitric acid upon cellulose and glycerine. During the six years which have elapsed since I had the honour of bringing before the members of the British Association the chief points of scientific interest and practical importance presented by the history of those remarkable bodies, their application to technical and war purposes has been greatly developed. Nitroglycerine and gun-cotton may now be justly classed among the most interesting examples of the practical importance frequently attained by the results of chemical research, while the history of the successive steps by which their safe manipulation and efficient application have been developed, affords more than one striking illustration of the achievements effected by combined physical and chemical research, in the solution of problems of high scientific interest and practical importance, and in the vanquishment of difficulties so formidable as, for a time, to appear fatal to the attainment of permanently practical success.

It is to a careful study of the influence which the physical characters of gunpowder (its density, hardness, &c.) and its mechanical condition (*i.e.*, form and size of the masses and condition of their surfaces) exert upon the rapidity of the explosion under confinement that we chiefly owe the very important advance which has been made of late years in controlling its explosive force, in its application as a propelling agent, and the consequent simple and effectual means whereby the violence of action of the enormous charges now used in siege and ship-guns is effectually reduced to within their limits of endurance, without diminution of the total explosive force developed. But, concurrently with these important practical results, the application of combined chemical and physical research to a very extended and comprehensive investigation of the action of fired gunpowder, has furnished results which possess considerable interest from a purely scientific point of view, as in many respects modifying, in others supplementing, the conclusions based upon earlier experiments and theoretical considerations with respect to the nature and proportions of the products formed, the heat developed by the explosion, the tension of the products of combustion, and the conditions which regulate it, both when the explosion is brought about in a close vessel and when it occurs in the bore of a gun. The results of these physico-chemical researches have, moreover, already acquired practical importance in regard to the light they have thrown upon the influence exerted by variable conditions of a mechanical nature upon the action of, and pressure developed by, fired gunpowder in the bore of a gun, and in demonstrating that modifications in the composition of gunpowder, not unimportant from an economical point of view in dealing with the very large charges now employed, may importantly contribute to render the storing of the maximum of work in the projectile, when propelled from a gun, compatible with a subjection of the gun to comparatively very moderate and uniform strains.

Other interesting illustrations of the intimate manner in which physical and chemical research are linked together, and of the important extent to which some of our most illustrous workers in chemistry have contributed to demolish the semblance of a barrier which existed in past times between the two branches of science, are furnished and suggested by the recently published list of grants of money which the Government has made to scientific men, on the recommendation of the Royal Society, from the fund which, for the first time last year, was added to the very modest sum previously accorded from national resources in support of research. The perusal of that list, representing as it does a most carefully considered selection by the highest representatives of science in the country, from a very large number of applications, affords important evidence, on the one hand, of the active pursuit of science in Great Britain, and, on the other hand, of the very wide range of subjects of interest and importance, the full investigation of which demands the provision of adequate resources. That the necessity for such resources needs but to be thoroughly made known to ensure their provision, even from other than national sources, has been demonstrated by the success which, in a comparatively brief space of time, has attended the efforts of the Chemical Society to establish, upon the foundation patriotically laid by one of its original members, Dr. Longstaff, a special fund, to be administered by the society, for the advancement of chemical science. An inspection of the list of contributors to this special fund in aid of chemical research, which, in about two years, has reached the sum of £4,000, and from the proceeds of which the first applications for grants have recently been met, is suggestive of two observations: one is, that the proportion and amount of contributions hitherto received are comparatively small from the source whence the greatest support of such a fund may naturally be looked for, namely, from those who most directly benefit by the results of chemical research. It is to be hoped that there are many prominent representatives of the chemical and metallurgic industries in this country who still intend to give practical effect to their natural desire to aid in the advancement of chemical science, and to the appreciation which they can hardly fail to entertain of the usefulness of this fund. On the other hand, it is a matter well meriting special notice that a very prominent section of the contributors to the fund is composed of some of the most ancient corporate bodies of the City of London. Most welcome evidence is thereby afforded of the readiness which the City companies are prepared to respond to appeals for the substantial support of measures well calculated to promote progress in science. This evidence, and the combined action which they are even now contemplating for promoting the application of scientific research to the advancement of industry and commerce, by establishing an institution for technical education upon a scale worthy to serve as a monument of the true usefulness of wealthy confederations, must be cordially hailed as very substantial proofs that these representatives of our national wealth and commercial supremacy are entering upon a new sphere of activity which will more than restore their ancient *prestige*, by according them a new rank, more elevated than any which their importance could, in the past or future, confer upon them—a rank high among the chief promoters of our national enlightenment.

EARLY STEAM NAVIGATION.

In the *Journal* of March 31st last, an account was given of Messrs. Wright's labours in connection with the introduction of steam navigation on the River Yare, which seem to have been almost entirely overlooked by writers on the history of the subject. A somewhat contemptuous notice in Dodd's "Treatise on Steam-boats" (London, 1818), quoted in Stuart's "Anecdotes of Steam-engines," vol. 2, p. 531, appears to constitute the sole record of an enterprise which lasted for four years, and was only terminated by the disastrous accident described in the former article. The editor has recently received from a correspondent at Norwich some interesting extracts from the local paper which fully corroborate the recollections of Mr. Wright which were published in March last. There appears, however, to have been a slight misapprehension as to the date of the commencement of the undertaking, which was certainly 1813, not 1811 as previously given on the authority of Mr. Wright. The extracts given below can leave no doubt on this point.

The earliest mention of the subject which this correspondent is able to find is in the following advertisement in the *Norwich Mercury* of Saturday, August 14, 1813:—

"The public are respectfully informed that the Steam Packet Boat will regularly leave Turner's Bowling-green, Yarmouth, at seven o'clock every morning, and leave Norwich every afternoon precisely at 3 o'clock. (2391)."

The same paper also has this paragraph:—

"On Monday morning last [August 9th] the public crier announced to the inhabitants of this city, that the new steam barge from Yarmouth was to pass Thorpe at half-past five in the afternoon. This notice had the desired effect, the village of Thorpe and the banks of the Wensum were lined with spectators until a late hour, when it was discovered it was a hoax, but on the next day [10th] at two o'clock the looked-for barge arrived at Sandling's Ferry. She made her passage in about five hours and a half."

The Yarmouth correspondent of the *Mercury*, writing on the 13th of August, says:—

"On Monday [August 9th] the first experiment was tried with the Steam Packet Boat, on which occasion Sir Edmund and Lady Lacon and family with a party of ladies went in the boat unto Braydon, and expressed themselves highly gratified with their excursion. She afterwards went through bridge amidst the acclamations of thousands of spectators. The boat has since gone regularly to and from Norwich, and answers every expectation, and we have no doubt but that she will reward the exertions of her spirited proprietor and projector."

The event is also alluded to in Matchett's "Norfolk and Norwich Remembrancer of Events occurred between 1701 and 1821" (Norwich, 1822), in which we find the following:—

"1813, August 10.—The first experiment made with a steam-barge, which arrived at the Norwich Ferry from Yarmouth. It proceeded at the rate of about five miles an hour."

The explosion is thus described in the *Norwich Mercury* of 5th April, 1817:—

"One of those unfortunate accidents which attend even the best arranged establishments that carry with them a certain though remote danger, occurred here yesterday morning, and we state the extensive calamity with much acute pain. The horrid spectacle of eight mangled carcases is yet before our eyes. These are the miserable victims of the bursting of the steam boiler in the packet which sails from the Foundry-bridge. Just after the boat had started, it had not gone 20 yards, when the tremendous explosion took place. The vessel was rent to atoms, so that little remains entire from the stern to the engine-room, except the keel and the flooring. Twenty-two passengers appear to have been on board—the bodies of eight are found (five men and three women) one child, yet missing, and six have been sent to the hospital in a wounded state, six escaped unhurt, of these last one man was standing over the boiler when the explosion happened. It is said Major Mason was another whose clothes were torn by the shock, but who was otherwise uninjured, the third was an infant two months old, and the little innocent was discovered at the bottom of the vessel in a profound sleep after the removal of the dreadful wreck. At this moment the Coroner's inquest is sitting, and we have only time to subjoin the names of the dead.

[Here follow the names.]

"The following statement will show readers the cause which must have produced an accident:—

"The boiler is a cylindrical vessel laying fore and aft the vessel, about 8 ft. long and 4 ft. diameter, made of wrought iron, excepting one end which laid towards the stern of the vessel, and is of cast iron. In consequence of the stress of steam being greater than the boiler was capable of sustaining, the cast iron part of the boiler gave way, and flew in a direction towards the stern of the vessel, on which taking place, a stress immediately falls on the boiler itself to throw it out of its situation, the stress depending on the magnitude of the orifice occasioned by the fracture, and consequently it was thrown in an horizontal direction out of the stern of the vessel, sweeping all before it in its passage to a distance of about 15 yards, at the same time that the concussion of the air and steam completely unroofed the vessel from one end to the other."

Matchett's *Remembrancer* has the following:—

"1817, April 4.—On Good Friday morning Wright's Norwich and Yarmouth steam-packet had just started from the Foundry-bridge, when the boiler of the engine burst with a tremendous explosion, by which the vessel was blown to atoms, and of 22 persons on board five men, three women, and one child were instantly killed, and six women with fractured legs and arms were conveyed to the hospital, where one of the women died, the remaining seven (including three children) escaped without sustaining material injury. Upwards of £350 was raised for the relief of the poor sufferers."

* * * * *

"1817, July.—Soon after the dreadful explosion of the steam boat, a packet was introduced on the Norwich river worked by four horses as in a threshing machine, by their walking in a path (18 feet in diameter) the distance of two miles; the vessel is propelled from six to seven miles, as wind and tide may be."

The unfortunate occurrence appears to have excited a good deal of attention. Most of the London papers of the day noticed the accident, and letters on the subject, by A. Galloway and another, appeared in the *Morning Chronicle*, of the 9th and 10th April. On the 8th of May Mr. Charles Harvey moved for a Select Committee of the House of Commons, to investigate the question of the use of steam for propelling vessels, with special reference to the Norwich explosion. The committee commenced to sit on the 13th of the same month, and their report was dated June 24. Several eminent engineers were examined, and the conclusion arrived at with regard to the Norwich accident was that it was caused by the improper construction of the boiler, and by the safety-valve having been overloaded. Not much information was brought out about the accident itself, and the history of the experiment was not touched upon. The report, therefore, adds to the narrative nothing that was not before known.

In spite of the explosion the other steam-boats were quite full on the Monday following, according to the *Cambridge Chronicle* of the 11th April. It would appear, indeed, that the progress of steam navigation was in no way hindered, and on the 2nd of August, 1817, the following advertisement appeared in the *Mercury*, stating that a steam vessel would ply between Garth and Norwich, and that it had been approved by Mr. Charles Harvey, M.P., Chairman of the Steamboat Committee of the House of Commons:—

"The public are respectfully informed that the steam vessel which passes between this city and Yarmouth, has this week been inspected by Charles Harvey, Esq., one of the members for Norwich, and the Chairman of the Committee of the House of Commons, lately occupied in preparing regulations under which a Bill will in the next session be brought into Parliament to ensure the safety of the passengers in vessels navigated by steam.

"Mr. Harvey has permitted the proprietor thus publicly to use his name, in order to spread and confirm the knowledge of the fact that the vessel above mentioned is constructed in every respect so as to comply with the recommendation of the committee, and ensure the most perfect safety. The engine employed is a condensing engine. The boiler is entirely of wrought iron, and it is furnished with two safety valves, the one of which is inaccessible to the man who has the care of the engine. The proprietor thus hopes to satisfy the public that they may pass in his vessel in the utmost security.

"The *Nelson* starts every Monday, Wednesday, and Friday, from Mr. Brickwood's garden, at nine o'clock in the morning, and leaves Yarmouth on Sunday, Tuesday, and Thursday, at the same hour."

GENERAL NOTES.

The Telephone in Mines.—A new application of the telephone has just been tested in Cornwall by Dr. C. Le Neve Foster, her Majesty's Inspector of Mines for the district. A ready means of communication between the surface and the workings of the mines has long been required, the present cord signals being obviously imperfect and the ordinary telegraph instruments being inapplicable for unskilled use, as well as costly. On Tuesday Dr. Foster and his brother, Mr. A. Le Neve Foster, who is a telegraph engineer, tried the telephone at the Eliza Mine, St. Austell, and found it, as might be expected, to answer perfectly. The instrument used was Bell's Articulating Telephone, the same which attracted so much attention at the British Association meeting at Plymouth. Its simplicity and the very low cost with which it can be applied were thought to render it specially applicable for such a rough-and-ready purpose as this, for it requires no more skill to use, or care to keep in order, than a speaking tube.

An International Exhibition of Hops, and of tools and apparatus used in the cultivation, drying, packing, and preservation of hops, is to be held at Nuremberg from October 7 to 15 next. Forms of application and all necessary information can be obtained from Herr Eduard Vollrath, Nuremberg.

Messrs. Sampson Low have in the press a work on "The History and Principles of Weaving, by Hand and by Power," reprinted, with considerable additions, from *Engineering*, with a chapter on "Lace-making Machinery," reprinted from the *Journal of the Society of Arts*.

Trade Marks states that a Bill to provide for the registration of Trade Marks under a permissive system has been recently introduced by the Attorney-General, and read a second time in the Cape Parliament.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,295. Vol. XXV.

FRIDAY, SEPTEMBER 14, 1877.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

DOMESTIC ECONOMY CONGRESS.

The following is a report of the proceedings of the Congress at Birmingham, on the first day of its sittings (Wednesday, July 18th):—

SECTION A.—NEEDLEWORK, CLOTHING, AND MATERIALS.
President—Miss Kenrick.

The President opened the subject of needlework and clothing by her paper on "Results obtained in some Elementary Schools."[*]

Miss Mary W. Willis followed with her paper on "Needlework,"[†] and **Mr. Joseph Pope** with his paper on "Clothing and its Materials."[‡]

In the discussion which followed,

Sir Henry Cole, K.C.B., said he thought they were all prepared to say "Amen" to what they had heard. He had but one general observation and one practical suggestion to make. He desired, firstly, to express his regret that her Majesty's Government were not represented at this Congress. He begged leave to suggest, through the medium of the winged messengers that would go forth, that her Majesty's Government could hardly do a wiser thing than instantly attach to the Committee of the Council on Education their practical President on this occasion. If they wanted to understand needlework, the person to teach them was a woman, and not a wrangler, and he was certain all would be satisfied that there was no better woman to propose than Miss Kenrick.

Mr. R. C. Browne Clayton (Oxford), referring to the remarks of Mr. Joseph Pope concerning clothing materials, called attention to a material manufactured at Bâle and the Grisons, but which he had never seen in this country. It was called *crêpe de santé*, and seemed to meet many of the requirements of clothing in a manner which other materials did not.

Mr. E. Chadwick, C.B., wished to point out that black was a colour which absorbed mephitic gases in large quantity, and to avoid that, doctors, clergymen, and others, who visited the sick, ought always to go about in white. With regard to texture of clothing fabrics, it was worthy of attention that those which were loosely woven were much warmer than those in which the fibre was broken up by hammering, in order to produce a smooth surface.

Mr. Traice (Manchester) said there was one point with which he had often been struck, and to which some time back he called Sir Henry Cole's attention, and that was the advisability of uniting drawing with the preparation of clothing patterns in their schools. They were doing a good deal to introduce drawing into their elementary schools, and there was no practical purpose to which it could be better applied than to the cutting out of patterns for clothing.

Miss Chessar (late member of tho London School Board), with regard to the question of needlework, said that very young children could do a great deal better needlework than people thought. It was a subject that required a great deal more attention than had been given to it, and she was glad that the Government had at last taken up the matter in an official way, and had published that much abused schedule on needlework which was said by everyone who had not tried it to be quite impossible, and by everybody who had tried it to be a thing to be accomplished. There was no doubt that chemes of needlework, to be really valuable, must be thoroughly graduated. The scheme which was now before the public was a well graduated scheme, but it also required that the teachers should know the subject themselves before they attempted to teach it. If more help were given to the schools, and if the teachers came better prepared than they now were to do the work, there was not the slightest doubt that needlework scheme could be carried out, and if carried out it would do an immense deal to make the girls in their elementary schools the good needlewomen they ought to be in the present day, but which they were not.

Mr. Danby Seymour (member of the London School Board, and of the Council of the Society of Arts) expressed the belief that the glove-stitching practised in this country, to which Miss Willis alluded, was an injurious occupation. He assured Miss Chessar that great attention was still being paid to needlework by the London School Board. He regarded the suggestion that the Society of Arts should publish patterns as a valuable one, and when the question came before the Society he should give it his attention. With regard to the present Congress, he thought the enthusiastic manner in which it had been taken up in Birmingham proved that the Society of Arts had taken a step in the right direction, and he hoped they would be successful in the object they had in view.

The Rev. J. P. Faunthorpe (Principal of Whitelands Training College) said he considered that the scheme put forth by the Government with regard to needlework was far above the capacities, not only of the children of the present time, but far above what would be practically within the reach of children for some years to come. This would be seen when it was remembered that the scheme expected a child of twelve or thirteen years of age to cut out and make every article required for what was termed "a large family." It had been said by a previous speaker that people who were practically well acquainted with needlework were entirely in favour of the new schedule, but, so far as his experience went, his impression was entirely the reverse; and those acquainted with needlework and its teaching said that the thing was impossible.

The Rev. J. T. Haworth (Birmingham) said they had been shown some wonderful specimens of work done by infants of three years old, and he would like to ask the parents present whether they would like their little ones of the same age to do such work. If not, why should they force it on the children of the working classes?

Miss Sturge (Birmingham) was averse to such teaching for very young children. She thought there was too great a tendency to turn their schools into manufactories, rather than to set the children in the right way for learning their work.

The President having pointed out that children of the middle class were not put to needlework so early, because their education did not cease so early as the children of the working class, the discussion on this subject closed.

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[*] See *Journal* for July 27. [†] *Ibid.* [‡] *Ibid.*

CLEANLINESS.—WASHING.

Mr. E. Chadwick described a paper on "Head to Foot Washing, and Public Measures for facilitating it,"* which he had prepared.

The Rev. T. C. D. Morse read a paper by the Rev. Harry Jones, on "Washing."†

Miss Chessar read a paper on "Baths and Swimming for Young Children;" and a paper contributed by Mrs. Watson, on "The Importance of Training Young Servants in Habits of Cleanliness," was read by **Mrs. C. J. Bracey.**‡

The Rev. Brooke Lambert (Tamworth) said, with reference to cleanliness in elementary schools, the weapons for enforcing it were already in the hands of the managers. In the Revised Code there was a paragraph to the effect that managers of schools would be required to satisfy her Majesty's Inspectors that all reasonable care was taken to bring up the children in habits of punctuality, good manners, cleanliness, and neatness. There was one objection which he had to make to the general tone of Mr. Chadwick's paper. The restrictions as to the presence of untidy children must not be obtained by compulsory measures, nor by such legislation as would be required for the establishment of Mr. Chadwick's grand washing apparatus, to wash a lot of School Board children in five minutes. They must trust rather to the teaching of the children those elementary lessons in physiology so well advocated by Professor Huxley. A lesson on the analogy afforded by the effect of a shower of rain upon plants would do more to inculcate habits of cleanliness than any amount of legislation. There was one thing quite as important as healthiness of the body, and that was independence of mind. This over-legislation and degradation of legislation to minutiæ, instead of making the practice arise out of teaching, did much to destroy the independence of the nation.

Mr. J. A. Youl, C.M.G. (Member of the Council of the Society of Arts) enforced the importance of cleanliness by several illustrations, particularly by the case of a young surgeon appointed some years ago to the charge of an emigrant ship bound for Australia. With some difficulty the surgeon succeeded in getting the whole of the passengers who were then on board to wash from head to foot at least once a week during the voyage. There were 63 women among them, for whom he had fitted up a strictly secluded bath. The result of the experiment was that the vessel was the first emigrant ship which arrived at Adelaide without the loss of a single life; while all the women were in good health except those who were suffering from consumptive complaints. That result was simply owing to "washing."

The **Rev. Canon Lea** (Droitwich) said he was manager of a school, and also Chairman of the local School Board. Some time ago they brought in a great number of children who had been greatly neglected, and had not been to any school before. He was at first most horrified with the condition of the girls' hair. Having failed in his endeavours to enforce cleanliness, he selected a number of them who were in the worst condition, and ordered them to be washed, and appointed a washerwoman to the school. At first there was, of course, a great deal of opposition to it, and one day when he was away two of the parents made a most violent and unprovoked attack upon the washerwoman. The borough magistrates, however, stood most nobly into the cause of cleanliness, for they punished the women severely, and after that they had no further opposition. The parents had now learned that it was necessary for them to keep their children clean. If the good ladies in the Birmingham Board schools would make the same investigation, they would most likely find the same state of things. He thought it was most important that those things should be looked into, and great good would accrue from the carrying out of the system he had described.

The Rev. E. F. M. MacCarthy stated, for the information of Miss Chessar and the Congress generally, that the Birmingham School Board had for the last two years and a-half had a simple machinery, by which they had put facilities in the way of the children of the Board schools to go to the baths periodically with the teachers. 10,000 tickets had been sold at a halfpenny each. He had no doubt that the stimulus given to the question by this Congress would lead to greater efforts to get a larger number of children to attend the baths. They had not in Birmingham such advantages as London enjoyed from the existence of the sheets of water in the public parks; but he hoped that in time they would get artificial pools for bathing made in the public parks. With regard to the remarks made by Canon Lea, Dr. Langford, who had interested himself very considerably in the question of the personal cleanliness of the children, had assured him that there was comparatively little liveliness about the heads of the children externally.

Mr. E. Chadwick defended the use of compulsory measures to secure the cleanliness of children, and laid special stress upon the illustration which Holland afforded, of the beneficial effect of making the sending of a child to school in a dirty condition a reprehensible offence. Those effects were seen, not only as regarded the children, but they gradually spread to the parents and their homes.

Mr. R. Browne Clayton said that on his estate he had four schools, one of them containing 700 children, and he was so anxious to inculcate habits of cleanliness that he had formed two swimming baths, and swimming was made part of the school education. He should like to see swimming taught in all schools.

Mr. Pope said he knew, from his experience in the army, that compulsion was necessary to ensure cleanliness. He knew that they had in some instances, notwithstanding the existence of the best bathing facilities in the place where the men might be quartered, found it necessary to hold bathing parades, and march the men to the water before they would go in.

Mr. E. C. Tufnell, late Inspector of Pauper Schools, pointed out that open sheets of water could only be used, on account of their temperature, a few months in the year. They ought to have baths attached to the schools, where the temperature of the water could be regulated. This would not only be good in a sanitary point of view, but it would be of great use in teaching the children how to swim.

At this stage the Section adjourned.

SECTION B.—HEALTH.

President.—Dr. T. P. Heslop.

This Section opened for the discussion of the above subject at 12.30 p.m.

Professor Huxley, F.R.S., described his paper on "Elementary Instruction to Children in Physiology."*

Mr. F. E. Hoggan, M.D., read a paper "On the Substitution of Scientific Subjects for Fancy Work in Girls' Education."†

The Hon. and Rev. W. H. Lyttelton (vicar of Hagley), addressed the Congress. He thought that if in all their elementary schools some lessons were given in popular science in such a way as to stir up in the children a love of those sciences, and in training them in those habits of mind in which they could be afterwards pursued, they would find a greater demand in their mechanics' institutions afterwards for lectures and classes of various kinds. Of course, in any elementary school it was impossible to give anything like a complete knowledge of any one of the scientific subjects taken up. All they could do was to start the children in the love of them, to show them the interest of those great subjects, and cultivate those powers of mind and observation by which they might collect information upon them afterwards. Ever since he had had to do with country parishes, he had endeavoured in his own little way, and he thought successfully, to promote the study of science in the schools under his charge. He had gone upon the system advocated by most of the greatest men of science before the Public Schools Commissioners. They all concurred in this, that all that need really be done for the main object in view in teaching these things, was to teach the children a thoroughly good lesson one hour in the week. They grounded that conclusion upon the idea that the object really was to start the children in these subjects, and to fish for those fish in their pools which were attractable by those baits. It would, perhaps, be objected by many schoolmasters and mistresses that, in the face of the Government requirements, it was impracticable to give this hour. They brought up the three idols, commonly called the "three R's," and said it was impossible to worship them as they ought to be worshipped if they were to introduce those additional subjects. He would answer that by stating that in the schools of his parish, when he asked his schoolmaster whether, on the raising of the Code, the weekly science lessons should be given up, the master replied in the negative, and stated that he found the lesson stimulated the interest and liveliness of the minds of the children, so that they studied the three R's afterwards with greater profit and advantage. These lessons were of great value in teaching the children to read, not merely words, but facts. One thing which was wanted was some further guidance and help from the central authorities in the teaching of these things. He hoped a time would come when in all their country districts there should be a central school of rural economy—an establishment where there should be a museum, a good library, and intelligent teachers, who should be ready to give advice both to schools and to institutions for adult instruction as to the best methods of teaching, &c. He also hoped that the time would come when schoolmasters would be trained with special reference to the particular characteristics of the district in which he was placed, so that a schoolmaster in a rural neighbourhood would have a lively interest in rural matters, and in mining districts an interest in geology, so that they would be able to instruct their pupils in those things. He also hoped the time would come when clergymen would make a necessary part of the curriculum of their education a practical knowledge of science in some of its popular aspects.

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* See *Journal* or August 17.
† *Ibid.*
‡ See *Journal* for July 27.

* See *Journal* for August 3.
† See *Journal* for August 17.

Gen. F. C. Cotton, R.E., C.S.I. (Chairman of the Council of the Society of Arts), said that, with reference to education in science in early life, he might furnish an illustration of how much could be done by it, and how much might be lost through the want of it. He referred to the army and the navy, and the fact of how little additional knowledge was brought home by those bodies from their visits to foreign countries. The only important exception to the rule were the medical men in the services. Here, they had an army throughout the world, men sitting with their hands before them, or, what was worse, drinking brandy and water, who, if they had a slight knowledge of science given them at school, would have taken up some branch, and brought back valuable knowledge from foreign parts. He did not hesitate to say that, if the officers of the army had had a slight scientific education before they went to India and other parts of the world, they would have brought back, not dyspepsia and discomfort in their livers, but specimens for the British Museum which would have been of great value.

Mr. Danby Seymour said it appeared to him that the want of time for scientific subjects, and the three R's in elementary subjects, was the greatest obstacle in the way. There was one means which he thought would help to remove the obstacle by the economy of time, and that was the spelling reform promoted by the London School Board, by which it was calculated that two years might be saved in the teaching of reading and writing. He was informed that the Birmingham School Board had supported the efforts made by the London School Board, and he hoped they would continue to do so, and that the proposal would be carried.

The Rev. J. P. Faunthorpe called attention to the fact that the question under discussion was by no means overlooked in the training colleges for elementary teachers, and that scientific subjects were taught in the greater number of them. It might also not be generally known that in any school where these subjects might be taken up, the Science and Art Department would undertake the examination of them. All that was necessary was that persons in the locality should form themselves into a Board to conduct the examination, and the Science and Art Department would send down papers.

Mr. Frank Curzon (organising secretary of the Yorkshire Union of Mechanics' Institutes), said he had long desired to see some means of infusing a little more scientific life into the institutions with which he was connected. The difficulty was that almost no preliminary instruction was given in science subjects in the primary schools. There was one other matter to which he wished to call attention, and that was the need of science models a little less costly than those which were now obtainable. A model of the human eye or ear cost from five or seven guineas, which was entirely beyond the reach of most school teachers and working men.

Mr. E. Chadwick directed attention to the practical improvement which was going on in the teaching of physiology in Germany. In consequence of the enormous losses on the field in the Franco-German war, resulting from want of information as to how to treat wounded persons, a new system of instruction had been instituted. Companies were assembled, and certain members were supposed to be wounded in various parts of the body. The men were instructed on the spot how to apply bandages, and take other measures to stay the mischief which had been done. It appeared to him that this was a very important practical application of physiological knowledge.

The President said it appeared to him that one important thing to make people know was, that the teaching of physiology was not a mere luxury for those in search of sweetness and light, but was an absolute necessity in daily knowledge and education. Another point to which he wished to allude, was that they wanted persons competent to teach physiology in their schools in the manner which Professor Huxley had indicated. It must be a pleasant recollection to Professor Huxley that he took part in advising the trustees of the fund which had been established in Birmingham to teach the laws of health to teachers. It was Professor Huxley who advised them as to the appointment of the first professor, and he was sure he would be glad to know that a few days ago one of the teachers examined, and to whom was put a paper which would have puzzled advanced medical students, obtained a fraction over 75 per cent. of professor's marks. There were wide gradations downwards, to one person who only answered part of one question, but there were a considerable number of those examined who had obtained 40 and 50 per cent. of the marks. He was sure Professor Huxley, accustomed to examinations, would admit that that was an excellent result. He (the speaker) could not leave this subject without expressing his sense of the loss that Birmingham had sustained in the death of their fellow-citizen, Mr. Arthur Ryland, whose name would ever be identified with the trust to which he had referred.

Professor Huxley then briefly replied. With regard to the question of supplying cheaper models, he was afraid that nothing could be done unless they could simplify the human frame. A model of the eye, for instance, to be of any use, required a great deal of attention in its production, and that attention capitalised meant a high price. One speaker had referred to the action of the Government with regard to science teaching as having been of a *dilettante* character. He wished to say that that was certainly not the case with regard to the teaching of physiology. When the present system of science and art examinations was instituted, it was found that the knowledge then existing was of a most unreal character, arising from the want of proper teachers. He did not mean to say that there were not plenty of persons of great intelligence and capacity engaged in the teaching, but they simply applied the methods of book-teaching to the teaching of science, and they made a mess of it. One of the first things which was done to remedy that state of things was to establish classes for the practical teaching of teachers, and there was nothing now to prevent a teacher going up to London for a short time to one of the classes referred to. Although the course might be short, it was marvellous how much a man of trained capacity could gather. He did not think the Government could do anything much more practical than had been done in this direction. With reference to what he had said about the present state of the law as bearing upon the practical teaching of physiology, he hoped he should not be misunderstood. Pray let them discriminate between the strict interpretation of the law, and the way in which it might be carried out. He did not for a moment suppose that the present Home Secretary, who was a gentleman of great intelligence and good sense, would sanction so frivolous a prosecution as that to which he had referred at the conclusion of his paper. He did not think there was at present the slightest danger of the law being put in force in such a way. It was quite possible, however, that things might change, and at any rate it was not a satisfactory thing that anyone should feel himself breaking even the letter of the law.

SECTION C.—METHOD OF TEACHING DOMESTIC ECONOMY.—TEXT BOOKS.

President—Mr. G. W. Hastings, J.P.

Sir Henry Cole described his paper on "The Practical Development of Elementary Education through Domestic Economy."*

The Rev. E. F. M. MacCarthy, in opening the discussion, said that in his opinion, from a practical point of view, Sir Henry Cole had hit upon a great blot in the Education Code—a blot which was all the more to be regretted because it first made its appearance only a little more than twelve months ago. One would have thought that such a step as that to which attention had been drawn, would not have been taken without very careful consideration and information derived from a very great variety of sources. A point to which he alluded was the fact that geography, history, and grammar had been taken from their place in the Code among the voluntary subjects, of which there were some ten or twelve, and any one of which could be selected and taught by a special school, according to the attainments or natural bent of the master or the peculiarities of the neighbourhood. What the Government did was this, they took grammar, geography, and history out of the category of optional subjects, where they had been ranked with a large number of others—English literature, botany, &c.—and put them so that schools, depending upon grants, were necessarily led to teach them before they attempted to teach any other subjects, amongst which domestic economy was one which that Congress took so much interest in. That was an error of principle, but there was also an error of detail to which Sir Henry Cole had drawn attention. The error of detail was that children at the commencement of the study of geography were first to learn the motion and forms of the earth and the meaning of a map. That was to say, that children of eight years of age were to learn the elements of astronomy. He need not say that practical educationists were quite aware that that was beginning at the wrong end of the stick. As a matter of fact, the books in use at elementary schools actually condemned the Government Code. Mr. Currie's book on school management, which was taken as a sort of standard by pupil-teachers, strongly condemned as a method the early introduction of those astronomical considerations. On page 131, it was said that maps should not be used at this period, since the position of various countries was not the object of study. This book, which was put into the hands of young pupil-teachers as a guide, set before them the true principle, whereas the Code told them they must do something entirely different. He could only attribute this extraordinary exhibition of ignorance of the principles of education to the fact that some elderly inspector, being called upon to draw up the schedule, opened a geography about 50 years old, and finding that the first chapter treated of definitions, put them down for the first year. He agreed with the position which grammar held in the Code, but thought that both history and geography should be put back to the position which they formerly occupied. Let them put domestic economy on the same footing, or, if they liked, on a better footing, and he was quite sure that, in the long run, they would have each school developing its own individuality, according to the discretion and aptitude of the teachers, and the requirements of the various localities.

Miss Smith (of the Oxford School Board), thought that the first lessons in geography in the Code had been much misinterpreted by the preceding speaker. She believed that she could give a lesson to children of seven or eight years of age on the form and motion of the earth that would be understood by them.

The Rev. J. T. Haworth said he thought that geography and history were quite different to domestic economy. In these days when the working classes possessed the franchise, history was essential for every lad in every elementary school. In a commercial and manufacturing country like England, geography was also an essential subject. Domestic economy, in his opinion, was more a matter for girls. With respect to the teaching of grammar, they had great difficulties to contend with from the number of text books, and the difference of opinion of the inspectors who had to examine the work. From a very lengthy experience, he could endorse the opinion of an old inspector, that the difficulties connected with grammar were such that he would almost propose that every child should be examined at its birth, and if it showed any tendency to write a grammar it should be at once extinguished. He advocated geography and history, not as sweetmeats but as essentials, in boys' schools, just as he would stand up for needlework and domestic economy in girls' schools.

Sir Henry Cole, in reply, said he denied that in the three million of children of the working class there was any real difference up to the age of 13 in the educational requirements of the two sexes. He maintained that a boy who knew needlework would be a better man all his lifetime than one who did not know it. With regard to the examinations, many of them ought to be conducted by women, for some of the inspectors knew nothing of the work, and were not even qualified for it by marriage. The system of appointing a young wrangler straight from the University to examine infants' schools was one that ought to be put down at once. If the Government were to properly carry out the education of the three millions of children, and give them the training, they ought to have, the matter must be looked after, not by senior wranglers and distinguished administrators but by a few competent people, the majority of whom should be women.

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* See *Journal* for August 0.

The Rev. J. P. Faunthorpe read a paper on "Text-books on Domestic Economy."*

The Rev. E. T. Stevens also read a paper on "Text-books on Domestic Economy; their Objects, Scope, Preparation, and Circulation."†

The President said that, in dealing with the subject of Domestic Economy in elementary schools, whether through text-books or examinations, it was desirable to understand what an acquaintance with the whole subject meant. He had had put into his hand what he thought was a remarkable answer given to a Government inspector by a little girl in the 4th Standard, who was asked what she had done on the previous Saturday. Although it was a graphic, detailed, and lucid account of the domestic work which the child had done on a given day, yet the words of her Majesty's Inspector on the paper were, in reference to general examination in Domestic Economy, "Can't do it," whether owing to the mistakes in spelling or putting capital letters in the wrong place he could not tell. He (the chairman) thought there was nothing which showed the effects of education more than the power of description of facts in their proper order, which that child eminently showed, and he thought it was a hard judgment upon her; and if that was the way in which domestic economy was to be treated in the schools, he did not think it was likely children would treat it as an optional subject.

Sir Henry Cole entirely objected to the assumption that the Code was like the laws of the Medes and Persians, and could never be altered. He trusted that the efforts of this Congress might have some effect next October in causing a complete revision of the Code. It had grown like Topsy, nobody could say exactly how. An old and able administrator of the Education Board was the inventor of the term Code—Mr. Lowe. It was very useful to get the rules brought together even anyhow, but they were certainly packed upon an illogical fashion. If any inspector of schools or gentleman connected with education were to be cross-examined about the Code, he would have to put to his name, "It is an intricate and difficult subject." He (Sir H. Cole) had often tried his best to make it logical and consistent; even if his life depended upon it, he could not fathom its mysteries. It was a curious fact that, 25 years ago, Dean Dawes, in a little village school in Hampshire, produced the most astonishing results, based on domestic economy, and induced the children of agricultural labourers to pay 3d. a-week for their education. That was long before the present notions of free institutions were talked about; and there was no better text-book on domestic economy in the English language than that which Dean Dawes introduced into his school. He protested against the existence of the present Code a bit longer than could be helped, and hoped that the period of its existence was next November, and no longer. He hoped that an alteration of the Code would come out of this Congress, and if not, he felt satisfied that it would out of a following one. In regard to the text-books, Sir J. Kay Shuttleworth helped schools to form an opinion of what books they should use; but that was afterwards thought an interference with the liberty of the subject. It was now assumed that every teacher, inspector, or manager of schools would know best; and thus they got into that chaotic use of text-books, without having any guide. He thought the School Boards of the country would do wisely to try if they could not come to an agreement upon what text-books should be used, and get the schools to use them generally.

The Rev. Canon Lea was not very much in favour of alterations in the Code. It was all very well for gentlemen in London and in large places to have alterations, but schools in the country found them a very great bore. No sooner did they get into one system and one set of books, than they were told that they were wrong and must have another, and all their trouble began again. He wanted to know why all those wise men upon the Council of Education could not, once for all, find out some system that would work satisfactorily?

Mr. Traice, referring to the question of text-books for teaching domestic economy, said it would require at least a dozen books to give the mere rudiments of the subject, and yet it was supposed that, in a single small volume, addressed to the minds of children, it would be possible to give both a series of rules and *rationale* of the science. The production of text-books on domestic economy, to be of any real service, was impossible as far as children were concerned. That a number of rules might be laid down was unquestionable, and that here and there they might begin with facts and go on with an interpretation which should come home to the simplest stage of the understanding was possible; but that the philosophy of the subject could be put into such books was simply absurd. Text-books on domestic economy must be superficial from beginning to end, but a text-book for teachers, who already had a fair knowledge of laws of nature to aid them in giving lessons to children, might be quite another thing.

The discussion then closed.

INSPECTION—WORKING OF THE SOCIETY OF ARTS EXAMINATIONS.

The Rev. E. F. M. MacCarthy read a paper on "The Mode for Inspection and Administration of Government Grant for Subjects included under Domestic Economy."*

Miss Joanna Hill said—Miss Synnot has been unable to furnish a paper which I was to have had the honour of reading this afternoon. I was only invited this morning to supply its place, so I must beg you to excuse the very hasty way in which my few remarks have been thrown together. I enjoyed the very great advantage of the personal friendship of the late Mrs. Nassau Senior, her Majesty's Inspector to the Local Government Board, whose death is a great loss to her country. She was as we all know, the only female inspector that has ever been appointed under a Government office, and her work, in the very words of the Minister who appointed her, Mr. Stansfeld, was to give "a woman's view as to the effect on girls of the system of education in pauper (a class of our elementary) schools." In her report she states, she gave her attention almost exclusively to questions affecting the physical, moral, and domestic training at the school. She did not attempt to judge of the scholastic work, as all the time allowed her was required for looking into matters on which the judgment of a woman was especially required. How that work was performed has been the subject of well-deserved eulogium both within and without the walls of Parliament. I need not say anything about it here. Miss Synnot, the lady whose paper it was hoped might have been read to-day, was, in conjunction with Miss Smedley, a chief assistant of Mrs. Senior, and could, therefore, give the results of practical experience on the branches in which female inspection is specially valuable, to co-operate with the ordinary inspectors of our elementary schools. Mrs. Senior's investigations extended over a large field, and were of urgent necessity in boarding schools and for the education of paupers, to whom the Guardians stand *in loco parentis*, but of which no mention is needed here. However, in the course of her duty she also directed her attention to those points in the actual school routine upon which a woman's ordinary life gives her a certain unconscious facility in perception, such as the hygienic conditions—cleanliness of the children and their clothes; the clothing most suitable to health; the atmosphere and temperature of the rooms; their cleanliness and adaptation to the needs of growing girls and of infants; the shape of the forms, and in many details. Also in the industrial department of the pauper schools, the knowledge of a female inspector, to whom these matters were as "household words," was of inestimable service. The value of female inspection with regard to sewing may be shown in the following pithy description by one of Mrs. Senior's helpers, of the quality of the knowledge in that branch of industry acquired by girls educated in the metropolitan pauper schools, which had been inspected for about 30 years by one of most able school inspectors, Mr. Edward Carleton Tufnell (I am quoting from the annual report of the Local Government Board, 1873-4). Speaking of the girls whom she visited in service, she says:—"All, without exception, were well taught in reading and writing. In arithmetic, as far as I could ascertain, they were fairly competent. All were, without exception, well taught in needlework, as regards the mere execution of stitches; and all, with one exception, were unable to arrange or to do any sort of needlework without constant supervision. All, with one exception, were stunted in growth and physical development, even where health was perfectly good." School instruction must only be regarded as a means to an end, *i.e.*, to provide the means and the inclination to the recipient to live a worthy life. Let, then, the best means and the best tests be employed to attain that end by which we can best promote our national welfare.

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* See *Journal* for August 10.

† *Ibid.*

* See *Journal* for August 10th.

Mr. Charles Critchett (Educational Officer of the Society of Arts) read a paper on "The Examinations of the Society of Arts in Domestic Economy."*

The Rev. Brooke Lambert (Chairman of the Tamworth School Board), hoped some such system for inspection as that described by the Rev. E. F. M. MacCarthy would eventually be brought into force. He was quite convinced that, with the multiplication of subjects under the Code, each attracting to itself some portion of the grant, it would be perfectly impossible to carry on the system of examination by results, and he ventured to think that if the surprise visits of the inspectors were turned to use, schools might earn on the result of the examination, a grant proportionate to the efficiency in which they were found in general matters. Each school should be visited three or four times a year, and should receive marks in accordance with the result of the examinations. If a school was in a low class with regard to its general work, it should receive a low grant in each individual subject, but if it was in a high class it should receive a high grant in each subject. He suggested that, because they had been playing at inspection for a great number of years. In old times they could remember the inspectors coming down, and if they gave them a good lunch they would give them a very good report. The result depended generally on the impression the inspector formed of the school. They found the new system of testing each individual scholar was weary work, and invented the system of assistant-inspectors, who did all the work, while the inspectors walked about and talked. Everyone knew that the amount of work done by the assistant-inspectors covered at least two-thirds of the whole. He thought that if the schools were visited at the end of the year, and grants given according to their condition and teaching power, a very much better result would be arrived at. Referring to the question of female inspectors, he said he was entirely opposed to specialism in education, and if the appointment of inspectors were brought before them on the ground that they understood special subjects, it would not, in his opinion, be a very strong argument in its favour. If they were to appoint women as inspectors simply because they understood a particular part of education, he did not know how far they would not go down dividing. Still he thought a strong case had been made out for the introduction of female inspectors on equal grounds with male inspectors. He thought the appointment of Mrs. Nassau Senior had shown what good a woman might do. Her report caused an opposition which showed that she had hit upon certain things never thought of before. The questions on dormitories and sleeping rooms were such as no one but a woman could enter into; but a woman interested in those subjects could examine the way in which schools were conducted, and report upon them in order that the evils which she saw, and nobody else could, might be remedied.

Miss Smith (member of the Oxford School Board), said the question of appointing female inspectors had been tried already and decided in another country, which was making such great strides in the work of education, bidding fair to fulfil the prophecy that "the last shall be first." She referred to Italy. Within the last few years, since its unification commenced and had been completed, Italy had been carrying out a most advanced system of elementary education. It would be shortly proposed to make the school attendance compulsory. In the towns of Italy it was quite the practice to have female inspectors, who were paid, not higher, but in proportion to the salaries given to the men. They visited the schools much more frequently than the inspectors do in England. They did not conduct yearly examinations, which were done chiefly by papers, and referred to the examiners appointed by the Municipal Council. The lady inspector made suggestions and criticisms on her visits to the schools, and those visits were of the greatest utility to them. The ladies did not undertake the care of hygiene, because the Italians went beyond us, and their schools were also visited by a doctor from time to time, who reported on the sanitary conditions of the schools. From the experience of the Italians, she thought the work of the female inspectors was very useful, and one that we might fairly derive advantage from in our schools.

The Rev. R. Burges (Birmingham) said he had heard no plan suggested by which they could get better inspectors than they had already; but he hoped a plan would come before that Conference by which the managers of large schools should not be called upon to suffer from the hands of young men fresh from the Universities, who knew nothing about the inspection of schools. He thought needlework would gain greatly if ladies were appointed to examine on the subject.

The Rev. J. P. Faunthorpe, after explaining the mode of examining candidates on entering a college, said that schools were at the present time almost examined to death, and if the examinations were to be multiplied, and they were to be paid by results, he would ask where they were to stop. Examinations were always upon them, and they were only accustomed to them on the same principle that a toad was accustomed to live under a harrow; it was not much better than that. He reminded Mr. Lambert, who had alluded to the "surprise" visits of the inspector, that there was no such word as "surprise" now in the Code. The words "friendly consultation and advice" had been substituted instead. Lord Sandon had asked for an education grant of nearly £2,000,000, and if they went on multiplying the examinations the grant would not be two millions, but four. He proceeded to argue that it was possible to produce a text-book on domestic economy within the comprehension of an ordinary well-educated child. He approved of the appointment by the London School Board of inspectors who had been schoolmasters, for they were better qualified for the work by their experience than men fresh from Oxford who had never entered a national school.

Sir Henry Cole said the last speaker had mentioned that two millions had been asked for, for the purpose of education, but he (Sir Henry) was afraid the amount would grow to be something larger when the three millions of children were properly educated. As an old administrator he could say that if the two millions were properly administered it would do a great deal more than it did now, and would be more satisfactory for all receivers. Referring to the practicability of examinations, he said for many years he had the honour of drawing checks for examinations. In the Department of Science and Art they had twenty-four specialities, with the first men of the country, like Huxley and Tyndall at the head, and there was no difficulty at all. He should not be afraid if the subjects numbered forty-eight, for there was no harassing of schools and training colleges with the Science and Art examinations. Last year they added Scottish agriculture. He said emphatically, they might subdivide and have special people to deal with the papers, and have as many subjects as they liked, without being harassed in their examinations.

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* See *Journal* for August 10th.

The President said he must, in the first place, enter his humble protest against any idea being entertained in that room or elsewhere that this country had, at any rate as yet, committed any extravagance in the matter of education, whether in Parliamentary grants or in the rating of towns and parishes. He ventured to say that Englishmen find no more profitable investment for their money than in the education of the people. When he was in the United States, a year or two ago, he looked very carefully into the question of education in that great and growing country. Seeing on one occasion the magnificent schools in nearly every street in New York, the colleges for the elder boys and the elder girls, he asked the then head of the Education-office in New York, whether he found any difficulty in obtaining grants for that purpose from the Corporation? He replied, "No, sir. I have had during the twenty years of my inspectorship a great many difficulties to contend with, but there is one difficulty I have never had to contend with. I have never yet had any difficulty with regard to money; and if to-morrow I went to the citizens of New York, after all that has been done, and asked them for £20,000 to spend upon the schools, they would give it me, without even asking a question on the subject." Depend upon it it was that spirit—generous or lavish, he preferred to call it liberal—which Americans had shown with regard to education, and their resolve that, as far as possible, every member of their community should grow up an educated man or woman, that the greatness of that country was owing. That was why they were now beating us in the iron market and other spheres of production, because they had an educated people to do their work, and if Englishmen wanted to keep abreast with the other nations of the world they must not grudge money, whether from Parliament or the rating authorities, in the matter of education. With regard to the employment of women as educational inspectors, when his opinion was asked as to the management and inspection of reformatory and industrial schools, he ventured to advise the then Minister of the Education Department that he should employ Miss Carpenter to inspect the reformatories and certified industrial schools for girls. That admirable, and in many respects, wonderful woman had now passed away from them; but, speaking in the town of Birmingham, he could not forget that, next to their late Recorder, Mr. Matthew Davenport Hill, it was owing to Mary Carpenter, in a meeting held in this town, that the great cause of reformatory and industrial school legislation first received its impulse. If she had been made, as he had hoped at one time she would have been made, inspector for girls' reformatories and industrial schools, he was convinced that their present efficiency would have been much greater than it was. After meeting on one occasion an old fellow collegian, who told him with great satisfaction that he had recently been appointed assistant-inspector under the Privy Council, and gave him a pamphlet which he had published on needlework, he (the President) was then particularly struck with the method of confiding to men the inspection of schools in so purely feminine subjects, and since he had been chairman of a School Board, and had taken a share in the management of elementary schools, he had had that opinion strongly confirmed. He was convinced that a necessity existed for the appointment of ladies as inspectors of needlework and other feminine employments, and he was satisfied they would never be what they ought to be until there were female inspectors. He believed it was owing to the devoted attention of a lady, who gave her services gratuitously, to the needlework in the Worcester Board Schools, that it had been so highly praised, and what was good for those particular schools must be good for the whole of the schools throughout the country.

The Rev. E. F. M. MacCarthy, in reply to the remarks of Mr. Faunthorpe, said that he did not advocate any increase in the number of examinations, but only a change in the examining body. On the subject of cost, he said Birmingham had shown in the past that it was not afraid of spending money for the purposes of giving a sound education, and he thought there was no fear but what it would be equally liberal in the future.

THRIFT—SAVINGS BANKS.

Mr. George C. T. Bartley described a paper on "School Penny Banks."*

Dr. Langford read a paper on "A Birmingham School Board Bank."†

Mr. M. Parker (of Leamington) said the first thought with every person accustomed to receive money was the finding of a place of safety to deposit it. The humbler classes and the working people had not the advantages of the upper classes in this respect. Nine months ago he tried in Leamington to find a place of safety for the deposits of the children and grown-up people of the working classes. He obtained four rooms in different parts of the town, and four nights a week he attended the committee of management to receive the deposits. At first they had but pennies brought by children, but when the parents saw the books of the rules under which the banks were conducted, they were so struck with the simplicity and safety of the system, that they forthwith commenced to deposit their savings, and afterwards the committee obtained permission to deposit the money with the Post-office authorities, the only restriction being that they could not take more than £5 from any depositor. At the end of nine months they had £300 deposited in the Post-office. The number of depositors was nearly 1,000, and they were increasing rapidly every week. After describing the spirit of independence the system had inspired amongst the depositors, Mr. Parker said that if Birmingham were divided into districts as had been done in Leamington, they would have not only the school children but their parents also for depositors. To do that, however, the bank must be unmistakeably sure and firm, and there must be no fear on the part of the depositors that they would lose their little all by the breaking up of the bank.

Mr. F. Curzon said he had great pleasure in endorsing the remarks of the last speaker, for in Yorkshire the penny bank system had been in operation for several years, and during the past year more than half a million of money had been received from depositors, and £650,000 at this moment stood to the credit of the working people of that county. This, he believed, arose from two causes—first, because the bank was perfectly safe, not a penny having been lost in twenty years from defalcation or deficit; and secondly, because they were perfectly free for access or withdrawal. The banks were held independently of schools or organisations of employers. One of the best banks in Yorkshire was unsuccessful in consequence of its being connected with the railway company, the men being suspicious that their savings would be tested by the wages they received. The safety of the banks was guaranteed by the nobility and gentry of the county. If they stopped at school banks the work would not be done efficiently. He hoped they would try to consolidate these banks by some union. There were other classes as improvident as the working classes, but they had an advantage in their favour of which the latter had hitherto been deprived.

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* See *Journal* for August 3.

† See *Journal* for August 17.

The President said he believed it was very important, in the beginnings of life, to teach children habits of saving, and to provide safe places in which to put their savings. He was afraid a great deal of ignorance prevailed on that subject in many parts of the country. In towns, a knowledge of savings banks had no doubt spread, but there was a great want of knowledge and information on the subject in rural districts at the present time. Only the week before last, he tried a man at the Worcester Quarter Sessions, for stealing £108 from the dwelling-house of a poor woman, who never had more than the ordinary wages of an agricultural labourer, and had saved the amount in sovereigns. It was hardly credible that she had never put the money in a savings bank or other safe place, but had always kept it in a box in the house. The consequence was, it was stolen, and on trying the thief, he ventured to point out the importance and value of putting money in a safe place instead of keeping it in the house. That instance showed the importance of training children not only in habits of thrift, but to put their money in some safe place when they have saved it.

Mr. S. Wall Richards read a paper on "The Influence of Order, Method, and Cleanliness in Factories and Workshops, upon the Home Life of Industrial Populations in Large Towns."*

The Congress then adjourned.

MISCELLANEOUS.

THE SURPLUS OF 1851.

The official report has just been published of the proceedings on the occasion of the reception, by her Majesty's Commissioners for the Exhibition of 1851, of a deputation of municipal representatives from provincial boroughs in England and Wales, at Marlborough-house.

On Friday, the 20th of July, 1877, a deputation of gentlemen, representing great provincial centres of industry, waited upon the Commissioners for the Exhibition of 1851 at Marlborough-house, to urge upon the Commissioners:—

1. The realisation of the funds of the Commission to as great an extent as possible.

2. The application of the realised funds in grants to provincial museums for buildings, and for the purchase of suitable objects for exhibition therein.

His Royal Highness the Prince of Wales, the President of the Commission, received the deputation in the saloon. His Royal Highness was accompanied by the following Commissioners:—The Prince Christian, the Duke of Buccleuch, the Earl of Rosebery, Earl Granville, Earl Spencer, Lord Aberdare, Sir Stafford Northcote, Sir William Knollys, Sir Thomas Bazley, Sir Thomas Fairbairn, Sir William Anderson, Sir Henry Thring, Sir Dighton Probyn, Mr. Bowring, Professor Duncan, Mr. Gibson, General Ponsonby, and Major-General Scott, Secretary.

The deputation consisted of—(1) Bath—Alderman Moore, F.G.S.; (2) Birmingham—The Mayor (Alderman Baker); Alderman Jesse Collings, Chairman of the Free Libraries Committee, Mr. J. T. Bunce, Chairman of the Art Gallery Sub-Committee, and Mr. W. Harris; (3) Blackburn—Councillor William Coddington, Ex-Mayor, and Councillor Lund; (4) Bolton—The Mayor (Mr. C. Wolfenden), and Councillor Hesketh, Chairman of the Free Library and Museum Committee; (5) Bradford—The Mayor, and Councillor Priestman, Chairman of the Free Libraries committee; (6) Bristol—The Mayor (Mr. G. Edwards), and Mr. C. J. Thomas; (7) Cambridge—Councillor H. T. Hall, Chairman of the Library Committee; (8) Cardiff—The Mayor (Alderman Elliot), the Chairman of the Free Library and Museum Committee; Alderman Taylor, M.D., Deputy-Chairman of the Free Library and Museum Committee; (9) Coventry—The Mayor (Alderman Banks), and Mr. J. Cash, Chairman of the Free Library Committe; (10) Derby—Councillor Hobson, Chairman of the Free Library and Art Museum; (11) Exeter—The Mayor (Mr. W. Cuthbertson), and Mr. W. Cotton, F.S.A., Honorary Treasurer, Albert Memorial Institution; (12) Hereford—The Mayor (Major Arbuthnot); (13) Ipswich—Aldermen Grimwade and Packard; (14) Leamington—The Mayor (Alderman Bright); (15) Leeds—Alderman Grant and Alderman Lupton, Chairman of the Free Libraries Committee; (16) Leicester—Alderman Baines, Chairman of the Museums Committee, and Alderman Stephenson, Chairman of the Free Library Committee; (17) Liverpool—Mr. J. Armstrong and Mr. J. A. Picton; (18) Manchester—The Mayor (Alderman Heywood), Alderman King, and Councillors Birch, Booth, and Croston, and the Deputy Town Clerk; (19) Northampton—The Mayor; (20) Nottingham—The Mayor of Nottingham (Mr. J. W. Bowers), and the Borough Engineer; (21) Plymouth—Mr. W. H. K. Wright, Secretary, Free Library; (22) Rochdale—Lieut.-Col. Fishwick and Mr. James Booth; (23) Swansea—The Mayor and Alderman Jones Jenkins, Chairman of the Free Libraries Committee; (24) Salford—The Mayor (Alderman Walmsley), Alderman Davies, and Turner, J.P.; (25) Sheffield—The Mayor (Alderman Bassett), Alderman W. Bragge, Chairman of the Free Libraries and Museums Committee, and the Town Clerk; (26) Warrington—The Mayor (Mr. S. M. Webster); (27) Wolverhampton—The Mayor (Mr. S. Dickinson), and Mr. J. Watkin, Chairman of the Free Library Committee.

The deputation was introduced by **Mr. Joseph Chamberlain, M.P.**, who said:—Your Royal Highness, My Lords and Gentlemen,—I have the honour of introducing to you a very important deputation, representing the corporations of all the boroughs of England and Wales which have under their control and management free libraries and museums. These gentlemen represent the governing bodies of a population of more than three millions, and they include the mayors of almost all our largest towns. The object of the deputation is very respectfully to urge upon the Royal Commissioners the claims of the provinces to some share in the surplus funds of the Exhibition of 1851. We have understood from the statements published that, providing those funds were realised to the best advantage, there would be a surplus of £750,000; and we have understood that the special committee propose to apply £100,000 of that sum in the erection of a Science and Art Library in London, and we urge that the claims of the provinces should now be considered in the allocation of the remainder. We base our claims upon two considerations: first, that we in the provinces contributed our share to the success of the Exhibition of 1851, both in the shape of contributions to the guarantee fund, largely made in the provinces, and also by the part which our manufacturers took in that Exhibition. In the second place, of all the objects to which a surplus fund of this kind should be applied, we represent at once the most deserving and the most necessitous. Our deserts lie in this. We have already done a great deal in the same direction out of our own resources. We have established those free libraries and museums which do carry out in the best possible way the original idea of the Exhibition of 1851, by promoting the education of the people, and by inducing the cultivation of artistic taste among our manufacturing classes. These institutions are extremely popular in the provinces, and the attendance at our museums and libraries is enormous; and the institutions represented here have an attendance very greatly exceeding the total attendance of all the institutions of a similar kind in the metropolis. I have some returns here which will illustrate this. In Liverpool the number of volumes issued in the reference and lending libraries last year was 957,000, and the number of visitors to the museum was 448,000; in Manchester the number using the library was 544,000, while the number of readers in the news-rooms was 1,118,000; and in Birmingham, 522,000 persons used the library, and 1,500,000 the news-rooms, while the visitors to the museum numbered 300,000. Then the class of visitors are precisely that class which would benefit most by special collections of objects illustrating the trades in which they are interested. For one visitor to a general museum in London who will be connected with any trade there illustrated, there would be 10 or perhaps 100 in Manchester, Birmingham, or Bradford, as the case may be. We also venture to represent that, inasmuch as the management of these institutions is popular and representative, we give the best possible guarantee for the permanence of the exhibitions, and the wise and just administration of their affairs. Our position is one of necessity, because the Act of Parliament only permits us to levy a rate not exceeding one penny in the pound, and all that is taken up by the payment of interest on the capital sunk and the expenses of management, so that we have no resources left to devote to the maintenance or the establishment of these special museums. We have learned from the same report that the Committee has reported to your Royal Highness the recommendation that the surplus should be devoted, in the first place, to the formation of scholarships in connection with local and metropolitan institutions, and in the second place, that direct grants of money or objects should be made to our museums. In regard to this point, the matter has been under the consideration of the representatives this morning, and we are unanimously of opinion that we greatly prefer the second alternative, for this reason, that scholarships in connection with local institutions could be only tenable in a very few of the towns represented; only perhaps half a dozen have institutions to which scholarships could be affiliated, and thus all the other scholarships would be tenable at institutions in the metropolis. Now, we greatly prefer a more direct application of the funds to local objects; besides, we believe we may rely upon private liberality for a sufficient number of scholarships for our different institutions. As regards the other proposal, we most heartily and respectfully urge it on your consideration and attention. We believe that no application of the funds would be more popular or useful; it would be a very great stimulus to the formation of those museums where they do not exist already, while it would extend the usefulness of those already established. From such a disposition of the funds, we anticipate an indirect advantage, to which we attach almost as much importance as to the direct advantage. We regret, not from any provincial jealousy, but on grounds of national moment, the tendency of all that is best in our midst to gravitate towards the metropolis. As far as that is due to the natural attraction of this great city we do not pretend to resist it; but we say that nothing should be done to foster and develop that artificially; and we do insist it is of the utmost importance that the most should be done to preserve in our provincial cities, centres of life, activity, and knowledge.

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* See *Journal* for August 17.

Mr. Chamberlain was followed by Alderman Baker, Mayor of Birmingham; Councillor Picton, Chairman of the Art Gallery, Liverpool, Alderman Heywood, Mayor of Manchester; Alderman C. J. Thomas, Mayor of Bristol; the Mayor of Exeter; Alderman Grimwade, of Ipswich; the Mayor of Swansea; the Mayor of Sheffield, and the Mayor of Cardiff.

The Prince of Wales said—Gentlemen, I have listened with the greatest possible attention and interest to the able speech which has been made by Mr. Chamberlain, and the remarks that have been added by the other gentlemen whom we have heard speak here to-day. I feel sure that I speak in the name of my colleagues, as well as in my own, in assuring them how gratified all the Royal Commissioners are to see the interest which they take in matters connected with science and art, as applied to the interest of the great and important towns which they represent. They will, I am sure, not expect me to give them any decisive answer with regard to what they have asked; but I may be permitted to say, in the name also of those gentlemen connected with the Royal Commission, that the large and influential deputation which has come here to-day has made a great impression upon us, and that we will give our due and most careful attention to the matter which they have laid before us. I cannot do better than ask Lord Granville, who is chairman of the committee to whom this important matter will be referred, and who, as one of the most prominent Commissioners of 1851, is so well able to cope with a matter of this kind, to make a few observations in reply to you. I can only assure you, and I think I am expressing the feeling of all my colleagues, it has given us great pleasure to see you to-day, and to listen to the remarks you have made to us.

Lord Granville said—Your Royal Highness, my Lords, and Gentlemen—I think that his Royal Highness in the statement he has made to you has shown the interest he feels in this matter, and the inclination he feels to pay every attention to the wishes of such a deputation as this. If his Royal Highness had called upon me to make a final answer on this occasion, I should have preferred that another Commissioner—that Lord Spencer—had spoken, and not I. But it will be remembered that the plan recommended by the Committee was adopted by the Royal Commission, and indeed received the confirmation of her Majesty. I understand from his Royal Highness that that will not prevent us from considering the matter independently, reserving our own judgment. Perhaps it will not be uninteresting to you to hear the sort of considerations which have weighed with the Committee. I understand from Mr. Chamberlain and the other gentlemen who have been good enough to speak on this occasion, the desire of this deputation is that, instead of the plan which has been already agreed on, we should realise to the full extent our property in South Kensington, and should apply the proceeds of the sale to the building of museums in different parts of the country, and furnishing and supplying them with objects. The arguments on which this has been based, are, first of all, a jealousy, if I may be allowed to say so—a very wholesome jealousy—of any thing like over-centralisation in this country. I entirely agree—perhaps I go rather further than some others—in that feeling—and I certainly wish to see everything done to strengthen the powers of local government, and local control over the resources of particular districts. Further than this, I am bound to admit that the government of this great town is perhaps worse than that of any of the boroughs represented here to-day. I am sorry to have to acknowledge it, but I think there is less of local public spirit in London than is seen in the boroughs which you represent. On the other hand, having been born in London, having worked a little in London, and having played a good deal in London, I have much of the Cockney about me. And I cannot admit that this metropolis, with its 4,000,000 inhabitants, this seat of government with visitors from all parts of the empire, this city which contains certainly many of the most distinguished men in science and art, is merely a dead excrescence upon the surface of the nation. But the only question is, I understand, in what proportion the funds should be divided. There was one argument used by Mr. Chamberlain to which I do not attach very much importance, and that was with regard to the pecuniary claims which the provinces have, in consequence of the way they contributed to the pecuniary results of the Exhibition of 1851. That matter was considered at the time, and with general approval, I believe, the Commissioners, a singularly strong body, decided that there was no question of returning these funds; but the Commissioners thought that they should apply the money as they best could for the promotion of science and art. I am afraid the argument would go against you. In the first place, the success of the Exhibition was mainly due to the illustrious father of his Royal Highness. I doubt whether any one even of the gentlemen here ever worked with more ability and industry in his own profession or business than did the Prince Consort in this great national undertaking, and he had with him the support and assistance of a singularly strong Commission, composed of men distinguished in all walks of life. In the next place came the exhibitors, and putting out of sight the foreign and colonial exhibitors, I have no doubt the bulk of them came from the provinces and not from the metropolis. At the same time they derived, as a body, a very great benefit from being allowed to exhibit. With regard to the mere pecuniary receipts of the subscription, rather more than one half came from London. With regard to the guarantee fund, it is 27 years ago, and you must not expect me to be quite exact about the figures, but I happen to have been employed in relation to it by the illustrious father of our present Chairman. The guarantee fund was proposed by Mr. Pusey, an eminent agriculturist; it was strongly supported by my friend Mr. Cobden, who stated that half a million could be subscribed in an afternoon in Manchester alone. It was strongly opposed by Sir Robert Peel, but it was adopted after his death, and was really the mainspring of the undertaking. I remember speaking to a person of considerable property and great reputation in these matters, who said, when asked to subscribe, "I do not care about the money, but I doubt whether I am justified in principle in subscribing a large sum of money for a thing which may be a complete pecuniary failure. You bring me a long list of great landowners, if you show me men of business I will subscribe." I said I had just received an intimation from a London contractor that he was ready to guarantee £50,000, and my friend put down his name for £10,000. Manchester guaranteed about the 50th part of what Mr. Cobden said they would, and I believe that a majority of the guarantees were subscribed by landed proprietors, and by the bankers and other great houses in London. The visitors, who spent their half-crowns and shillings, came next, and there is no doubt whatever that the 4,000,000 people, who form the population of London, supplied the greatest part of those. But I do not think the argument of importance. The real thing is, not to consider the interests of London or your especial boroughs, but to do what we can in the best way for the ultimate promotion of science and art in this country. The question of the full realisation at once of our property is one of very considerable importance. There are some considerations against such a course. I myself, from my connexion with the Exhibition of 1851 (I think there are three other Commissioners only here present who belonged to that), may have an undue feeling on the subject, but we consider 1851 a great epoch, and we should dislike to sever the memory of the Exhibition entirely from its local habitation. But, putting that aside, the Special Committee have had financial arguments to the very opposite effect. We have been told "You are in a great hurry. You are realising part; you intend to realise more. (We do intend.) You are very impatient, and are throwing away valuable prospects for the future." I believe there is a medium in this. We are acting upon very good advice. The whole matter shall be considered in accordance with his Royal Highness's recommendation. We are inclined to think that partial realisation is better at this time than sending the whole property into the market. Then the deputation recommend that whatever amount remains should be applied to the building and supplying museums in the country. Mr. Chamberlain has just put into my hands a statement of the sums already expended in the country out of local resources in this direction, and it is most creditable to the public spirit that has been shown by the representative boroughs. Even this imperfect list amounts to £300,000 or £400,000. I apprehend that your resources have been chiefly of a voluntary character, and that you have also received assistance from the Government. [Mr. Chamberlain—Not from Government; only temporary loans to a small extent.] If the Government lent you articles for exhibition, that would certainly assist you for the museums. I will put that aside, however; voluntary subscriptions are very important, and there is a danger of stopping the flow of them if you get a great central body supplying everything. There is the consideration how far even a large sum would go. If we determine upon the Commission of 1851 supplying money for building, and furnishing, and supplying museums all over the country, it would be very difficult to know exactly what the end of these subscriptions might be, and how soon the funds might be entirely swallowed up. No one can attach more importance to museums than the Commissioners themselves. From the lowest point of view, they are means of showing the working people the arts connected with their own occupations, and, coupled with educational institutions, they are of the greatest possible value. By themselves museums have only superficial advantages; to be of real use they must be accompanied by educational aids. Up to this time we have thought we should do best by assisting the Government with regard to a central museum in London, and on the other hand by supplying means to establish studentships, not in the metropolis alone, but also in different localities. I understand the delegates prefer subscriptions to museums. I only want to point out that the Commissioners have not been acting upon any crotchets of their own; their views are based upon recommendations from two quarters; one a Royal Commission specially appointed to inquire into scientific education, and the other a memorial sent by nearly all the Fellows of the Royal Society, as to the best means of promoting science in this country. These are not authorities to be lightly put aside. His Royal Highness has promised that the matter shall be fully considered, and I hope you will not think that anything I have said betokens a final determination on the part of the Commission. At the same time it would not be fair to you that you should go away and think we have no reason for the recommendations on our side.

Mr. Chamberlain—Lord Granville has somewhat misunderstood some of the expressions of the deputation. They were not guided by any jealousy of London; we are quite willing that the wants of London should be first considered. It is only as to what remains after London has been fairly considered that we wish to put in any claim.

Lord Granville—You do not object that a portion of the fund should be applied to assist the Government in providing a central museum?

Mr. Chamberlain—We express no opinion on that point. Then, in the way of realising capital, we do not ask for complete realisation; we ask for a share of the fund, whether as interest or capital.

Lord Granville—That implies selling the property.

Mr. Chanberlain—It implies selling that portion of the property which produces nothing. It is true that we have received loans from the Government, but of an infinitesimal amount; they bear a very small proportion to the whole. At Birmingham, my own town, we have one case of objects from South Kensington to 20 of our own. Then these temporary loans do not answer our purpose; we want permanent exhibitions before the population of such objects as are connected with their special industries. I have only now to return to your Royal Highness our most cordial thanks for the prompt courtesy with which you have received us and considered our request, and to say that we are confident that the matter we have brought before you will receive your favourable consideration.

The deputation then withdrew.

Appendix.

Statement submitted to his Royal Highness the Prince of Wales, in explanation of the object of the Deputation of Representatives of Municipal Corporations.

It became known last year that the Royal Commissioners of the Exhibition of 1851 had under consideration the desirability of applying to the direct promotion of science and art the funds in their hands accruing from the investment of the surplus of the Exhibition, and subsequent augmentation from property purchased therewith.

The Free Libraries and Museums Committee of the Corporation of Birmingham therefore requested the Mayor of Birmingham to convene a conference of representatives of corporations having free libraries and museums, for the purpose of considering the propriety of making suggestions to the Commissioners as to the manner in which their surplus fund might, in the judgment of the representatives, be most advantageously employed for the benefit of the great centres of industry which had contributed to ensure the success of the Exhibition, and, consequently, to the accumulation of the fund now at the disposal of the Commissioners. The conference was held in Birmingham on the 5th of January last, and was attended by representatives of the corporations of Birmingham, Bradford, Coventry, Derby, Kidderminster, Leeds, Leicester, Liverpool, Manchester, Salford, Sheffield, Swansea, and Worcester. Other corporations, not actually represented at the meeting, expressed their concurrence in its proposed objects, and further adhesions to the resolutions then adopted have since been received. These resolutions affirmed the desirability of making arrangements for the loan of examples selected from the national galleries and museums, for exhibition in museums established by municipal corporations; and also the allocation in aid of such museums of part of the fund at the disposal of the Royal Commissioners of 1851. In reference to this fund, the subjoined resolution was unanimously passed:—"That it is desirable to urge upon the Royal Commissioners for the Exhibition of 1851 the propriety of realising the property under their control, and of applying it, in part, as recommended by their Special Committee, to grants in aid of building museums in connection with Municipal Corporations, and in making provision for the purchase of objects suitable for exhibition in such museums."

The following extracts from a paper submitted to the conference by the Birmingham Free Libraries Committee, will explain the grounds upon which the foregoing resolution was based, and the advantages which, in the judgment of the representatives of corporations, would result from acquiescence in it on the part of the Royal Commissioners:—

"The Commissioners of the Exhibition of 1851 had a large surplus (about £186,000) remaining in their hands as the result of the above-named Exhibition. By careful investment in land at South Kensington, this original fund has been largely augmented, and, if now completely realised, would, it is estimated, yield a capital sum of more than £1,000,000, after defraying all the liabilitie incumbent upon it. The Commissioners have lately directed their attention to the best means of dealing with the property in their hands, and a committee, consisting of the Marquis of Ripon, Earl Granville, Earl Spencer, the Earl of Carnarvon, and the Right Honourable Lyon Playfair, M.P., was appointed to prepare a scheme to be laid before the Commissioners for their approval. The Committee has recommended several alternative plans for dealing with the property. Of these, the Committee particularly recommend two schemes. That which they specially prefer is that the Government should buy from them, for purposes of science and art, the Horticultural Gardens at South Kensington, with the galleries and arcades adjoining them, at half their present value. This plan would give the Commissioners the command of a sum of £720,000. The other plan is to sell a portion of the ground, and to retain the Exhibition buildings and the Horticultural Gardens, with a view to their future use for public purposes; and this mode of dealing with the property would yield upwards of £350,000, free from all liabilities.

"Whatever may be the amount realised by the Commissioners, the Committee propose to expend part of it, not exceeding £100,000, in the erection of a building in connection with the South Kensington Museum, for are and science libraries, in the first instance, with the ultimate view of converting it into an educational and scientific library and museum of scientific instruments and objects, the want of which is very much felt. The remainder of the available sum the Committee propose to employ in two ways—(1) promoting museums of science and art throughout the country, by grants in aid of buildings or collections of suitable objects; and (2) in founding scholarships of science and art in connection with central institutions and provincial colleges of science and art now arising at Manchester, Birmingham, Bristol, Leeds, Nottingham, and elsewhere. In reference to this project, the Committee observe in their report:—'In recent years a great impulse has been given to the scientific instruction of the populations in our great centres of industry. It would be a great benefit to these new institutions if their more promising students could be brought up to the laboratories of chemistry, physics, and biology, which are in active work at South Kensington. The same system of aid would be of equal importance to the more advanced schools of art, as a supplement to the aid now given by Government."

The Conference is urged, by means of a deputation to the Royal Commissioners, to press upon them the main recommendations of their Committee, which have yet to be considered by the general body of the Commission. The points to be specially insisted upon, as promising to yield the greatest advantage to the country, are—(1) The realisation of the funds of the Commission to as great an extent as may be possible; (2) the application of the realised fund in grants (*a*) to provincial museums for building, and (*b*) for the purchase of suitable objects for exhibition [*and (*c*) to the creation of scholarships for the benefit of advanced students in science and art. Such scholarships, it is suggested, should be made tenable, not merely at central metropolitan institutions, but also at provincial centres, it being in all respects inadvisable that the growing tendency to centralisation should be fostered in an additional degree.] The claim of the provincial towns to share in the Commissioners' funds may be forcibly supported by two considerations. In the first place, the Exhibition of 1851, from the profits of which the fund was originally derived, was rendered possibly larger by the guarantees which were given by the provincial towns; and therefore, as a matter of justice, these towns are entitled to participate in the benefit secured by their own enterprise and spirit of self-sacrifice. In the second place, the claim of museums under the control of corporations is based upon the permanence of such institutions, and the guarantee afforded by public management for the just administration of money entrusted to them; and also upon the difficulty which is felt in raising, by means of rates, amounts adequate to meet the expenses of building and maintaining scientific museums and galleries of art. In all towns where such museums exist, large sums have been expended in their construction and in the provision of suitable objects, and this outlay constitutes a burden which the limited rate is unable to bear, and the pressure of which interposes an insuperable barrier to the extension of the museums from the same source. It is necessary, therefore, to find other means of increasing the funds at the disposal of corporations for the above-named purpose. It is submitted that the property held in trust by the Commissioners of the Exhibition of 1851 affords a source of supply specially adapted to this end; and it is consequently advised that the Commissioners should be strongly urged to approve the principle of realisation and distribution recommended in the report of their committee.

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* The passage within brackets is withdrawn.

"In support of this conclusion, it is further submitted that if the people of the great provincial towns are to be instructed in science and art, if their education is to be extended, their taste improved, and their knowledge rendered capable of being turned to practical account, the national collections and national funds applicable to science and art must be more directly and largely applied for their benefit. There is no better or more immediate method of accomplishing this purpose than by the formation and adequate maintenance of the local museums under the management of corporations. Large sums, raised by rates or gifts, in the various localities, have already been expended upon such museums, and much voluntary labour has been bestowed upon them by the committees entrusted with their management. The time has now arrived when local self-help—strained to its utmost capacity—requires to be supplemented by a liberal system of assistance from central sources, of which the fund at the disposal of the Commissioners of the Exhibition of 1851 is one which is considered specially important and readily available."

THE INTERNATIONAL LAW ASSOCIATION ON THE PATENT QUESTION.

The Association for the Reform and Codification of the Law of Nations has this year held its annual congress at Antwerp, the proceedings of which were brought to a close on Monday, the 3rd inst. Among the many questions dealt with, perhaps the one most likely to interest readers of the *Journal* was that of the assimilation of the Patent-laws of different countries.

The late Mr. Webster, Q.C., F.R.S., was a member of the council of the above-named association, and after his death the subject was brought forward by Mr. Lloyd Wise, in a paper read before the association at the Hague Conference, in 1875, which contained the following suggestions:—Where a patent has been applied for in one country, subsequent publication of the invention during a limited period should not necessarily prejudice the original applicant's right to patents in other countries; he should, however, be required to specify the countries in respect of which he desires to retain the option of obtaining patents, at the same time that he applies for his first patent. A notification of the reservation should be entered on the records of the country in which the original application is made, and a like notification should accompany every document concerning the invention, officially remitted to each of the countries reserved, the applicant to be deemed to have abandoned his right to ask for a patent in any country so reserved, when not exercised within the period prescribed. As the fundamental object of a Patent-law is to induce the early communication of new inventions, the original applicant should, except in case of fraud, be regarded as the first inventor.* Every application for Letters Patent should undergo examination limited to the questions whether the specification is clear, and whether the invention is open to objection as being contrary to morality, or wanting in novelty, regard being had to prior publications in the Patent office of the country. Should the result of the examination as to novelty be unfavourable to the applicant, he should, nevertheless, be entitled to a patent, subject to the insertion in his specification of an acknowledgement of the existence of the prior matter, with a clear statement of his claim. Patents should be refused only in cases of fraud, or when the invention is contrary to public morality; all other points should be left to the adjudication of the courts, only in the event of the validity of the patent being called in question. There should be no publication of any report or opinion of the examining authorities, with regard to any application for a patent, saving only reports of proceedings in disputed cases. Provisional protection should be granted for twelve months, at a nominal cost, to allow time not only for perfecting the invention, so that it may be properly and fully described in the final specification, but also for obtaining, if needful, the co-operation of capitalists. Every patent should be granted for the full term, which might well be 20 years, subject to periodical payments of—say £50 at the end of the 5th year, £50 at the end of the 10th year, and £50 at the end of the 15th year. In the absence of prior publication or notification of reservation by an independent inventor, the validity or duration of a patent granted in any one country should not be in any way affected by the circumstance of a patent of earlier date having been granted elsewhere for the same invention. The patentee should be at liberty from time to time, on payment of a moderate fee, to add to his original patent any improvements he may have made, which clearly involve the use of the main claim granted to him under the original patent. A patentee should not be compelled to put his invention in operation within any specified period, as he will naturally endeavour to secure a return as soon as possible; nor should he be precluded from importing into one country, where he holds a patent, articles manufactured in another. Where the patentee does not himself manufacture in the country where he holds a patent, he should be required to grant a license, in consideration of a reasonable royalty, to any responsible manufacturer desirous of working the patent in that country.

A committee, consisting of Messrs. Hinde Palmer, Q.C., R. E. Webster, H. D. Jencken, Lloyd Wise, and J. G. Alexander, was appointed to deal with the paper containing the foregoing suggestions, and to report on the patent question generally. That committee submitted to the Bremen Conference in 1876, a report in which they set forth that they considered it abundantly established by experience that it is for the commercial interest of every nation to grant protection in the shape of patents to inventors. Referring to the resolutions of the Vienna Congress of 1873, the committee recommended that in any action taken by the association in favour of an assimilation of the Patent-laws, the second resolution passed at Vienna should be adhered to as a basis, though it might be necessary to supplement the principles there enunciated by some other provisions. In particular, it might probably be found desirable to embody some of the suggestions contained in Mr. Lloyd Wise's paper, especially as to the extent and character of the preliminary examination, and the course to be adopted in the event of an adverse report. The Bremen Conference having received the report, a more numerous committee was appointed, with power to add to their number.

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* This proposition has since been incorporated in the German Patent-law.

Among the additional members may be mentioned—Sir William Thomson ,Mr. A. H. Brown, M.P.; Mr. Theo. Aston, Q.C.; Mr. A. S. Woolley, Sec. Institution of Naval Architects; Admiral Selwyn, Mr. Lewis Olrick, C.E.; Mr. Edward Field, C.E.; Mr. Henry Merryweather, Major Crease, and Mr. D. Murray. The report of this committee, and a number of resolutions passed by a branch committee formed in Paris, were presented to the Antwerp Conference, which was held at the Hotel de Ville, under the presidency of Lord O'Hagan. While many of the suggestions contained in the paper which formed the original basis of operations are substantially adopted, others, particularly those with reference to preliminary examination, have been somewhat modified.

The following is an abstract of the report, signed by the chairman, Mr. A. H. Brown, M.P., and put in by Mr. J. G. Alexander, the hon. sec., to the committee. On the committee requesting its members to send in lists of those points in the law and practice relating to patents, which they considered capable of being made the subject of international law or arrangement, several papers were submitted, and of these an analysis was made by the secretary. The committee proceeded to consider these points *seriatim*, with the view of elaborating a uniform standard of Patent-law and practice applicable to all countries, while putting aside those questions of practice and procedure which, from their bearing on the legal and administrative constitution of each country, require to be dealt with differently by different States. This plan of proceeding was interrupted by the introduction of Bills into the German Reichstag and the English Parliament respectively, for the amendment of the Patent-laws in those countries, which turned the committee's attention to the specific provisions of those Bills. The following resolution on the subject of the effect of prior user in a foreign country, had, however, been previously passed by the committee:—

"In no case should proof of prior user in another country, unprotected by a subsisting patent in such country, suffice to effect the refusal or invalidation of a patent."

And on the subject of preliminary examination, the committee had adopted the following resolution:—

"Any preliminary examination of applications for Letters Patent should be subject to the following limitations and conditions:—

"1. The examination should be limited to the questions—

"(*a.*) Whether the specification is clear.

"(*b.*) Whether the invention is contrary to public morals, or

"(*c.*) Wanting in novelty, regard being had to prior publications in the Patent-office of the country.

"(*d.*) A prior publication, to be fatal, should come strictly within one or other of the following conditions:

"(1.) It should be not more than 21 years old, and be in the form of a full description, identical with the applicant's description; or (2), if the prior description be more than 21 years old, it should be proved that the identical invention as claimed by the applicant has been openly used within 21 years last past.

"2. Whatever be the result of the examination as to novelty (unless the application comes within the terms of the above sub-section *d.*), the applicant should be allowed a patent, if he still desire it, provided that in his specification he shall distinctly mention the prior matter, pointed out by the examining authorities, and state clearly what he nevertheless claims as novel.

"3. Subject as above, patents should be refused only in cases of fraud, or when the invention is contrary to public morals.

"4. The reports and opinions of examining authorities, as respects applications for patents, should not be open to the public, except in cases where the grant has been opposed. On this point the practice of the English law officers should be followed."

A sub-committee having been appointed to consider the German Bill, their report, approved by the council, was forwarded to Count Münster, the German Ambassador in London, for transmission to the proper authorities in Germany. Though two or three of the suggestions made by the committee were adopted, the Act finally passed, with comparatively few modifications. The committee regard this law as a great improvement on the many conflicting systems of the Patent law and practice previously in force in the various German States, and they approve the principle of annual progressive fees, the placing of foreigners and German subjects on the same footing, and the practical manner in which the question of infringement is dealt with. Some of the provisions of the Act are, however, disapproved of, especially the publicity given to applications for patents, with the view, apparently, of inviting public criticism before the patent is granted. This is considered to afford a wide opening for opposition, on the part of powerful manufacturers, to the introduction of new inventions which might possibly injure their immediate interests, although benefitting the general public. The committee also protest against the clause providing that articles of food and medicines should not be subjects of patents, as discouraging inventions in these branches of economic science, especially as to this category of exceptions have since been added substancess produced by chemical process. They hold that these exceptions set aside the first principle upon which all Patent laws are based, viz., that it is in the interest of the State to grant temporary exclusive privileges to inventors, in order to encourage the exercise of that enterprising industrial genius on which the progress of civilisation and commerce so largely depends.

With regard to preliminary examination, the original Bill has been improved by the omission of a paragraph which, it was feared, would enable the examiners to entertain objections grounded upon the apparent impracticability or inutility of an invention. The committee regret, however, that it is still left in the discretion of the Commissioners of Patents to reject an application which they deem to be wanting in novelty. As this question is one so difficult to decide, the committee urge that the applicant should be allowed, notwithstanding an adverse opinion of the examiners, to take out a patent, if he be willing to make an acknowledgment in his specification of the pre-existing publications pointed out by them. Such a patent would be taken out at the applicant's own risk, the question of novelty in his claim being left for subsequent decision.

The term of fifteen years established by the German Bill cannot be considered as satisfactory, seeing that in Belgium patents are already granted for twenty years, in the United States for seventeen years, and in England there is a power in the Privy Council of extension to twenty-eight years. Experience shows that many of the most important inventions have required as much as ten or twelve years of outlay and loss, before becoming remunerative to the inventors. While the committee approve of the mode in which the fees are to be levied, they regard the total amount as excessive, seeing that the fees to be paid in respect of a fifteen years' patent amounts to 5,300 marks, whilst in England, where the fees have long been complained of as absurdly high, a fourteen years' patent only costs £175 (3,500 marks), in France a fifteen years' patent costs 1,500 francs (£60, or 1,200 marks), and in Belgium, where the cumulative system of payments is also in force, a fifteen years' patent would cost only 1,200 francs (£48, or 960 marks), and a twenty years' patent, 2,100 francs (£82, or 1,640 marks). In the United States, a seventeen years' patent costs in Government fees, only 35 dollars (£7, or 140 marks).

The committee remark that the English Bill, introduced by the Attorney-General into the House of Commons early in the session, was in many respects a great improvement on the Bills introduced by the Lord Chancellor into the House of Lords in 1875 and 1876; though they doubt whether on the whole it would have been an improvement on the law at present in force in Great Britain. On the one hand it proposed to confer on inventors the boon of a term of twenty-one years in substitution for the present term of fourteen; but on the other, its system of preliminary examinations was likely to encourage crotchety objections and factious opposition at every stage, affording ground for litigation, while, the total amount of fees was also to be increased instead of being diminished. The Bill met with a great deal of opposition, so that the committee thought it right to protest against such of its provisions as they conceived to be opposed to true policy and the general interest. A memorial was prepared for presentation to the Attorney-General, embodying the principal objections to the proposals contained in the Bill, and the modifications proposed by the committee. This memorial, approved by the council, was forwarded to Sir John Holker, with a request that he would receive a deputation in support of it. This he promised to do as soon as the Bill should have passed its second reading, a stage which, however, was not reached. Meanwhile, the committee had communicated with several members of Parliament, in order to obtain support for the amendments proposed by them, and found in Sir Henry M. Jackson, Q.C., M.P., an able supporter, who undertook to take charge of the amendments of the committee (except a few taken up by Mr. A. H. Brown, M.P.) and to put them on the paper for consideration in the House.

The committee objected to the manner in which preliminary examination was to be carried out, power being given to the examiners on the provisional specification, not only to report against an application on the ground of want of novelty, but also to state their opinion whether the subject matter of the application lay within the scope of the Patent-laws. It was proposed that these reports, together with the specifications, should be made public on the filing of the complete specification, and before the grant of the patent, thus giving facilities for factious opposition, on which the applicant might have to sustain his claim both before the law officers of the Crown, and on appeal before the Lord Chancellor, involving an expenditure of some hundreds of pounds before even obtaining the grant of his patent. Against these proposals the committee protested, urging the substitution of amendments which should embrace the resolution on the subject which they had already passed.

With regard to revocation of a patent for non-user and failure to grant licenses, the provisions of the Bill were very similar to those in the original German Bill. The committee objected to forfeiture for non-user, and while admitting that licenses may in some cases reasonably be required, proposed amendments guarding this requirement from abuse. The clauses dealing with foreign and colonial inventions were held to be objectionable, inasmuch as they would have thrown great obstacles in the way of foreign and colonial inventors, and also have perpetuated the system of making a patent expire in one country on the expiry from any cause, even fraud, of one of the foreign patents for the same invention. Seeing that patents are designed to enable the inventor securely to invest capital in bringing out or introducing inventions which may add to the resources and to the commerce of the State, the placing of obstacles in the way of inventors, whether native, foreign, or colonial, is a suicidal policy; and a country which witholds from any inventor the temporary monopoly which is the reward of his skill, is at the same time depriving itself of considerable commercial advantages. As to fees, the committee simply recommended that no further tax should be put upon inventors than is necessary to cover all the expenses legitimately belonging to the maintenance of a patent-office.

Mr. Alexander, after reading a letter from Sir William Thomson, sympathising with the action of the committee, expressed a hope that some definite resolutions would be submitted to the congress next year, and that in the meanwhile, foreign members would join in the deliberations of the committee.

M. H. Becker, of Paris, secretary to the French committee, put in some resolutions which they had passed, and now submitted to the congress, of which the following is a free translation;—

1. A temporary privilege of sufficient duration to ensure the remuneration of their labours and outlay, should be accorded to inventors.

2. This period may extend to seventeen years, the first two being regarded as years of experiment.

3. The fees should be payable by progressive annuities, the first being as small as possible, and the last not exceeding twenty times the first.

4. The specification should be kept secret for a certain period; the patent should bear date from the deposit of petition; and this should take place simultaneously at the authorised office, and at the consulates of the various foreign nations.

5. At the expiration of the secret period, the specification should be published, when the patent should be granted, provided it be not opposed to public order, and, also, during a further fixed period, there be no opposition. In the event of opposition the case should be decided by a specified tribunal; and the granting of a patent should be no bar to opposition.

6. Patents of importation should only be granted to the inventor or his representatives.

7. Patents for the same invention in several countries should only be granted for an equal period. In other respects, the several patents should be perfectly independent of each other.

8. The principle of expropriation on the ground of public utility is applicable to patents. There is no reason to admit obligatory licenses. Patents should be declared void if, after a certain delay, the inventors or their representatives do not work them, the causes of non-working being, however, left to the consideration of the courts.

9. The introduction by the patentee of similar articles manufactured abroad should only be permitted under the condition of reciprocity resulting from treaties or the laws.

10. The mere fact of the transit through a country of a patented article manufactured abroad should not be regarded as an act of introduction, except so far as the trade-mark laws apply.

11. For giving publicity to inventions and designs, it would be well to adopt a system of cheap and rapid reproduction, by printing or otherwise, so that they may be placed in detached sheets at the disposal of the public.

M. Becker then observed that the resolutions passed at the Vienna Congress, in 1873, had the tendency of giving the greatest possible protection to invention. He thought that the progressive annuities should not be so heavy as to cripple the inventor. In the resolutions now submitted were two innovations; first absolute security for the inventor during the provisional period; and secondly, the simultaneous petition by means of the electric telegraph, through the consulates of the various countries in which the inventor seeks a patent. When protection is once accorded, tho committee advocate the greatest possible publicity of the invention brought about by cheap means of reproduction of the specification and drawings. M. Becker concluded with the hope that these innovations may be incorporated in the new project of law.

Mr. Hinde Palmer, Q.C., said that many of the suggestions made in the two reports submitted to the congress were good, though they did not quite agree with the recommendation of the committee of the House of Commons on which he had served. He suggested that the reports be received and referred to a committee consisting of both French and English members, which should compile from them a project of international law

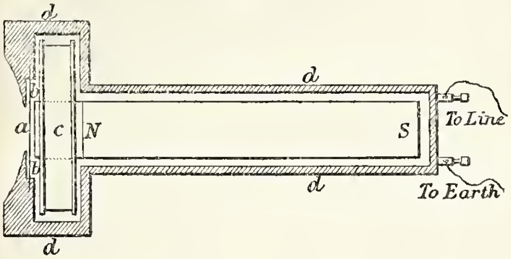
Mr. Lloyd Wise asked if it would be competent for the conference at Paris next year to adopt any elaborated report that the committee might prepare.

The Chairman replied that it would. He quite approved of the proposition; and ultimately the following resolution, proposed by Mr. Hinde Palmer, and seconded by Mr. D. Murray, of Glasgow, was carried unanimously:—"That the two reports of the English and French committees, with the other papers on the subject of patents for inventions, be received, and be referred to the same committees to form a *projet de loi*, having regard to the recommendations of both committees."

THE TELEPHONE.*

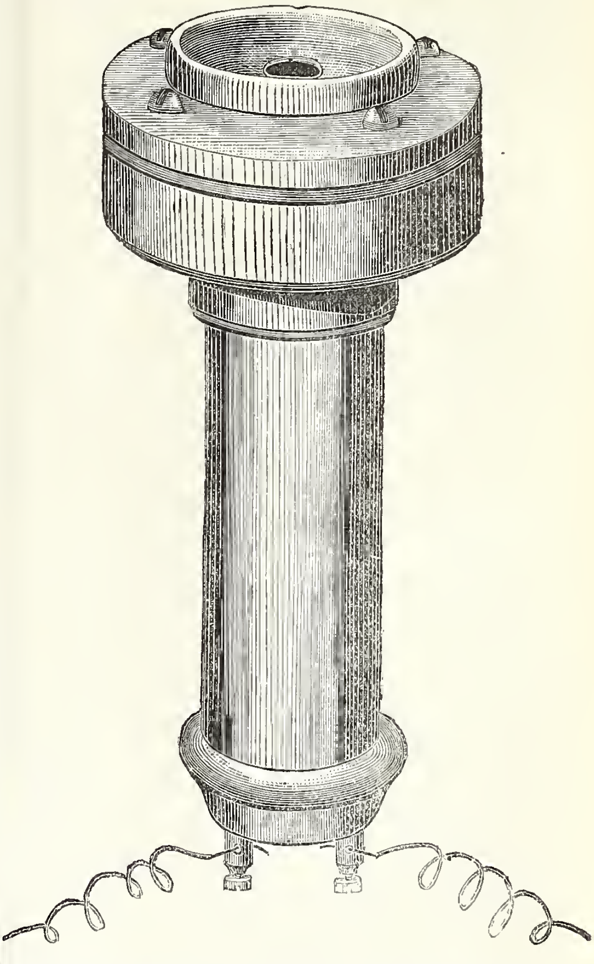
On the occasion of the recent trial of Mr. Cromwell Varley's Telephone in London, a description of that instrument was reprinted in the *Journal* from the *Times*†, but no account has yet been given here of the more important invention of Professor Graham Bell. That Professor Bell was not the first to transmit sounds to a distance by means of electricity is well known to all interested in the subject, nor does he ever appear to have made any such claim; what he really has done is to transmit the sound of the human voice, or to speak more accurately, to cause spoken words to be reproduced at a distance. It is obvious that an apparatus which will do this may be of the highest practical utility, and it may now be considered certain that the telephone is such an apparatus. The means by which Professor Bell was led to his great discovery have been several times described, and those who have not already read the account given by Mr. Preece at the British Association meeting at Plymouth, cannot do better than refer to it for information as to the history of the invention. It must be sufficient to note here that Mr. Bell derived his first suggestion from a consideration of the mechanism of the human ear, and it was simply by imitating that mechanism that the telephone was produced.

FIG. 1.



Perhaps the most remarkable feature of this instrument is its great simplicity, as may be seen by a reference to the illustration. A small permanent magnet is enclosed in a wooden case, which conveniently takes the form shown in Fig. 2. Round one end of the magnet is wound a bobbin (*c*, Fig. 1) of fine insulated wire, the ends of the wire being led to the line and to earth respectively as shown. Opposite the pole of the magnet is a disc (*a*) of thin iron (the ordinary tinned iron, popularly known as tin, is as good as any), which is fitted in the wooden case (*d*) so as to be held only by its edge. Opposite the centre of the disc is an opening in the lid of the case, which is expanded in a trumpet-shaped form. This is the whole apparatus, one serving for sending and a second for receiving. The sender speaks in at the trumpet-shaped mouth, while the receiver holds the mouth of his instrument to his ear, in fact, using the instruments much in the same way as the ordinary speaking tube. The words are distinctly audible without effort, but only when the instrument is close to the ear, though some persons of very quick hearing can catch what is said at a distance of a couple of feet. This may certainly be said to be the outside limit that has yet been reached by the telephone, though there is, of course, the possibility that it may be greatly developed and improved. If an instrument is placed in the circuit from a battery—say of one or two Léclanché cells—making and breaking contact produces a sound which, if the breaks succeed in rapid succession, pass into a rattling or pattering sound, which is distinctly audible at a distance from the instrument. A similar sound is produced if a telephone is joined up to a telegraph-wire which passes near other wires in use, the induced current caused by these wires being strong enough to affect it. A still more remarkable proof of its delicacy is that if a single cell be short circuited, and a long circuit be also formed from the same terminals, and including the telephone, any break of contact in this longer circuit is distinctly audible. It is thus an instrument of most

FIG. 2.



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* The woodcut showing the sectional view of the instrument is reproduced from *Engineering*, and that giving the perspective view from *Nature*, by permission of the editors.

† See *Journal* for July 21st, p. 833.

wonderful delicacy, as it is audibly affected by currents which would not be shown at all on a common galvanometer.

DR. HULLAH ON MUSICAL EDUCATION IN GREAT BRITAIN.

Dr. Hullah has laid before the Committee of Privy Council on Education the report of his fifth annual inspection of the training colleges in Great Britain, and of his examinations of the students in music. The number of students who presented themselves was unprecedentedly large, being 1,964, or 116 in excess of the largest number in any previous year, and the quality of the instruction given in the colleges has continued to improve. There is, however, Dr. Hullah states, no sensible decrease in the number of students who enter the colleges without any musical skill or science whatever, and, as a proof of this, out of the 1,964 students who presented themselves at his examinations, and the majority of whom had been pupil-teachers, 803 admitted that they had entered their colleges wholly ignorant of music. As to the possibility of enabling such students to become satisfactory teachers of singing by note, the inspector points out that it would involve a sacrifice of time which the colleges are unprepared to make, and an amount of labour on the part of the students which it is unreasonable to expect should be long sustained. In other words, Dr. Hullah holds that if the future teachers in the elementary schools of the country are to be really competent to instruct their pupils in the art of singing at sight, their own musical education must be commenced when they are themselves at school, instead of being left to the short period of their stay in the colleges. As to the actual results of his examinations, Dr. Hullah reports that there were very few failures, and of these the majority were in students from Scottish colleges; but this he ascribes not to any inferiority, incapability, or disinclination for music on the part of the Scottish people, but to the fact that the students had come up to Edinburgh, Glasgow, and Aberdeen from distant rural districts where it is almost impossible to obtain instruction. In the Scottish training colleges, the inspector says that not only is vocal music taught skilfully and zealously, but instrumental music also, and far more systematically and generally than in the English. In regard to instrumental music the number of students able to "accompany" themselves is reported to be steadily increasing, and at Liverpool, Wandsworth, Lincoln, and York all the students receive instruction in instrumental music, while at Culham College there is a band of wind instruments. On the other hand, Dr. Hullah mentions a case in which the musical instructor of a female training college, a professor of the highest rank, had offered, without cost to the college, to instruct the students in the pianoforte, but his offer was declined on the plea that such practice would not only interfere with their other work, but that it did not become persons of their station in life. "We have learned," remarks Dr. Hullah, "from Mrs. Malaprop that 'thought does not become a young woman;' it is new to hear, from an education committee too, that to accompany a school song, possibly even to play a pretty tune to her pupils now and then, 'does not become' a schoolmistress." The experience of another year's work leads the inspector to adhere to the scepticism he had already expressed as to the existence of entire musical incapacity, even in persons who have attained middle life without giving any attention to music, and he holds to his absolute belief in its existence among young persons. As an instance, he cites a case where students were presented to him as "voiceless and earless," but who possessed as he found on investigation, contralto voices in as yet unformed conditions, so that they had consequently great difficulty in using their "second registers" at all, and greater in passing from one register to the other. A part of Dr. Hullah's system of examination consists in hearing each student sing a solo previously studied, and here he notes an improvement not only in execution but in selection—"the lists of songs to be sung in some of the colleges might," he adds, "have satisfied the most critical taste, including as they often did fairly representative compositions of the very best masters." Dr. Hullah concludes by insisting upon the importance of teaching the children in the elementary schools to sing by note, instead of as at present is generally the case, to sing only "by ear." One means of effecting an improvement in this respect would, Dr. Hullah urges, be by the extension of musical inspection from the training colleges to the elementary schools, and he submits to the Committee of Council a plan for carrying out his suggestion.—*Pall Mall Gazette.*

GENERAL NOTES.

Artisan Culture.—Sir John Bennett recently wrote to the *Times*:—"In the midst of commotions on every side—with a furious fight in the East, a cruel famine in India, a mad freak of despotic power in France, and a dislocation of trade everywhere—it was quite refreshing to see an interesting letter in the *Times* on so homely a subject as the necessity of technical education. Any illustration of the subject is valuable, if it only makes us wiser for the information, but it seems to me hardly fair to blame the entire system of popular education in the United States because the writer finds the convicts of the Philadelphian Prison but poorly instructed in the practice of some productive industry. He calls it 'a satire on their boasted free-school system' that their brains are full of knowledge, and yet 'their hands untaught to accomplish some skilful work.' I wish to God our people of all classes had got so far as to have their brains full of 'all sorts of impossible knowledge.' Our School Boards know full well that if all that were only done, we could have the best possible material for the reception of subsequent practical training. Unfortunately, we have but to examine the intellectual culture of our successful rivals in any manufacture, and we find ourselves beaten by the foreign schoolmaster, not in prison convicts, but in the great mass of our industrial population. For instance, I go to France, Saxony, or Switzerland, whence comes the great bulk of our watches and clocks for home consumption, and wherever I find most success I find most culture. The workmen's fingers are full of brains, and their brains crammed full of the principles that guide and fortify every act they perform. Brain power in perfection is the one thing needful for the man's work in perfection. I know our present School Board programme is poor enough. Our schools are in an embryo state. It is true our School Boards are no longer tied and bound by the chain of ecclesiastical domination. We are emerging from that antediluvian restriction, and are steadily passing through the Little Bethel stage of transition. Let us take heart then. Our people shall not perish through lack of knowledge much longer, and then will come a system of technical instruction with which we can defy the world in the mechanical and artistic production of most of the things which are demanded by home and foreign markets."

An American statistician gives the number of miles of railway in the different countries of the world, in 1876, as follows:—United States, 77,470 miles; Germany, 18,229; Great Britain and Ireland, 17,263; Russia, 13,702; France, 12,722; Austria and Hungary, 10,956; Asia, 8,266; Canada, 5,219; South America, 5,218; Italy, 5,028; Spain, 4,112; Sweden and Norway, 2,966; Australasia, 2,498; Belgium, 2,278; Turkey in Europe, 1,888; Africa, 1,708; Switzerland, 1,211; Holland, 1,091; total, 191,825 miles.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,296. Vol. XXV.

FRIDAY, SEPTEMBER 21, 1877.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

PROGRAMME OF EXAMINATIONS FOR 1878.

The Programme for 1878 is ready, and can be had on application to the Secretary. The Society's Examinations now comprise the following divisions:—

1. Commercial Knowledge.
2. Domestic Economy.
3. Fine Arts applied to Industry.
4. Music.
5. Technology of Arts and Manufactures.
6. Elementary.

DOMESTIC ECONOMY CONGRESS.

The following is a report of the proceedings of the Congress at Birmingham, on the second day of its sittings (Wednesday, July 19th):—

Section B. (*continued*).—Sickness.

President—Dr. T. P. Helsop.

Mrs. C. J. Bracey read the paper of Mrs. W. E. Gladstone on "Nursing."*

Miss Helen Taylor then addressed the Conference on nursing in connection with education. She said she wished to throw out a few hints, in which she would convey her general idea of the scheme which she thought were needed, leaving it to her hearers, if they approved of the suggestion, to consider the details by which it might be worked out. Of all the domestic occupations of women, it seemed to her that none was so essentially and indisputably an art to be learnt as the occupation of nursing. In some classes of society, where there was a great fortune, the ladies were often released from all domestic care. They employed either men or women of smaller means to do the details of the work for them, and it was often superintended by the gentleman of the family, who settled the accounts, and engaged the principal domestics, such as the stewards and the housekeepers. She hoped the time would come when, thanks to such meetings as the present, something like co-operative housekeeping might be managed for the poor, when working women would be left free from many of the cares and troubles which now pressed upon them at home, the married ones to devote their time, as they should do, to the education of their children; and the unmarried ones to labour and to lay by a little money for their old age, or to begin domestic life whenever they should marry. Thus she thought the time might come when even cooking and needlework might be done in a great measure on a large scale, and when many women might be released from those occupations altogether. She believed, however, that in the nature of things women should be nurses. There were physical reasons and moral reasons for it. Physically, the soft voice, the light step, and the delicate hand of a woman made her the best nurse. Morally, the quick perception and the warm sympathies made woman more fitted for the duties of a nurse than any man could be; and she believed they would never come to a state of things when men and women would not wish to be nursed by those who were near and dear to them. The medical profession was beginning now to be aware of the great importance of moral influence in sickness. The very sight of a face which we love was a comfort to us when we were ill, and many who had personal experience of the sick room knew that the nurse often could scarcely leave the invalid a moment without increased fever supervening. The very presence of a dearly beloved daughter, or wife, or mother, was calming and soothing to the invalid. She was far from undervaluing the importance of trained nursing. She believed it to be essential to efficient nursing. They must not forget what doctors often pointed out to them, how the too great readiness to emotion, the too deep interest felt by the home nurse was of itself a danger; but against that was to be put the intimate knowledge of the personal characteristics of the invalid, which made the family nurse—the near relation—valuable even to the doctor. She had herself known a case where life depended upon a certain effect to be produced within an hour. The best-trained nurse and the doctor would have tried in vain to get at the right means, but the daughter who was there said such and such a thing always had such an effect upon the patient, and the result was that within an hour the patient was out of danger. What she wanted to see was this, that every woman should be a nurse, and that every nurse should be trained. She wished it for home reasons, for the comfort of the family, and she thought that if they looked at national considerations the same thing held true. They all knew how valuable and how expensive a commodity was the British soldier. In this country, with its small population, they had no men to spare for nursing. Every man who had strength to go to the field ought to be a soldier, and they should train their women for military nursing in an effective and systematic manner. There was another reason why their women should be trained nurses, and that was, that it was an admirable profession for them. Women of all ranks in society had a talent for it; but let them not forget that though the near relation was the best nurse, yet there was a great gift of nursing. Some little girls had it at an early age and did it well, while others never could achieve it. She would open that profession to all girls, of all ranks of society, and she would give them the means whereby they would get the training which would enable them, if they had the gift for nursing, to rise in it as in a true profession. What she asked was that her hearers would suggest the means by which the matter might be carried out, for she must say at once that she thought nursing, in common with all domestic training, could not safely be put in the place of elementary education. From what she had seen, she was deeply persuaded that the whole school life of their girls in elementary schools was not too much to give them a fair chance in the battle of life if they were unmarried, and to make them worthy to train their children if they should marry. What she looked to with earnest hope was that some scheme should be adopted to institute two things. In the first place, she should like to see prize scholarships in domestic training for the girls of the higher standards in the elementary schools. She would not place domestic training in the place of that elementary learning which was all that even the highest standards at present gave, but as a reward for it. After the girls had shown themselves capable of learning, let them reward them, and reward the parents who had kept them at school, by giving them prizes and scholarships in the various domestic arts, which would make them happy at home, and capable of earning a living if they went away. Especially ought they to turn their attention to nursing, and they had in their hospitals a kind of training institution ready to their hands; while ladies who had experience in nurses' training institutions might make an addition to their operations by taking young girls as boarders, and sending them out to hospitals which they judged fitting for them. There was another thing which she thought should be done. There were a number of endowments in this country left for the benefit of rich and poor, and for boys and girls alike; but the benefit of them had to a large extent been monopolised by the rich and by boys. She asked them why they should not claim some of this money to be used for the secondary and domestic training of girls throughout the country. She would urge as of the first importance—firstly, that efforts be made either to obtain subscriptions or secure something from the various educational endowments, to be devoted to scholarships in domestic training, cooking, and nursing for girls who had passed the highest standards in our elementary schools; and, secondly, that technical schools for domestic training be established as the foundation of secondary education for girls. If they really cared for the domestic training of women, and especially for their training in nursing, her lady friends would not be content with working at a few girls here and there, but they would persuade the gentlemen of their families that they would have no peace until large sums of money were devoted to this purpose, either from the endowments or from the public purse.

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* See *Journal* for August 3.

Mr. Lawson Tait, F.R.C.S., read a paper on "Provident Dispensaries; a Means of Providing for Sickness."*

Miss Rose Adams read a paper on "The Work of the Ladies' Sanitary Association."†

The President said the change which had gone on in nursing during the last 25 years was one of the most remarkable on the face of society. He could give an illustration of that which he thought would be considered conclusive—an incident which he thought had some effect on the issue of the Crimean War. Twenty-three years ago, Lady Canning wrote to Mr. Yorke, of Birmingham, with reference to the character and qualifications of two women then under sailing orders for the Crimea, and he (the President) was consulted with reference to them. He knew them only too well, as they had been for many years nurses in a hospital of the town. Both of them had splendid testimonials, but they were totally unfit, by character, by intelligence, and in every respect, to take charge of sick soldiers. He said to Mr. Yorke that the matter was too important for a telegram, or a few observations, and himself wrote a long letter to Lady Canning, earnestly pressing her not to take those two well-known nurses. He advised her, if she wanted nurses for sick soldiers, not to go to the British hospitals, but to send out into the little country villages, and get young women of 25 or 26 years of age, of good character above all things, of fair intelligence, and they, after three or four weeks' training, would be infinitely more fit for the work required than the average of hospital nurses in this country at that time. They might judge of the sense of responsibility under which he wrote that letter, knowing that countless lives might depend upon it. Lady Canning at that time possessed great authority in these matters, and he felt it was incumbent upon him at that critical moment to give her his idea of the utter worthlessness of British nurses. Had he to write a letter on the subject of the nurses of the present time, how different it would be. They had heard from Miss Taylor, and also from the paper of Mrs. Gladstone, how necessary it was that a technical training in the subject of nursing should be given. The mere making of a thermometric observation, the placing of the thermometer in the proper place, and then recording the observation, was a matter not to be learnt in a few seconds, and numerous other illustrations of a similar kind might be given. He had learnt from experience that a true regard for the welfare of the patient, a character for veracity and temperance, and general intelligence based upon sound teaching in elementary schools, were more important than the technical training of nurses. If, however, they could have both, it was of great importance; but if he had to choose between technical training on the one hand, and the qualifications he had named, he should not hesitate for a single moment. In listening to the admirable address of Miss Helen Taylor, he was pleased to find confirmation of what he had hitherto thought was an idea entertained only by himself. He had an ever-increasing confidence in the nursing of the home as compared with the nursing of the hospital, and he sometimes could not help speaking bitterly of certain abuses, when he compared what it was possible to do in the worst houses of the poorest and most ill-conditioned class with what could be done in the most richly endowed hospitals. He hoped that what they had heard from Miss Taylor, and from the paper of Mrs. Gladstone, would induce them to press on this question of nursing, and do all they could to carry out the admirable suggestions which had been made to them. He had long seen that the word "nurse" must not be employed in hospitals. At one of the hospitals at Birmingham the delightful word "sister" had been substituted, as was also done in most of the London hospitals, and the effect of that upon the nurses and upon the doctors was such as he could not describe. All he could say was, that from the moment he heard the word uttered at the bedside of a patient, he felt that he was talking to an equal coadjutor in the interest of the patient, totally different to what tradition had implanted in his breast with regard to nurses. With regard to nursing as a profession, he thought they would never keep women to it for life, unless they were to establish guilds and pensions. It was necessary to make them know that when illness, age, or infirmity, came upon them, they might spend the remainder of their lives in some healthy and well furnished retreat, or should have pensions if they preferred to live among their friends.

Mr. J. C. Lord said he had been requested to say a few words as to what had already been done in Birmingham in the matter of training nurses. Since 1869, they had had an institution which was composed of a committee of ladies and gentlemen, who, aided by subscriptions, took young women from the ages of 25 to 35 of all classes, and gave them a good training in sick nursing. They trained them in the General, the Women's, the Homœopathic, the Children's, and the Wolverhampton Hospital. The whole of the nursing in the Children's Hospital was done by their nurses. They had now four head nurses and head probationers, and they had upon their books 53 nurses and probationers, being an increase of 18 during the past year. Those who took part in the affairs of the institution felt very much the need of some system of education, such as that advocated by Miss Helen Taylor, because whenever they wanted probationers they had a difficulty in finding them, except in the class who came simply from their own necessities. He was very strongly of opinion that if they could have a desire for the knowledge of nursing infused into young women of all classes, there would be a much larger number of suitable candidates for such institutions as the one with which he was connected to put into hospitals. In addition, there were training nurses to attend upon the sick who were able to pay for them, and they had now 21 nurses working in private families. The committee had also a fund at their disposal—he was sorry to say, as yet, a very small one—in order to put free nurses into particular districts to nurse the poor. They had only one such nurse, but she had attended 120 different persons, and had been the means of not only of directly benefiting those who were sick, but of inculcating habits of cleanliness, good management, and providence among those by whom they were surrounded. He hoped that means would be forthcoming to increase the number of such nurses.

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* See *Journal* for August 17.

† See *Journal* for August 31.

The Rev. E. F. M. MacCarthy said he should like to say a word upon endowments for girls. It might interest Miss Helen Taylor to hear that in the great endowment of King Edward's School at Birmingham, a large portion had for the last thirty years been set apart for the education of girls, and that there were in the town four branch schools, in each of which there were some 200. A new scheme, which had now been before the public some time, contemplated not only secondary schools for girls, which would be of the third grade, but also a high school. Among the secular subjects to be taught, domestic economy was in the schedule. It was obvious that there would be ample scope for the development of the teaching of those subjects in the two kinds of schools which he had mentioned. With regard to the subject of endowments generally, he was very glad Miss Helen Taylor had drawn the attention of the ladies to this question. A very large number of the present schemes had an objectionable clause maintaining the doles. Nothing could be stronger than the words of condemnation used by the Schools Inquiry Commission with reference to these doles; and it was supposed on all hands we had seen the last of them, and that the money devoted to them would take the form of scholarships, to pass the children on from the public elementary school to the secondary school of their neighbourhood. The feeling of Parliament on this matter was loyally carried out by the much abused Endowed Schools Commissioners, but he regretted to say a retrograde step had been taken by the Charity Commissioners in this matter. In the parish of Wolverley, an extensive parish near Kidderminster, there was a very important endowment consisting of land in London, which in a few years would be worth some thousands a-year. The scheme was published in the usual way, and in that scheme they had actually perpetuated a system by which a certain number of poor men and women in six parishes could go and receive a loaf of bread if they presented themselves at the Sunday evening service at their parish churches. He thought it was time that the daylight was let in upon such things as these, and he hoped these schemes would be carefully watched, so that such antediluvian legislation should cease.

Mr. E. Chadwick, C.B., referring to Mr. Lawson Tait's statement as to the mean age of death, said he had to complain very much of the manner in which the mortality statistics were published. They had it stated that London was a healthy city, with a death-rate of only 20 in the thousand. But that was the mean of a large number of districts. He had no doubt that in some of the districts and classes of people they would find a death rate of 60 per thousand. He had taken the trouble to get out the mortality of the different classes, and he found that with respect to the professional class in London the mean age of death was 44 years, while in the wage-earning class it was 22 years. The attacks of epidemic disease by which that mortality of the working class was affected might be shown in this, that whereas amongst the professional persons and their families the proportion of deaths from epidemic or foul air diseases was only 6 per cent, the proportion of deaths from the same causes in the wage-earning class was 22 per cent.

The Rev. Canon Bowlby (Birmingham) said that with regard to provident dispensaries he wished to say as the result of his experience, and after large acquaintance with the class of persons those institutions were intended to benefit, that he was sure, looking at the matter from their point of view, the movement was one which ought to have the encouragement of every thoughtful person. With regard to the giving of doles in connection with church attendance, he begged as a clergyman to say, and he believed his brethren would agree with that, he did not desire their continuance. They were productive of the greatest mischief, by pauperising persons, and inducing them to come to church from an improper motive.

The Rev. H. W. Crosskey (Birmingham) said that upon the question of provident dispensaries he wished to throw out one or two points for consideration. The first was that there should be no element of charity whatever in connection with them, but that they should be really and truly self-supporting institutions. He was convinced that what was wanted in this country was not more great charitable institutions, but more organisation for self-help. His second suggestion was that there should be no restriction as to who should be allowed to join. The application of a wage test was not at all possible, and he was also averse to the admission of members by an election committee. In the third place, he suggested, as worthy of consideration, whether those who were to enjoy the advantages of the dispensaries ought not to be entrusted with the management of them. They had done too much in managing for people, and now they must have people manage for themselves.

Miss Kenrick closed the discussion by pointing out that in connection with Ladies' Sanitary Associations there were lectures to poor women, and she had found that those who attended such lectures were very ready to follow the advice given. It only required that medical knowledge should be translated into the vernacular, and that those who spoke should be acquainted with the houses of the working classes.

The Dwelling.—Warming and Ventilation.

Dr. Carter read a paper by Mr. R. Rawlinson, C.B., on "Buildings for Working Men."[*]

Dr. Alfred Hill, Medical Officer of Health to the Borough of Birmingham, read a paper on "House Drains in their Relation to Health."[†]

Mr. Frank Curzon read a paper on "The Appointments and Appearance of the Workman's Home."[‡]

Capt. Galton, C.B., F.R.S., read a paper on "Warming and Ventilation."[§]

Mr. George Skey (Tamworth), in opening the discussion on the papers, said he was sure that the importance of the subject of buildings for working men could not be overrated. While agreeing with the numerous suggestions which had been made on the matter, he asked what they were to do with reference to the cost. He had done a little in the practical way by building a model lodging house for 24 young men, giving a separate sleeping apartment to each; and also half-a-dozen houses, which some people were pleased to call model dwellings for the labouring class. The model lodging house he had to close and turn into dwellings; and the model cottages remained still. The whole property was in his possession at this moment, but what about the returns for it. It was not three per cent. He reminded them that the cost of building was enormous, and he wanted to know how they were to meet the difficulty. He found that the experiment did not pay. If these buildings had paid an ordinary interest, he might have gone on with the scheme. He was sorry to say that, even in Birmingham, speculative builders were putting up a number of houses which the sanitary authorities would prevent if they had the power. If they could bring forward some economical and complete plan for building such houses as had been suggested, then he thought the thing might be done, but not otherwise.

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[*] See *Journal* for August 24.

[†] See *Journal* for September 7.

[‡] See *Journal* for August 24.

[§] *Ibid.*

Mrs. Edmunds (Bimingham) asked whether hammocks could not be introduced into the dwellings of the poorer classes. Blankets and mattresses cost money, however common they might be, and it was almost impossible for many of the poorer people to keep the mattresses clean. She suggested that hammocks might be used for sleeping purposes.

General Cotton, C.S.I., pointed out that, owing to the increased information which had been diffused in the public mind, the builders in London now paid much greater attention to the sanitary arrangements of the buildings which they put up. They now hardly considered a house was ready to go into the market unless a sanitary engineer had gone over it

The Rev. Brooke Lambert said that, with regard to the question of cost raised by Mr. Skey, buildings of the kind in question had been put up in London with success, the houses having given a return of 5 per cent. Those houses were paying mainly from the fact that the tenant had an interest in conserving the property, and so the waste and expenditure were enormously reduced. He thought any scheme would be useless without some such provision as that.

After a few words from **Col. Phelps** and **Mr. Peyton**, the business of this Section concluded, and an adjournment for luncheon took place.

AFTERNOON SITTING.

Section A (*continued*).—Food and Cookery.

President—Miss Kenrick.

Sir Henry Cole, K.C.B., described a paper by Mrs. Charles Clarke, on "The National Training School for Cookery."[*]

Miss Guthrie-Wright (Edinburgh) read a paper on "The Art of Preparing Food; its Place in General Education."[†]

Mrs. Fenwick (Leeds) read a paper on "The Teaching of Domestic Economy in Conjunction with Cookery in Elementary and Secondary Schools."[‡]

Mrs. Rowland Williams (Liverpool) read a paper on "The Combination of Practice with Theory in Cooking Lessons for Public Elementary Schools."[§]

The Rev. J. P. Faunthorpe spoke on the encouragement given to the teaching of cookery at Whitelands Training College. He remarked that a competent teacher of cookery might earn from £100 to £150 a year, which was much more than untrained governesses could earn. He recommended that a knowledge of cookery should be considered essential when a schoolmistress applied for a situation, or, if the managers chose, she might be sent to the school of cookery for a month or six weeks.

The Rev. E. T. Stevens said he represented the country villages, whose schools were very ill supplied with the various materials, and the teaching staff of highly educated and exceedingly willing ladies who were to be found in such a place as Birmingham. The difficulties in teaching domestic economy in country villages were very great indeed. He should be very glad if, as the outcome of the Conference, some association of ladies could be found to take the country villages under their guardianship and give lessons in domestic managment, and especially in cookery. It would also be of the greatest advantage if ladies would give the young persons and children whom they had instructed a certificate of being able to cook properly, when they entered the service of richer families. He should like to see domestic economy associations going voluntarily into parish schools or other places in the villages in order to teach the girls and young women practical domestic economy, for he was convinced that the mere giving of demonstration lessons was not sufficient; the children and young women who were taught must be able to do themselves the thing they saw their teachers perform. He therefore suggested that a body of voluntary teachers should be created, to teach the lessons in domestic economy practically, and when the pupils had learnt to do the things they taught, they should give them certificates to take to their future mistresses on seeking a situation.

The Rev. Brooke Lambert thought there were too many associations in the world, and that one of the best associations would be teach people how to do without associations at all. With regard to the expense of training children in cookery, he believed that if a cookery class was established in a Board school in Birmingham, and joints cooked and sold, the whole expense of the kitchen would be saved. From his experience in Tamworth and London, he was perfectly convinced that a cooking kitchen in connection with a public elementary school would pay. If cookery was conducted on a large scale at one of the Birmingham Board schools, the artisans would take as much dinner as they could possibly cook. He suggested the establishment of central cookery schools throughout the country, in which the Government might give elementary cooking lessons to the children.

The Rev. Newton Price next read a paper on "Cookery in Elementary Schools."[*]

Mr. R. Browne Clayton read a paper on "Several Years' Experience of Cookery Taught in Various Schools."[†]

Mr. W. Stephen Mitchell read a paper on "The Practical Use of the Food Collection of the Science and Art Department."[‡]

Dr. Wilson read a paper on "Errors in Diet."[§]

Miss Helen Taylor opened the discussion on these papers, observing that in the few words she wished to say on this subject, she spoke rather as an old housekeeper than as one interested in popular education. The question, which in her opinion was pre-eminently a man's question, was one that effected the middle classes much more than the working classes, for, without undervaluing the importance of good cooking, she was afraid that there was a lasting truth in the old proverb about who it was that sent meat and who it was that sent cooks. Who was it that felt so very deeply upon this subject? It was the gentlemen who were well-to-do. And who was it that told the women such sad tales of indigestion? So much for the too enticing effects of good cooking. As regards the working classes, she thought the exact reverse effect was produced by the very same thing. The well-to-do classes, especially the gentlemen, were tempted to eat a great deal too much by the good cooking at the clubs, and perhaps it might be a Providential arrangement that they did not find such good cooking at home. Looking to the working classes, and speaking as one who had kept house in France, and for 18 years had been deeply interested in the cooking of France, and had studied the cottage and farm-house cooking among her poorer neighbours, who had passed the best years of her life in travelling among the mountains of France, Italy, and Germany, and who knew what the cooking was in the humble dwellings in this country, she could say emphatically that she believed a great deal of the good health of English working men was owing to the fact that their wives cooked so badly that they would not put up with wishy-washy soup. There was a great snare in the good economical cooking of French women. They made almost anything so appetising that women and children were satisfied, and thought they had had enough to eat; but they rose the next morning to their work without having had enough to keep up their bodily strength. Whatever they did, they should be careful that the cooking they attempted to introduce should not be too elaborate; and another thing—regarded from the point of view of working men, and perhaps also of men of all ranks in life who are not rich enough to afford well trained, high-class servants—it would be infinitely better for their health and good temper, if their wives were precise as to time rather than being tempting in what they presented to eat, for if there was one thing that ruined the health and temper of men—and justly so—it was the way in which the women, and especially the working women, kept them waiting for their meals. She believed that the most ill-cooked mutton chop or piece of bacon given at the minute that the man went in was better than tho best cooked dish half an hour afterwards. Therefore she put in a word for primary education—that education which taught girls to be precise and exact; and if ever they did get to a high-class system of cooking, this would be the foundation of it. The reason they had such bad cooking in their lower middle-class establishments was because their servant girls were so ignorant. As regarded teaching girls cookery, she thought they should do something of it, but she was to a great degree an advocate for the theoretical teaching of girls. She was sure the ladies present would bear her out that a young woman, and far less a young girl, could not be taught to cook with one, two, or three experiments; it was constant practice which taught a woman how to cook, so that the mistakes made one time might be remedied another. As a rule, they wanted to teach the young rather than the old; but it seemed to her that it would be better to give the cooking lessons to the mothers, who had the means of putting them in practice and instructing their daughters. She did not think the girls would ever teach the mothers. She thought they would do more to advance cookery by opening classes all over the country, in connection with the training schools, for the mothers, for they might depend upon it that the mothers, if they were good cooks, would teach the girls, whereas the mothers would consider the girls most intolerable prigs if they attempted to teach them. A good deal might be done to attain the end they had in view by preparing the girls, by teaching them the laws of health, physiology, such parts of chemistry as appertained to cookery, what cookery meant, and what were its objects, and, in fact, by giving them a philosophical view of the subject. When that had been done, all the intelligent girls would be anxious to learn more as to the practical work of their lives. They did not put the boys to school to learn their trades, and as cooking and domestic work were, or ought to be, the trade of most women, they should give women their trade or technical teaching directly after they left the primary schools. They ought to have secondary technical schools, where domestic work could be taught by highly-trained teachers, for to attempt to make a certificated teacher of a school into a good cook was to spoil two good things. The French understood cookery better than the English, and a celebrated French cook had gone so far as to say that it was a gift which came, like poetry, from heaven. Let schoolmistress and cook keep their respective places in the world; in short, let them not be too economical in the training of girls; let them not want to squeeze into thirteen years of a girl's life both the school training and what she called the trade learning. Let a girl learn her trade of mistress, mother, and housekeeper after she had been well prepared for it by a thorough course of elementary teaching.

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[*] See *Journal* for August 31. [†] *Ibid.* [‡] *Ibid.* [§] *Ibid*

[*] See *Journal* for September 7.

[†] See *Journal* for August 31.

[‡] This paper was, in the main, a repetition of the paper read by Mr Mitchel at a meeting of the Society, on the 16th of May last, and printed in the *Journal* of May 18.

[‡] See *Journal* for September 7.

Mrs. Fenwick read a paper, in which she contended that the present regulations militated against the successful teaching of domestic economy as a branch of national education. If a girl took specific subjects domestic economy must be one; but no girl, except in the fourth, fifth, or sixth standards, was allowed to compete for the Government grant. The effect would be that the few dull girls would frequently leave school without any domestic training, never having attended those higher standards. She, therefore, thought that the standard for commencing the study of cookery should be the age and not the brains of the girls.

Mr. H. W. Hart spoke on the subject of errors of diet, They could not have a greater illustration of the errors of diet than in the widespread dyspepsia throughout the country, and he would suggest that medical men who took an interest in their fellow creatures should combine together with the view to inform the public as to what was proper diet. Proper food should be capable of sustaining and invigorating every organ of the human body, and maintaining uniform health for any length of time, without the assistance of stimulants, tonics, or aperient medicines. Meat did did not supply all that was really necessary for the sustentation and growth of the various parts of the human body. Milk, ripe fruit, vegetables, and farinaceous foods would sustain life more or less perfectly; but to obtain this desideratum to perfection recourse must be had to wheat. The value of bread made of the entire grain, and without fermentation, would, if freely and constantly used, and excluding starchy foods, effect a speedy and marked improvement in the physical and mental condition of all who partook of it. The great disadvantage of Scotch oatmeal was that it was unduly heating to the system.

Mrs. Francis Lupton, in reply to what had been advanced by Miss Helen Taylor, said the result of their practical experience in Lancashire and Yorkshire of the teaching of cookery, and the relation of foods to health, showed that reformation, to be practical, must begin with the young rather than the old, and not with those who from their stereotyped habits were unwilling to accept new truths. If they confined their teaching to adults, the result had shown that the next generation would be as ignorant as the present. It was therefore to the schools that they must look for the carrying out of a more systematic training in the principles and practice of household cookery. In the recognition by the Government of cookery as a branch of study in State schools she saw an omen of a better state of things for the future.

The Rev. Newton Price said the lady who had just spoken was evidently under the impression that there was an antagonism between the education they were then advocating and primary education; such, however, was not his experience, and in his experience he had found primary education decidedly improved and the intelligence of the children promoted by the lessons they received in cookery, while he had the authority of Miss Chessar for stating his school was in a very high state of efficiency with regard to general education. He had also found that the mothers did not object to receive lessons from their children. If they were to defer the teaching of cookery to children until after the age of 13, as had been suggested, they would in most cases have no opportunity of teaching them the subject.

The Rev. J. P. Faunthorpe said his experience, which was probably very inferior to that of Miss Taylor, was that the mothers showed the greatest willingness not only to allow their daughters to practise what they had been taught in the schools, but also to learn from them themselves.

The Rev. E. F. M. MacCarthy admitted that they might commit the error of allowing those interesting practical subjects to absorb too much of the time that ought to be given to the training of the mind. While they were exhorted not to squeeze into thirteen years of a girl's life both school training and technical training, yet they were met by the fact that they were not likely to have another opportunity of getting technical training at all, in that particular area, unless they did it within those years. He should like to imagine the day was near, but he believed it was a generation ahead, when the endowments of this country, with all their richness and wealth, would be devoted throughout the length and breadth of the land, to scholarships for carrying children from public elementary schools to secondary technical and trade schools. There were sufficient funds in the country for the purpose, and it only meant in very many cases their diversion from harmful, and in some cases wicked, uses, to the very best uses to which money could be put. The class which was now being pauperised by these endowments was the same class which, under proper legislation, would profit by them when they were turned to other and more useful purposes. He agreed with Miss Taylor that mothers would be apt to put up their backs against being taught by a chit of a girl, but that would only be the case for one generation, because those daughters would in a few years themselves become mothers, so that all the difficulty and unpleasantness which they were now bound to take into account would only be temporary, and would be one of the results necessarily accompanying any change or improvement of a system. With reference to what Mrs. Fenwick had said, it was quite true that, by the present Code, girls in elementary schools could not be taught domestic economy until they had arrived at the fourth standard, and it was also true that the bulk of the children who ought to share in the teaching would have left school before arriving at that stage. A modification of the Code, by allowing the subject to be taken on the second or third standard, would meet the difficulty. The selection of girls by age and not by intellect to receive lessons in cookery, would, he was afraid, be found absolutely impracticable. The schedule of the Code, however, wanted revising, as it was artificial, and not based upon practical experience, domestic economy not having been taught before. The best plan would be to have elementary stages, advanced stages, and honour stages, and to pay for the results accordingly.

Mr. W. S. Mitchell briefly replied, and the discussion closed.

The Rev. E. F. M. MacCarthy then announced that there were certain resolutions to be passed before the Congress terminated. During the day the Earl of Lichfield had been at the Congress, and if time had permitted he was to have moved the adoption of the first resolution. The noble Earl had been obliged to leave early, but if he had been present he would in his speech have read an extract from a work ("The Annals of Agriculture") published between 1790 and 1800, on the very point they had been discussing during the last two days. His Lordship's object was to show that seventy or eighty years ago the principles upon which they were working had impressed themselves upon the minds of some of the thinkers of those days. He could not do better than read the extract which his Lordship intended to bring before the meeting. It ran,—"this economy in all cases is the more to be urged because the difference in comforts of the same families, at the same expense, well or ill-conducted, is greater often than that of different families at different expenses. There is more difference, comparatively, in the mode of living from economy than from income. The deficiency in income may possibly be made up by increase of work or wages; but the want of economy is irremediable, and the least income in question with it will do more than the greatest without it. No master can in the first place afford wages, next, no overseer can make allowance, lastly, no magistrate can order relief, enough on any calculation but that of their being severally well-managed. If the poor do not prudently serve themselves none can effectually assist them; if they are not their own friends none can sufficiently befriend them. The idle in procuring, or the wasteful in using, the means of subsistence, have neither merit in themselves to deserve, nor have others power to grant them that supply which is alone due, and can be alone afforded, to the honest, industrious, and prudent. It highly, then, interests all conversant with the poor, who ought to be literally all, and it is hoped are most, to consult and co-operate with them in the practice of economy; it is far more useful to teach them to spend less, or to save a little, than to give them much more."

The Next Congress.

Mr. Traice proposed a resolution, the design of which was to remove the mere fugitive character of these meetings, and to produce some sort of organisation by which the movement now inaugurated would be more or less perpetuated. The resolution was:—"That in view of obtaining practical results for this Congress it is desirable that the local committee and subcommittees remain in action until the next annual Congress, which has been announced by the Society of Arts to be held in Lancashire in 1878." He supposed the fact that the next annual Congress was to be held in Lancashire was the reason why he had been chosen to move the resolution. At any rate, he hoped that the result of the Congress which had been held in Birmingham would be to give to those who had attended the Congress some incentive to enter upon some new work, which would not only be of advantage to themselves, but to all their fellow-creatures.

The Rev. Brooke Lambert, in seconding the resolution, said one object of the Congress was to give information, and that he believed, had been well achieved.

The motion was unanimously adopted.

General Cotton said, that when this Conference was first suggested in the Society of Arts Committee, one lady gave her vote against it very decidedly; but he would not hesitate to say that the Congress held in Birmingham had been a great and decided success. Sir Henry Cole had been their herald in Birmingham, and the President, and Vice-President, and the secretaries had shown a faithfulness and an earnestness in everything which had been done. If there had been any ruffled temper, he was confident that anyone, after they had left the meeting, would at once forget it. So far as he was concerned he had not seen anything of the sort. In their studies during the two days their object was to bring luxury to all classes. They did not use the word in its ordinary acceptation, but they had in domestic economy the means of bringing luxuries to the people; for who would deny that pure air, well-ventilated homes, food well-cooked, and food well-selected, were not intense luxuries? He moved:—"That the thanks of this Congress are due, and are heartily tendered, to the inhabitants of the town of Birmingham and its neighbourhood, who have given so graceful a reception, and extended such generous hospitality to the visitors to this Congress; also to Colonel and Mrs. Ratcliff for their thoughtfulness in seeking to relieve the heavier duties of the course, by throwing open their grounds for a few hours of agreeable relaxation, and for entertaining the members of the Congress there; to the president, vice-president, and committee of the Royal Birmingham Society of Artists for placing at the disposal of the Congress the suite of rooms in which the *conversazione* and sittings of the Congress and exhibition have been held."

Mr. Danby Seymour, in seconding the motion, said that he thought the Congress had been a great success, and he was sure that the Society of Arts did right in initiating it.

The resolution was cordially adopted.

The Mayor of Birmingham (Mr. G. Baker) acknowledged the vote, and expressed his regret that he had unavoidably been absent from most of the discussions which had taken place. He noticed that it was proposed that the next meeting should be held somewhere in Lancashire, and he was sure that the persons attending that meeting would be as warmly received there as they had been in Birmingham. With respect to Colonel Ratcliff, he was sure they all appreciated the very great kindness and the thoughtful consideration he had shown in providing the company with such a pleasant entertainment. The Society of Arts, which had originated a Congress like that, had done a very great work, and they had to thank Sir H. Cole and other persons for the great zeal and energy they had shown in the matter. No one could measure what good such a Conference could do, and he hoped it would be continued in the future.

Mr. E. Chadwick next moved:—"That the members of the Congress desire heartily to congratulate the Executive, Reception, Exhibition, and Finance Committees, the Presidents of Sections, the Treasurer and Honorary Secretaries, and all who have contributed to the efficient conduct of the proceedings, on the great success which has crowned their exertions; and they also desire to express their thorough appreciation of the arduous labours which have contributed in so many ways to that success, and to their personal convenience and comfort."

This was seconded by **Miss Helen Taylor**, and unanimously adopted.

Sir Henry Cole briefly responded, and the President then announced that the Congress was closed.

MISCELLANEOUS.

THE ECONOMIC USES OF REPTILES,

By P. L. Simmonds.

Without looking somewhat closely into the subject, few are probably aware of the extensive applications in this utilitarian age of almost every kind of animal. Even the reptiles which heretofore furnished only the economic products of turtle flesh and tortoiseshell, are now eagerly sought for, for various commercial products obtained from different tribes; the alligators, crocodiles, and serpents for their skins, and even for food; the amphibians for food, and the land, marsh, and sea tortoises are now hunted in all directions.

Taking the first order, tortoises or turtles, we find the flesh of many kinds is tender and palatable, and the eggs of some are much sought for, while tortoiseshell is in demand for objects of luxury. The collection of the Museum of Natural History of Paris has 121 species of tortoises, and Professor Dumeril has classed them, according to their habits, into four families:—1. *Chersites*, or land tortoises; 2. *Elodites*, or *Paludines*, marsh tortoises; 3. *Potamites*, or fluviales, river tortoises; and 4. *Thalassites*, or sea tortoises. Speaking generally, it may be stated, that all tortoises are edible, for there are people who eat different kinds in various countries, but as the flesh of some is better flavoured than others those are necessarily most sought after.

1. The Land Turtles or Tortoises (*Testudo*.).—In Sicily and Italy land tortoises (*T. Græca*) are sold in the markets principally for making soup, which is more esteemed than the flesh prepared in any other way.

The flesh of the gopher tortoise (*Testudo polyphemus; T. Carolina* of Leconte) is said to be excellent, and it is therefore sought after for the table. Of late years, in London, numbers of the small Moorish tortoises have been common on the barrows of costermongers. These creatures are sold for about sixpence each, as pets for children. They are among the minor exports of Morocco, as they abound about Mogador and Saffi. They are collected by the country people, and bought up by the Jews, who pack them closely in barrels for exportation.

The eggs of the land tortoises of Africa are about the size of a pigeon, and are said to be much esteemed as food by the natives. The close tortoise (*Testudo clausa*) is much sought for in North America, on account of its eggs, which, like those of the African variety, are reckoned a delicacy, and are about the size of pigeon's eggs.

Certain species of tortoises (*Peltastes* [*Chersina*] *homopus*) are eaten in the Cape Colony.

Darwin gives a good account of the great elephatine tortoise, of the Galapagos Islands, which he terms *Testudo indicus*. The flesh of this animal is largely employed, both fresh and salted, and a beautifully clear oil is prepared from the fat. When a tortoise is caught, the man makes a slit in the skin near its tail, so as to see inside its body whether the fat under the dorsal plate is thick. If it is not, the animal is liberated, and is said to recover soon from this strange operation. While staying in the upper district of St. James's Island, where a party of Spaniards were employed in catching tortoises, Mr. Darwin and his companions lived entirely on the meat of these animals. "The breastplate roasted with the flesh attached to it" (he says) "is very good, and the young tortoises make excellent soup, but otherwise the meat, to my taste, is very indifferent."

Some of the largest of the land tortoises of the Galapagos Islands weigh 300 or 400 lbs., but their common size is between 50 and 100 lbs. Capt. B. Hall ("Extracts of Journal in Chili, Peru, &c."), says, "Their flesh, without exception, is of as sweet and pleasant a flavour as any that I ever eat. It was common to take out of one of them 10 or 12 pounds of fat when they were opened, besides what was necessary to cook them with. This was as yellow as our best butter, and of a sweeter flavour than hog's lard."

The terrapin (*Cestudo Carolina*) inhabits North America from Hudson's Bay to the Floridas. The flesh is eaten, and the eggs, which are about as large as those of a pigeon, are accounted excellent, and greatly sought after. The terrapin is met with about the lagoons and morasses in Jamaica, and lives chiefly among the woods that grow in those places. The body is generally of a compressed oval form, and seldom exceeds eight or nine inches in length. It is often served up at gentlemen's tables in that island, and looked upon as delicate, wholesome food by many people.

To show the importance of the tortoise trade in the States, the following account from an American paper, of a Baltimore establishment, may be quoted:—"The most novel feature of the house is the terrapin department. This room is kept warm, and the terrapins luxuriate in air-tight chests, each from five to ten bushels capacity. These are packed full of terrapins, which number many hundreds in the aggregate. The most of them are of the Chesapeake diamond back variety, and all are at least seven inches across the under shell, that being the measurement which the terrapin must reach before, in the opinion of the epicure, it is fitted for the table. There are also kept, in some of the chests, hundreds of slider or red fender terrapins, a fresh water variety, chiefly from the James river. The habits of the terrapin have been made a study by the dealer. He keeps them in his air-tight chests, without food, and says they not only exist deprived of air, but grow fat, and if kept in the chests for six months will each weigh four or six ounces more than when put in. If the terrapins are allowed to have liberty or free air, even in the most limited space, they become very poor, as they seem to draw sustenance from themselves, but do not take food. All the terrapins in the chests are enjoying vigorous existence, as proved by their movements when the lids were raised. The terrapins are principally sold to hotel keepers, and to be served up at extra junketings, and bring about 24 dols. a dozen. During the terrapin season of 1874, one house in Baltimore sold a thousand dozen."

The painted river tortoise (*Emys* [*Chrysemys*] *picta*) and the red-bellied turtle (*Calemys mechlenburgii*) are now less common in central New Jersey, both being sought after by restaurant keepers, who palm them off on their customers as terrapin (*Malacolemy spalustris*); but no cooking, however skilful, can deceive those who are accustomed to the genuine article.

The flesh of the European box tortoise (*C. Europæa*), though not very delicate, is nevertheless eaten on the Continent. It is said, however, to be greatly improved by feeding the animals for some time on grain, bran, and other vegetable aliment.

2. The River Tortoises of Africa, Asia, and America are highly esteemed by man as food.

Le Vaillant ("Travels in Africa," vol. i, p. 116) thus speaks of the tortoises there:—"Next morning, the weather being cool and cloudy, we marched six hours in order to reach the borders of a very large pond abounding with small tortoises, of which we caught about twenty; we broiled them all in the same manner on the coals and found them excellent. They were from seven to eight inches in length and about four in breadth. The shell on the back was of a whitish grey colour, inclining a little to yellow; when alive they had a disagreeable smell, but by roasting this was entirely destroyed. Their eggs are as large as those of the pigeon. These they deposit on the borders of ponds and small lakes, and leave to the heat and the sun the care of hatching them. These eggs have an excellent taste; the white, which never becomes hard by the force of fire, preserves the transparency of a blueish jelly."

The salt-water terrapin of America (*Emys concentrica*) is in great request, its flesh being highly esteemed as a delicacy for the table, especially at the close of the summer, when the animals have retired to their winter dormitory. They are then fat, and considered as a delicacy. The flesh of an *Emys* is eaten in China, and is considered medicinally pectoral and emollient. The fat, it is asserted, prevents the hair from turning grey. The shell cut up in small pieces is given in decoction. The carapace is, however, carefully examined to observe if there are nine divisions or markings at the sides, for if so, its value is great. It is boiled in vinegar and water to form a jelly, much prescribed in rheumatism, debility, and other disorders. The flesh of the hairy tortoise is considered excellent in many maladies.

The flesh of the matamata (*Chelys matamata*, Dumeril) is highly esteemed, and in Cayenne and Guiana incessant warfare has been maintained against it, so that it has become scarce.

The flesh of the tailed tortoise, or alligator tortoise of North America (*Chelydra serpentina*, Schwigger) is considered unpalatable, and has a musky odour. That of the fringed snouted tortoise (*Chelys fimbriata*) is, however, excellent eating. The flesh of the *Cryptopus granosus*, Bibr, is eaten inIndia.

Some of the fossil turtle and tortoises found in America were twenty feet in diameter. Some had their shells extended into star-shaped disks.

3. Marine Turtles.—We come now to the marine turtles, and of these, in commencing his notice of them, M. Lacepede well remarks:—"One of the best presents which nature has given to the inhabitants of equatorial countries, one of the most useful products which it has deposited on the confines of land and water, is the turtle. Of these we may notice the green turtle (*Chelonia midas*) the logger-head or hawk-bill turtle (*Chelonia* [*Caretta*] *imbricata*) furnishing the tortoise shell of commerce, and the luth or leathery turtle (*Spargiscoriacea*).

The flesh of some species of marine tortoises, but particularly of the green turtle (*Chelonia midas*), is in the greatest request as a luxury for the table, at least in England, and the animal itself is an object of commerce. The arrival of a cargo of "lively turtles" is by no means a thing of trifling importance. Of late years, the flesh is imported dried, which has placed it within the reach of general consumers. The flesh is also salted in some quarters. All the turtles afford a considerable quantity of oil, which is employed for various purposes. In some of the West Indian islands, it supplies, when fresh, the place of butter or salad oil for culinary purposes, and it is also used for burning in lamps.

Turtle would seem to have been first introduced in England as an article of food about the 18th century, for a record in the *Gentleman's Magazine*, under date August 31, 1753, shows that it was then a rarity; but they did not understand how to dress it. It states:—"A turtle, weighing 350 lbs. was ate at the 'King's Arms,' Pall Mall; the mouth of an oven was taken down to admit the part to be baked."

Steam communication has greatly increased the imports of this reptile. About 15,000 are now introduced into our ports, and from thence to our kitchens every year. They weigh from ¼ cwt. to 3 cwt., and may be valued in the aggregate at about £8,000, or more. Not that all these shielded animals so arriving can be called "lively turtle," for the voyage has very often a damaging effect upon them, and they have to be brought into flesh before they can be used for the table.

Dr. Browne, in his "History of Jamaica," speaking of the turtle, says it is delicate, tender food while young, but as it grows old it becomes more tough and gristly, and is not so agreeable to the stomach in those warm countries; the juices, however, are generally reckoned great restoratives, and often observed to heal and smooth the skin in scorbutic and leprous habits; nay, it is said to cure even the most obstinate venereal taints.

In Portugal, syphilitic patients are often sent to the Cape Verd Isles, to be cured by feeding on turtle flesh.

The flesh of the green turtle is employed in the West India islands generally in all the maritime cities of the United States, Brazil, and Peru, in England, in Africa, the Cape Verd Islands, and among the natives who inhabit the Western Coasts of Africa, Guinea, and Congo, the islands of Mauritius and Reunion in the Indian Ocean, at the English Presidencies of India, and in Australia. There is not a four-footed animal, a voyager tells us, the flesh of which the Japanese esteem like that of the kecame or turtle.

The flesh of the turtle is thus, we find, a universal food, if we except some of the States of Europe, which do not seem to appreciate it as a delicacy. I may add that this has been so in all ages. Diodorus of Sicily, Pliny, and Strabo speak of it. The former named "Chelonophages," certain people inhabiting islands at the entry of the Red Sea, whose principal occupation was catching turtle.

The flesh is cooked in all ways. It is made into soup, it is roasted, it is made into fricasees, stews, and pies. The liver, intestines, bones, all are employed and esteemed excellent.

There are in the turtle two pieces of flesh very white, compared to knuckles of veal. It may be larded and made into fricandeaux and patés, equal to those of Rouen or Pontoise. The turtle is, as it were, the fry of the sea for every part of the flesh is edible. The bones being easily saturated with the gravy, are left in the ragouts which are made, and the fat, which is very fluid, serves instead of butter or lard. The two most choice food preparations of the turtle in the West Indies are the soup and the boucan or plastron. The soup made there is flavoured with sherry, and seasoned with strong spices, capsicums, ginger, cloves, and nutmeg. It is considered to be excellent when, after having eaten, one is obliged to rest with the mouth wide open, and cool the fevered palate with madeira or port. So that, to appreciate this fiery soup, the taste has to be acquired.

The plastron of boucaneered turtle, is made by mincing the flesh fine, and cooking it in its own shell.

Here is the receipt given for preparing and cooking it:—"The plastron or buckler is the shell of the belly, on which is left three or four inches of flesh, with all the fat, this being green, and of a very delicate flavour. The plastron is placed in the oven. It is seasoned with lemon juice, capsicum or cayenne, salt, pepper, cloves, and eggs beaten up. The oven must not be too hot, as the flesh of the turtle being tender, it should be cooked slowly. While it is baking, the flesh should be pierced from time to time with a wooden skewer, so that the gravy may penetrate all parts. The shell is sent up to table, and the meat carved out from it. I have never eaten anything more appetising or better flavoured." This is not the receipt of a royal *chef de cuisine*, or of an ordinary cook, but of Father Labat, a Dominican monk, and we know that in all that relates to the table, and especially the food of fast days, monks are the authorities. The old buccaneers, from whom this dish was named, having no ovens, cooked their turtle in a trench covered with lighted charcoal, and this mode of cooking was said to be preferable. But in whatever manner dressed, all agree that the flesh of the turtle is an excellent and palatable food.

Green turtle soup is now manufactured in America and the West Indies. A manufactory at Key West, Florida, puts up in air-tight cans for exportation 200,000 lbs. yearly, and employs ten vessels and sixty men in collecting the turtle. It is sent to England and Cuba chiefly. At Jamaica some factories are also doing a good business in a preparation worthy of the gastronomic patronage of an aldermanic banquet, so rich is it in green fat and calipee, calipash, and those delicate gelatinous morsels appertaining to the fins. A steady supply of turtle is obtained monthly through the West India and Pacific steamers from Colon, besides those brought from the Caymanas. 5,484 lbs. of prepared turtle, valued at £356, was shipped from Jamaica in 1874.

Although all the varieties of the edible turtle are palatable, yet they are distinguished by the localities from whence they are obtained, and some are preferred to others. Those of the Bay of Honduras are most esteemed in England. Of the Cape Verd Islands, those of St. Vincent are considered the best. Dampier tells us that they are not so large as those of the American islands. The flesh is white, and intermixed with the green fat, which is firm and of good flavour.

Jamaica is the principal mart in the West Indies to which the turtle are brought from the coasts of the Gulf of Mexico, from Trinidad to Vera Cruz, principally from Honduras and the Tortugas. From Jamaica they are sent to England and the United States.

The eggs of most of the species of sea tortoises of turtle are excellent, being both nutritious and agreeable to the taste. They have no firm shell, and the white or albuminous portion does not harden on cooking. A native of Brazil will consume as many as twenty or thirty at a meal, and a European will eat a dozen for breakfast. They make an excellent omelet. The Indians frequently eat them raw, mixed with their cassava flour. A large quantity of rich oil is made from the immense number of turtle eggs deposited on the banks of the Orinoco and Amazon; each turtle lays from 100 to 200 eggs. Several thousand persons are occupied on the banks of these rivers preparing this mantega or turtle oil as a local article of commerce.

Diodorus tells us, that besides furnishing food for the people bordering the Red Sea, they made of the carapace small boats to cross the Red Sea, utensils for holding various substances, and tiles for covering their dwellings.

"I have been told," says Dampier, "of a monstrous tortoise taken in the Bay of Campechy, which measured 4 feet from the back to the belly, and 6 feet in width. The son of Captain Rock, nine or ten years old, used this as a boat to go from the shore to his father's vessel, about a quarter of a league." Another voyager, Lemaire, states that, at Cape Blanc, the turtles are of such a size that some with the bones removed yielded a barrel of flesh without the head, throat, tail, fins, tripe, and eggs, and would furnish a good meal to 30 men; Firmin ("Voyage in Equinoctial Holland," page 80).

The specimens to be seen in the Natural History Museums of Paris and London, give an idea of the monstrous size of some of these sea turtles, so that there is nothing exaggerated in the accounts of these travellers. But it is not these large turtles that are most esteemed; those of 10 lbs. or 25 lbs. weight are the best flavoured.

(*To be continued.*)

THE PARKES MUSEUM OF HYGIENE, UNIVERSITY COLLEGE, LONDON.

It will be a matter of interest and satisfaction to all interested in the subject to be informed that a fresh impulse is being given to the study of hygiene, through the establishment, at University College, of a museum specially devoted to this all-important branch of applied science; and this information will be particularly welcome to those who, having been connected with the Society of Arts for a long series of years, can recall to mind the successive steps taken by its Council for promoting the study and practice of the laws of health. As far back as 1852 a resolution was passed, approving of Mr. T. Twining's scheme for the formation of public collections, calculated to bring the united influence of science and inventive industry to bear on the physical condition and hygienic requirements of the million. In the autumn of 1855, the Society's official deputation at the Paris Universal Exhibition had the satisfaction of assisting at the inauguration of a special annex, where that scheme received its first realisation, in the form of a comprehensive selection of the articles and appliances best suited for promoting health and comfort among the industrial population. This highly successful experiment has since been repeated on a large scale by eminent philanthropists in various countries; but more directly connected with the present purpose than these temporary exhibitions, is the Museum of Domestic and Sanitary Economy, or Economic Museum, which was begun by Mr. Twining at the House of the Society of Arts in 1856, and which, after giving rise in the following year to Dr. Lyon Playfair's Food Museum at South Kensington, was exhibited for a time at the Polytechnic Institution, and removed in 1860 to a building specially erected at Twickenham, for being more conveniently worked out in detail. In ten years of unremitting exertions, many thousands of articles and illustrations bearing on the well-being of the masses, became closely but methodically packed in a space of about 80 feet by 30 feet, and little more was wanting to prepare this collection for appropriate display in some London institution, when on the 5th April, 1871, the building and its contents were destroyed by fire. This was the base of the Parkes Museum, as is shown by the following extract from the programme of the proposed Museum of Hygiene:—"Those who remember the Twickenham Museum will, it is hoped, have the satisfaction of seeing many of its best features resuscitated in the Parkes Museum."

It was thought that no better name could have been associated with the proposed institution, which bids fair to grow rapidly into national importance, than that of the late Dr. E. A. Parkes, F.R.S., so well-known for his valuable works on hygiene, and whose enlightened devotion, not only to the duties of his Professorship of Hygiene at the Army Medical School, Netley, but also to the general furtherance of hygienic science, was manifested so unremittingly up to the time of his death. At the same time, no more suitable memorial could record the public appreciation of his merit than a Museum of Hygiene consecrated to his memory at University College, where he had received his medical training, and had occupied an important professorial chair, and the prosperity of which he always had so much at heart. It has been felt by his friends that a rapid development would be secured to the proposed museum, through the high importance long since attached to hygienic knowledge at the medical schools of the Continent, through its growing appreciation in this country, and through the prominent position which University College has assumed in this important movement, by instituting the Chair of Hygiene filled by Dr. W. H. Corfield.

An executive committee having been appointed, uniting names of the first eminence, the council of University College has placed at its disposal a large room, well suited for purposes of display, together with a small adjacent one, which is being fitted up as a library. Contributions in kind to the various departments are abundantly promised, and there is a fair prospect that, besides directly subserving the college studies of medical men, architects, engineers, and others, on whose special attainments the public health so largely depends, the Parkes Museum will, by methodically displaying in the most convenient manner, select illustrations of every branch of hygiene, acquire national interest as a standard repertory of the latest sanitary improvements, and as a pattern for facilitating the formation of similar collections at other educational centres.

Those who have had the advantage of attending Dr. Corfield's course of hygiene, in 20 lectures, delivered last winter at the Society of Arts Rooms, need not be reminded how manifold are the bearings of this most interesting science on the requirements and resources of daily life, but there are many persons able and willing to offer appropriate contributions to the Parkes Museum, who will be glad of the guidance afforded by detailed lists of desiderata, and it is mainly for their convenience that a full classified programme has been issued. It appears that every appropriate form of illustration and means of knowledge will be admissible, according to the nature of the subject. For instance the following :—

Books, pamphlets, &c., in any language.
Statistical tables and schedules.
Maps and charts. Relief maps.
Plans, elevations and sections. Tracings.
Views, including original sketches, photos, and prints of every description. Bird's eye views, &c.
Models (if possible to scale).
Appliances or apparatus.
Articles, specimens or samples.

It will be seen, by looking through the programme, that many of these suggestions are by no means exclusively addressed to persons taking a professional or commercial interest in hygiene. There are, for instance, thousands of amateur artists, especially ladies, the benefit of whose talent is now confined to a very narrow circle, and who might, by elaborating the contents of sketch-books and albums, produce an instructive series of views of noted watering-places and health resorts in various parts of the world. Another series would consist of costumes, interesting in a hygienic point of view; a third, of dwellings, illustrating the application or neglect of sanitary principles, and so on; or, for the last-mentioned purpose, the talent possessed by many of constructing card models might be turned to good account for propagating sound and appropriate notions of cottage improvement.

The eight proposed classes of the Museum stand as follows :—

Class I.—*Local Hygiene and Sanitary Engineering.*

Class II.—*Hygienic Architecture*, comprising, firstly, general designs, arranged in 18 groups, for which a special system of display has been provided; secondly, details of construction, including all devices, materials, and fixtures comfortable to hygienic principles.

Class III.—*Apparatus and Materials for Lighting and Warming, and Appliances for kindred purposes.*—Here, as in the preceding classes, the limits of space will, in many instances, preclude the display of the actual articles, and necessitate recourse to classified albums, of which the contents may be simply selected from illustrated prospectuses.

Class IV.—*Clothing, to include materials, processes, fabrics, and costume, and the kindred departments of Household Furniture.*

Class V.—*Food.*—It is easy to perceive, on referring to the programme, that in this class, as in Class II., the arrangement of the Twickenham Economic Museum has been closely followed. It is mainly the same as was originally devised by Mr. Twining at the Society of Arts, and adopted by Dr. Lyon Playfair in developing this class into a national food museum. It was subsequently set aside by his successor, Dr. Edwin Lankester, who adopted Liebig's plan of classifying food articles as flesh-formers and heat-givers, or under equivalent titles. For particulars we must refer to the programme, merely mentioning that among the articles already got together, are a set of educational illustrations of proximate food constituents, and a series of results of proximate analyses of various cereals expressed in metrical quantities.

Class VI.—*Personal Hygiene. Comfort for Invalids.*

Class VII.—*Safety and Rescue.*

Class VIII.—*Industrial and Professional Hygiene.*—This division of the programme includes a synopsis of accidents, injuries, and diseases incident to industrial employments, means for the prevention of which are particularly desired. This synopsis was prepared in 1854, by Mr. John Simon, of the Board of Health, for the use of the Industrial Pathology Committee, appointed by the Council of the Society of Arts, at the suggestion of Mr. Twining, and presided over by the Marquess of Blandford, now Duke of Marlborough. The original proposal was to get together and to form into a special exhibition, the best available means for preventing or alleviating the evils in question. It was, however, deemed preferable to undertake every year an inquiry into some group of trades. Dr. T. King Chambers took charge of this task, and supplied useful reports on dusty trades, and those which affect the eyes. The subject, after remaining dormant for a time, was revived by Dr. W. B. Richardson's course of lectures on "Unhealthy Trades," delivered at the Society of Arts, and recorded in the *Journal* for January and February, 1876. The idea of a special exhibition has been furthered by the attention paid to this branch of hygiene at the Brussels Exhibition of last year, and it may be hoped that the Parkes Museum Committee will meet with a ready response to their appeal for assistance in making of this department a growing repository of all that may serve to protect the lives and health of working people in their various occupations.

The Library.

The promoters of the Parkes Museum held that no museum should be without its library, and, in the development of a science like hygiene, this rule is particularly imperative. It is, therefore, a matter for congratulation that, judging from the contributions already promised by many eminent publishers, this will be one of the most complete departments of the Parkes Museum, uniting with a standard selection of English and foreign works of reference, a comprehensive assortment of pamphlets, reports, &c., from nearly all parts of the world, as well as a variety of records of analyses and other authentic information.

The Laboratory.

Under the direction of Dr. Corfield, it is hoped that this department can scarcely fail to realise an important development as a practical school of hygienic research, especially if the support received from the public should enable the committtee to secure the permanent services of a competent assistant and curator.

Preliminary Department.

It is proposed not merely to perfect the hygienic training of those specially concerned, but also to show how interesting and how easy to acquire is an amount of hygienic knowledge amply sufficient to have a marked influence on the comfort and duration of life. It is hoped thus to further its introduction as a standard element of both juvenile and adult education; and in order to denote that its teaching should always rest on a scientific foundation, it has been deemed expedient to display the diagrams and apparatus best suited for illustrating the elements of human physiology, including of course the indispensable preparatory notions of chemistry. It is by bestowing attention on all stages of development of the studious mind, whether they are to be limited to the practical pursuits of daily life, or to be pursued into the regions of theory and research, that the Parkes Museum hopes to acquire an expansive usefulness, worthy of him in whose memory it is instituted, and of a college that has always been among the foremost in the race of genuine educational progress.

Much care has been bestowed on the elaboration of the programme, which, independently of its convenience for persons willing to become contributors to this valuable institution, is meant to become interesting as a classified synopsis of the subjects included in the domain of hygiene. Copies have been deposited at the Society of Arts for being freely supplied to members and their friends.

EXHIBITION OF INDUSTRIAL ART, GHENT.

About the middle of last month, an exhibition illustrating the application of art to various industries, was opened at the Ghent University by the *Chambre Syndicale Provinciale des Arts Industriels*, which was founded in 1876. The exhibition comprised two sections, one a loan collection of ancient objects of art, which might serve as models or suggestions for designers of the day, and the other a modern section including the building industries, furniture and decoration, iron and metal work, textile fabrics, jewellery, book-binding, printing, engraving, photography, models for the teaching of drawing, and the reproduction of works of art. Special prizes were also offered for original design, furniture, and art applied to textile fabrics. Taking the objects exhibited in the order they are set down in the catalogue, the following are most worthy of attention.

Building.—Some inscriptions and ornaments in relief, were shown by F. de Smet, Lacken. No indication is given of the method by which the letters are produced, but the ground is sunk about $\frac{1}{32}$ of an inch, so that the presumption is a process like the sand-blast, or eating-in by acid is employed. Some double doors, both for a *porte-cochère* and also for a saloon, are shown by Brunneau Frères, Ghent, and some balustrades, turned in oak by J. B. Dogny, Brussels. Many examples of ornamental wrought iron work, executed entirely by hand, were exhibited, amongst them a balcony in the style of the Flemish renaissance, ornamented with leaves and flowers. The first prize in the competition was carried off by M. Wanters-Koeck, of Brussels, for an artistic *grille*, three metres square, with roses each of forty-four leaves, lilies, and ferns—a complicated piece of work executed with the hammer alone. Two safes were sent by M. Matthys De Clerck, of Brussels, with an offer of 10,000 francs to anyone who can pick them; and an elaborate lock for safes, patented by the same exhibitor.

Furniture and Decoration.—Many cases were on view of those ornamental bolts, handles, and mountings, in bronze and silver, which are so conspicuous on the doors of Belgian houses. There were several panels, painted to represent various woods and marbles, by P. A. Cluytens-Muls, the Institut des Beaux Arts, Mechlin, and others. In the group of glass and porcelain, the Compagnie Anonyme des Cristalleries et Verrerie Namuroises made an artistic show with various services. Most of the stoves exhibited had open bars in front, capable of being closed by a damper, and were also provided with a hot-air chamber behind for equalising, as far as possible, the temperature of the room. Several stoves had also a hot closet for use in the dining-room. The first prize for the design and execution of stove and chimney-piece combined, was awarded to M. Verhengen, of Ghent, and the second to M. de Lorge, of the same town. The prizes for the design of the decoration of a vestibule, with the execution of the principal details, were not awarded; but the first and second prizes for the design of a floor for the same, the cost price of which was not to exceed 8 francs per square metre (6s. 6d. a square yard), were awarded respectively to M. Desmet, of Ghent, and M. Delvigne, of Liege. The first prize for a double door for a dining-room, executed in natural wood for subsequent painting, polishing, or varnishing, was granted to M. Spilthoorn, of Ghent, but the second was not awarded.

Various Industries.—Among these, there were some specimens of book-binding, of which the exhibits of MM. Bosquet, of Brussels, and Duquesne-Fonteyne, of Ghent, were the chief. M. Jules Meens, manager of the *Moniteur Industriel*, put in some bound volumes of that journal; and Messrs. Callewaert Frères, of Brussels, besides a large collection of educational works, exhibited a cheap and clear map of Belgium, showing the coal basins and the altitudes of the various districts. Specimens of typography, both ordinary and "de luxe," were contributed by M. Van Dossclaere, of Ghent. The catalogue was prepared and printed by M. Eug. Vanderhaegen, a member of the Council of the Chambre Syndicale, and secretary of the Société pour l'Encouragement des Beaux Arts.

THE CULTURE OF EUCALYPTUS IN ALGERIA.

Consul-General Playfair states that, during a journey made through Tunis, he has been impressed with the decadent condition of that country, and the causes of the exhaustion of the soil, which he attributes to the destruction of its forests, a process which has been going on ever since the Arab conquest, and more especially during the past hundred years. Since this visit, the Consul-General has given much consideration to the question of the *reboisement* of Algeria. The same causes which have been at work in Tunis have produced similar results, though in a less degree, in Algeria. In the latter country the destruction of the forests has been less complete, therefore the country has remained more fertile, but the climate is changing in an appreciable degree every year. At the period of the conquest the whole of the Sahel and a great part of the Metidja was covered with wood or scrub, which acted not only as a parasol to the earth, preventing the undue evaporation of its dampness, but as a means of attracting and condensing moisture in the atmosphere and causing it to descend in refreshing dews or rain. The first serious clearings were made in 1845, since which time the operation has been going on with ever-increasing rapidity. The diminution in the rainfall commenced in 1855. In the seventeen years prior to this date it was only on two occasions more than 1,000 millimetres, and on eight occasions more than 800. In the twenty-one years which followed it has only twice reached 800 millimetres, and the present year is almost the worst of all, and something very like famine is imminent in Western Algeria.

The question, not only of restoring to the country the wood that it has lost, but of providing a supply of a constantly decreasing article, is the most important one that can engage the attention of the statesman or the colonist. If this had to be effected by planting such trees as oak. ash, pine, &c., all of which are indigenous to the country, it may well be imagined that a speculator would hesitate before engaging his capital in an enterprise which could hardly yield him a return in his lifetime; but with Australian trees, which grow as freely in Algeria as in their native country, he may expect to cover his expenses in ten or twelve years, and after twenty or twenty-five to obtain as great results as could be realised by oak forests of a century's growth. It is hardly more than fifteen years since the first eucalyptus trees were introduced into Algeria by M. Ramel, and very few indeed exist in the colony of a greater age than ten years; even now it can hardly be said that any attempt has been made to grow them on a great scale. There are many other Australian trees, suited to almost every condition of soil, found in Algeria, such as the beautiful acacias, or wattles, the grevilia, casuarmas, &c.; these are, no doubt, destined to play an important part in the *reboisement* of the country; but it is the eucalyptus alone which merits to be planted over extensive areas for the sake of its timber. There may be parts of Europe where this tree could be cultivated as well as in Algeria—though that is very doubtful; but hardly anywhere is the price of land sufficiently moderate to enable it to be grown with a certainty of profit. As a rule, wherever the orange tree flourishes, so does the eucalyptus. In Algeria it attains, in six or seven years, the same dimensions as the oak does in twenty, and, in its twentieth year, it may be expected to furnish such logs of timber, for shipbuilding or other purposes, as could not be furnished by an oak tree under 100 years old.

There are trees which, even in Europe, under certain circumstances grows with great rapidity, but the marvel is, that growing with the rapidity it does, the eucalyptus should produce at the same time hard and dense timber. A short time ago, wishing to send a eucalyptus tree of four or five years of age to England for experiment, it was found impossible, on account of its great length, to put it into a boat to convey it to the steamer. The boatman naturally decided on towing it alongside. but the moment he put it into the sea it sank to the bottom, and divers had to be employed to raise it. When properly seasoned its specific gravity becomes less, and it then floats on water. To illustrate the quality of the timber, Consul-General Playfair instances the use of a vessel, the *Marie*, of 230 tons burden, which entered the port of Algiers with a cargo of timber in 1875. It was built in Melbourne in 1848, the hull being of blue gum (*Eucalyptus globulus*), and the interior fittings of red gum (*Eucalyptus resinifera*). At twenty-seven years of age it was still rated by the *Bureau Veritas* of the first class.

The first trees were planted in Algeria in 1862, and M. Trottoir gives certain pecuniary results he thinks obtainable from a hectare of land planted with eucalyptus. Thus a plantation of one hectare, which gives appreciable results in the third year, will yield in the tenth a minimum of 7,000 frs., and in double the time it ought to produce four times the value. This estimate may be exaggerated, but even allowing a liberal margin for pardonable enthusiasm, the result cannot fail to be most remunerative. But to arrive at the best results with eucalyptus they must be planted in the best land, and for the first year at least be carefully cultivated. Thus treated they may be expected to realise immense returns. For instance, the average yield of a hectare planted in cereals in Algeria may be estimated at 250 frs., and, without taking any account of the years when such land must of necessity remain fallow, the total produce in twenty years may be stated at 500 frs. During those twenty years the cost of cultivation, the value of seed, the transport to market, &c., may be considered as equivalent to the cost of planting the same area in eucalyptus, tending the trees, and finally cutting them down. According to M. Trottoir's statistics the timber would then have a value of 26,000 frs., or for the sake of being well within the mark, say 20,000 frs. If the cultivator has to remain a long time without any return for his money, surely the result is worth waiting for. The time during which these trees occupy the soil may be divided into two periods of ten years each, the first the period of growth, the second period during which the ligneous products are condensed and consolidated. If, during the first period, the land is kept clear, and the same amount of culture is given to the trees as would be given to a vineyard, the cost, calculating 5 per cent. interest on the sums successively expended, might amount, in round numbers, to 1,000 frs. During the second period no care of any kind would be required. Under the circumstances, there is every reason to suppose that the trees would make as much progress in 20 years as they otherwise would in 30. The cost of this extra care would amount to 1,000 frs., and the profit to 13,000 frs. According to the tables of Cotta, a hectare of land produces 450 cubic metres of oak in 100 years, the value of which, at 105 frs. the metre, amounted to 47,235 frs. The same quantity of eucalyptus wood might be produced in twenty years, and would realise 20,000 frs. This sum of money, placed at compound interest for 100 years, would realise the enormous sum of 816,800 frs.

The number of species of eucalyptus is great, but for the purpose of commerce, two or perhaps three species only should be cultivated. The first, the *Eucalyptus globulus*, or blue gum, is best suited to warm positions, deep fresh and moist soil. The second, *Eucalyptus resinifera*, or red gum, resists drought in a remarkable manner, and should be used in poorer or drier soil, or at greater altitudes than the other. It is hardly probable, however, that either of them will thrive well at a greater altitude than 200 or 300 metres above the level of the sea. The third species, which promises well, is the *Eucalyptus colossea*, but hitherto our experience of it is limited, and we have not sufficient data on which to calculate its rate of growth.

There is another point of view from which the cultivation of eucalyptus must be regarded, namely, its action in improving the sanitary condition of unhealthy districts, and in dissipating miasmatic influences, which created such havoc amongst the colonists in the first years after the conquest. To place this subject as far as possible beyond doubt, an inquiry was instituted by the Society of Physical and Natural Sciences at Algiers, under the presidency of Dr. Bertherand, and reports were received from thirty localities. The spots best suited to the growth of the plant on a large scale, and the price of the land available for the purpose, is another subject worthy of consideration. To ensure the commercial success of the scheme the trees must be planted on a line of railway, and as close as possible to a station. The soil ought to be rich and deep, and there ought to be sufficient water available for irrigating the trees during the first year, not unfrequently, but once when they are planted in the autumn, and twice or thrice during the course of the subsequent summer. They will grow in the driest soil, but their growth is infinitely more rapid when planted under the above conditions. The locality which fulfils these conditions best is the plain of the Metidja. Between Algiers and Blidah, on the line of rail, it is hardly possible to obtain land for less than 500 to 700 frs. the hectare; some has recently been sold for 1,000 frs. Further from the railway it may be had in some few places for 300 frs., but the cost of transport would neutralise the saving. In the plains of Chelif and the Mina there is an enormous quantity of land which may still be obtained for a merely nominal price. It would be an immense boon to the country if some of this were planted with eucalyptus, but the chances of profit to the cultivator would not be so certain. The soil is hardly inferior to that of the Metidja, but the hydrometrical conditions of its climate are very different. The range of hills stretching westward from Miliand cuts it off from the sea breezes, which always afford a certain quantity of moisture; rain is more scarce, and the farmer can hardly hope for more than one good year out of three. From Affreville, where it commences, to Oran, is a distance of about 300 kilometres. It is traversed by the most important river in Algeria, the Chelif, which rises in the Sahara and falls into the sea near Mortaganem. Other suitable spots are likewise mentioned by Consul-General Playfair. Along the line of railway from Algiers to Oran, considerable numbers of eucalyptus have been planted. Where this line passes through the Metidja the trees have grown most successfully, but in the Chelif they have failed in almost every case. It is true that they have not been tended in any way; they have merely been planted, and left to their fate. In and around villages in this plain they have thriven better, but never so well as in the Metidja, while, in the marshy plain of the Macta, conceded to M. Debrousse, which at first sight seems a typical position for them, they have not done well at all. The reason of this is, that the land is not yet ready for them, it has lain in a state of marsh for centuries, the subsoil is saturated with salts, and the more the trees are watered after being planted, the sooner the capillary attraction brings the salt to the surface, and kills the trees or checks their growth.

On a careful consideration of the whole subject, the Consul-General is more convinced than ever that no culture in Algeria offers such prospects of success as the eucalyptus, if the cultivator can afford to remain for a considerable time without any return for his capital, that in the long run it will be more economical to purchase land for the purpose at 600 frs. a hectare, than at 60 frs., but that to ensure success the experiment should be made close to a line of railway, and in a comparatively cool and salubrious position.

TRADE-MARKS, CONSIDERED BY THE INTERNATIONAL LAW ASSOCIATION.

This subject was introduced to the Antwerp Congress by Mr. J. Rand Bailey, one of the honorary international secretaries, who proposed that a committee be formed to consider the matter and report to the next Congress to be held in Paris during the ensuing year. In support of this proposition, Mr. Bailey cited some facts, showing that the legislation in various countries had not kept pace with the growing importance of the subject, though in the United States the law of 1870 was revised in 1876, and in Germany a law was passed in 1875. In England the registration of trade-marks had given a great impetus to the matter; from the 1st January to the end of June in 1877 there had been 9,779 applications by 3,348 claimants, figures which show the great importance of the question. Such large interests were involved, that this was a most desirable subject for international legislation.

M. Le Comte Maillard de Marafy, Président du Comité Consulatif de Legislation étrangère de l'Union des Fabricants, Paris, said that, being president of an association for the protection of trade-marks, he had attended the Congress especially for this question. Though France, Spain, and Norway had made great progress in this matter, Canada, Brazil, and the Argentine Republic were still further in advance—more so than even Great Britain. An inquiry into the subject had been made in Belgium, which was especially due to the action of the Antwerp Chamber of Commerce. For several years he had been endeavouring to obtain the placing of Frenchmen in Belgium on the footing of the French law, and similarly for Belgians in France. There already existed a convention between Belgium and some other countries. For saving the expense of a journey to a central office, he advocated the deposit of trade-marks at any post-office in a State, when they would bear the date of the office stamp. He did not approve of any previous examination. Count de Marafy then put in a *projet de loi* on the subject, which he had drawn up for France. This is divided into five sections, the first relating to the right of ownership in trade-marks; and the second, as to arrangements affecting foreigners, is to the following effect:—

Foreigners who possess in France establishments of industry or of commerce enjoy, for their products, the protection of the same law as natives by fulfilling its formalities. Frenchmen and foreigners, whose establishments are situated out of France, also enjoy the protection of the law if conventions or the laws of their country establish, directly or indirectly, a reciprocity as regards trade-marks. The execution of foreign judgments, as regards trade-marks, is guaranteed in France to those countries where reciprocity is established. The use in France of a foreign mark, even if not registered, gives no right to it. Every mark properly registered abroad shall be regarded as also registered in France at the same date, provided there be reciprocity. The mere use of a mark not registered, without any injurious intention, does not form a ground of action.

The remaining sections deal with penalties, jurisdiction, and general provisions. The following resolution was then moved by Mr. J. Rand Bailey, seconded by Mr. H. D. Jencken, the general honorary secretary, and carried unanimously:—"That a committee be appointed to take into consideration the laws of various countries relating to trade-marks, and the system of registration adopted therein, and report thereon to the next conference."

The President, Lord O'Hagan, said this was especially a question for a committee, and he was glad to learn that Mr. Hinde Palmer had consented to take the presidency.

THE INDUSTRIES OF TURIN.

The city of Turin is situate in latitude 45° 4′ 8″ north, and longitude 7° 40′ 15″ east, in a fertile plain, the narrowest portion of the plains of Piedmont, between the upper and lower divisions of which it forms a connecting link as they circle within the lines of the Alps. Placed at the confluence of the rivers Po and Dora Riparia, at the foot of the last spurs of the hills of the Monferrato as they stretch towards the west, the city faces the mighty chain of the Alps, from the first slopes of which she is distant some kilos. The territory of the commune of Turin consists of an irregular polygon, enclosing an area of 127 square kilos. It is divided into a town and country district; the population of the latter forms rather less than one-eleventh of that of the entire commune. The city, which stands some 239 metres above the sea level, forms an irregular square with one side resting on the banks of the Po, having a perimeter, as formed by the boulevards of circumvallation, of 7,550 metres, the greatest length within this limit being 2,650 metres, and the greatest breadth 1,550 metres. The perimeter of the line of the octroi, including the Borgo Po, which is unrivalled, is 16,190 metres. The city is divided into seven sections and three borghi, or suburbs; the streets are regular, running in straight lines, and generally crossing one another at right angles, dividing the houses in square "isole" or blocks.

The recovery of the population after the fall (20,000 inhabitants) caused by the transfer of the capital to Florence in 1865, until in ten years it had nearly regained its previous importance (in 1875 219,173), is a first sign that Turin has entered on the right course to maintain her position among the other cities of Italy.

Consul Colnaghi remarks in his report that, as compared with our own greater establishments, the factories of Turin are insignificant, their interest lies in the real progress that appears to have been made of late years, and in the capabilities indicated by some of the industries for future development on an extensive scale. The observations made include amongst others the manufacture of leather, which Mr. Colnaghi states is an important industry, not only in Turin but throughout Italy. Although the process of tanning in itself is said to be good, Italian leather is not so well finished as that of other countries; it is, consequently of inferior quality, and fetches a lower price. As, however, the tanners of Turin appear not to fear foreign competition, and to be able even to export leather in small quantities to France and Germany, this inferiority, it may be concluded, is being gradually overcome. Sole leather and upper leather for shoemaking, saddlery, and belts for machinery, and dressed lamb and kid skins for gloves, are the qualities chiefly produced in Turin. The hides and skins are purchased for one-third fresh in Italy, while for two-thirds, dried or salted they are imported. The principal Italian markets are Turin, Genoa, Aosta, Ancona, and Leghorn; the proper markets are Trieste, Calcutta, and London. The Suez Canal route now enables the cowhides of British India to be imported direct from that country, without passing through the London market, though, in some instances, the old route seems still to be preferred. The oak-bark required for tanning is procured in Piedmont, Lombardy, Romagna, and Tuscany. Among the principal tanners and leather dressers of Turin may be mentioned Messrs Ceresole and Azimonte, Durio Brothers, Martinotto, and Liantani. The manufacture of gloves, for which Turin has long been in repute, is constantly progressing. Messrs. Fiorio, in their factory, give employment to 60 men and 25 women, besides 300 glove stitchers who work at their own houses. They make 10,000 dozen pairs of gloves per annum, half of which are exported to France and England. Lamb and kid skins are also exported undressed to France and Germany.

The working of iron and other metals is assuming a continually increasing importance in Italy, although the native raw material figures, as yet, in small proportions as compared with foreign products. The iron used in the Turin foundries is chiefly imported from England and France, though Lombard and Aostan iron is also occasionally employed, as well as old iron of all sorts in larger quantities; the steel is brought from England and Prussia, the copper is partly Italian and partly imported from South America, the zinc comes from Silesia, and the brass in sheets from France. The manufacture of wooden furniture, especially of a cheap description, is a flourishing industry in the hill districts of North Italy, from whence a considerable export of cheap chairs is made to Egypt and South America. In Turin, the manufacture is chiefly of the finer kinds of furniture; and the cabinetmakers and upholsterers of this city, if their taste is not always of the purest, are good and intelligent, and, in some instances, admirable workmen. The manufacture of pianofortes, barrel-organs, and harmoniums, appears, on the whole, to be increasing. About 800 instruments are said to be made per annum, at prices averaging from 500 lire to 1,200 lire; one firm alone, that of Mr. Marchisio, manufacturing pianos of 2,000 lire. The Turin pianofortes are able to hold their own against second-class foreign goods, but their makers are not yet entirely free from the necessity of selling the instruments in Italy under foreign marks. The materials used in the manufacture are native, with the exception of the cords, pegs, ivory, and felt. The largest maker in Turin is Mr. Argmonino, with 300 pianofortes and harmoniums per annum, of which some twenty or thirty are exported to South America, Austria, and Turkey.

The important industry of silk spinning and throwing is more particularly carried on in the country districts, and gives employment to a large number of females. It is represented in the commune of Turin by two spinning mills only, by a throwing mill belonging to Messrs. Dupré, situate on the north side of Turin, near the Porte Mosca, in which about 200 persons are employed, and by another mill on the Ceronda Canal. Mr. Tasca's ribbon factory is not without importance; it contains 190 automatic looms, of which half are for plain and half for figured ribbons, and 180 machines for making silk and woollen braid, which have been added since 1870. Mr. Solei's factory of brocades and damasks, for furniture and trimmings, contains 100 looms. His business is increasing, because he has established branches in the principal cities of Italy, and works energetically as a merchant as well as a manufacturer. Messrs. Mazzoni's cotton mill contains 11,494 spindles for singles, and 2,188 for twists, with 18 operatives per 1,000 spindles. The attempt to introduce the woollen manufacture, which flourishes in the neighbouring province of Novara, on the territory of the commune of Turin, has, as yet, not met with entire success, principally, it is said, from the difficulty of obtaining good hands, by which an experiment, tried at first on too large a scale, has been greatly hampered. The manufacture of hats appears to be flourishing. Mr. Mantellero is able to produce felt hats that sustain French competition, and exports his products to South America. There are now in Turin, without counting smaller firms, five large chocolate factories, among which may be mentioned that of Messrs. Rochet, Gay and Co., in which 1,000 kilos of chocolate can be produced per diem, and those of Messrs. Moriondo and Gariglia, and of Messrs. Bass. The raw material is imported from the ports of Bordeaux, Lisbon, Hamburgh, and London. The origin of the export trade of vegetables, fruit, poultry, eggs, and other articles of food, which embraces the products of all Italy, is due to Mr. Francesco Cirio, a well-known provision dealer, of Turin, who has carried it on, with great energy and resource, under various difficulties, to the present day. Its progressive importance may be recognised from the fact that, commencing in 1869 with but a few waggon loads, the number reached 100 in 1870, exceeded 200 in 1871, and was not less than 2,000 in the first seven months of 1876. The principal articles exported are vegetables from the Neapolitan provinces, and fruit from Piedmont. Mr. Cirio is of opinion that the trade in fruit, poultry, eggs, and preserves, soups, meat, and vegetables, now in its infancy, would be largely increased, and would be of the greatest benefit to the country. The breeding of rabbits was entirely neglected in Italy until it was taken up in 1873 by Messrs. Costamagna and Son, and Co., furriers, Turin, who believed it might not only be of great advantage to them in their trade, but form an important article of food for the poorer classes of the population. The success of their undertaking appears to be continually on the increase.

In addition to the establishments belonging to the Government and to public companies, where a large number of work-people are employed, Mr. Colnaghi, in conclusion, observes that Turin possesses a Chamber of Commerce, which contains the Exchange, Silk Condition Room, and Silk Assay Office, Bonded Warehouse, opened in 1866, and several important banking establishments, among which may be mentioned the National Bank, and the Land Credit Institute, besides various private bankers and silk merchants of position and respectability.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,297. Vol. XXV.

FRIDAY, SEPTEMBER 28, 1877.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

PROGRAMME OF EXAMINATIONS FOR 1878.

The Programme for 1878 is ready, and can be had on application to the Secretary. The Society's Examinations now comprise the following divisions:—

1. Commercial Knowledge.
2. Domestic Economy.
3. Fine Arts applied to Industry.
4. Knowledge of Public Museums.
5. Music.
6. Blow-pipe Analysis.
7. Technology of Arts and Manufactures.
8. Elementary.

NATIONAL TRAINING SCHOOL FOR MUSIC.

A competition for three Scholarships was held in the Philharmonic-hall, Liverpool, on the 4th inst. The Examiners were Mr. Toms and Mr. Rensberg, and the Scholarships were awarded to Misses Arnstein, Burleigh, and Crawford.

The Bristol Scholarship, founded by Samuel Morley, Esq., M.P., and competed for at the National Training School for Music on the 25th June last, has been awarded to Miss Clara Louisa Ross. The Examiner was Dr. Sullivan.

The School re-opened for study, after the Midsummer vacation, on Monday, the 24th inst. The number of scholars is eighty-seven.

CANTOR LECTURES.

THE CONNEXION OF GREEK AND ROMAN ART WITH THE TEACHING OF THE CLASSICS.

By Sidney Colvin.

Slade Professor of Fine Art at Cambridge.

LECTURE I.—DELIVERED APRIL 16, 1877.

Professor Colvin commenced by remarking that ever since modern Europe, at the close of the Middle Ages, commenced to turn its attention to the antiquities of Greece and Rome, two kinds of antiquities had been sought after and studied, viz., the remains of literature in books, and the remains of art and handicraft in architecture, sculpture, pottery, &c. But, although a classical education might be defined as the training of the mind by a systematic study of the genius of ancient Greece and Rome, that study had been, and was being, pursued in England almost entirely with reference to the literary remains alone. And yet, since the early days of the revival of classic learning, our materials for the study of ancient art had increased much more than our materials for the study of ancient literature. The stores of literary and monumental remains which we now possessed would have overwhelmed the imagination of the early labourers in the field of classic antiquity, enthusiastic as they were. Their enthusiasm gradually resolved itself into a settled, sober study of, and regard for, classic antiquity, and all civilised nations had agreed that this study of Greek and Roman antiquity should form part of the education of their sons. However great might be the progress of science, and however important might be the increase in our knowledge of the natural world, the study of the antiquities of Greece and Rome would probably continue to the end of all things to be one part of the education of civilised men. A classical education, properly speaking, was one which, firstly, sought to get as much knowledge, and that knowledge as thorough and profound as possible, of the works and life of those two great nations of antiquity, the Greeks and Romans; and, secondly, in the course of the acquisition of that knowledge sought to impart to the mind as complete a training as possible. The one sovereign characteristic of the Greek genius was its anthropomorphism—that tendency of the Greek imagination to conceive of all the forces, both of nature and the human spirit, all powers, both of the physical and mental world, as incarnated in divinities possessing the attributes and lineaments of men and women, only stronger and more perfect than the men and women of the real world. This was the source of all the religion and all the art of that great people. Not only were they endowed with great physical beauty and perfection in their persons, but they lived under extraordinarily favourable conditions of climate; and the outcome of these conditions was that when they began to put their hands to tools, and to paint and carve the creations of their minds, in the course of a few generations they filled all the temples and towns with images the most beautiful the world had ever seen. Although an immense number of these works of art and handicraft had perished, they had not all disappeared, any more than had the whole of their literary remains. It was, unfortunately, true that all the most famous works of art known to the ancients were either destroyed or lost. Nevertheless, we possessed a mass of materials for the study of Greek art which could be made of the utmost service in connection with the study of classical literature. It should be borne in mind, too, that while the literary remains of ancient Greece and Rome were not at all likely to be materially increased—or, at any rate, the possibility of their increase was very remote—it was, on the other hand, quite certain that our store of classic antiquities in the shape of sculpture, architecture, pottery, and specimens of handicraft generally, would be largely augmented—to an extent, indeed, to which there was hardly any limit whatever. Perhaps some of his (the lecturer's) audience had read in the *Times* of that morning the interesting account which was given of one winter's discoveries in that great centre of ancient art, Olympia. These and kindred successes gave us every reason to hope that we were now only at the dawn of an era of such discoveries, and encouraged us to believe that our stores of antiquities would be enriched to an indefinite extent. Now, art was a language—and a language, moreover, which did not change, or become corrupt or forgotten, as did the languages of speech or literature. Was it not, then, of the highest importance that in training our youth in the knowledge of classic life and literature, we should also train them in a knowledge of classic art? This was a species of knowledge which, once properly imparted, would never be forgotten, and, taken in conjunction with the study of classic literature, would explain and illustrate the meaning of passages and make the study much more interesting. If a knowledge of classic art and antiquities formed part of a generally-recognised curriculum, our museums would not have the aspect of so many collections of mere dry bones which they presented, even to those who had had some classical training. What did the average classical scholar really know of classical art and antiquities, further than what he had learnt by turning to a dictionary to see how the toga was worn, or what was the arrangement of a Greek theatre? Any systematic study of classical art was almost totally unknown in England, in fact, it had only recently commenced to be known at all. It was almost completely neglected in our great centres of education, the Universities; not that we had not in England archæologists of equal name with the greatest of other European nations, but simply because they received no encouragement to popularise their special branch of learning, but had to pursue it almost alone, or in positions they might hold at the British Museum or elsewhere. In short, it formed no part of the general culture of educated Englishmen. Here, classical literature and language were studied to the neglect of classical art and archæology. But it was not so in Germany, where there had been a great revival of classical knowledge and studies during the last century, this revival being largely characterised by the renewed interest devoted to monuments and works of art. For a long while England was at the head of classical scholarship, but since the time of Heyne and Winckelmann her supremacy in this respect had been on the wane. In every university of importance in Germany there was a more or less complete museum of casts from works of classic art, and the antiquities of Greece and Rome were studied, as they should be in this country, *pari passu* with classic literature. The casts were used to illustrate the teachings of lecturers and professors. These studies were having the result of placing the Germans in the forefront of archæological research, and we in England were compelled to go and sit at their feet. For a long time they had excelled as interpreters of classic antiquities, England being content with her until lately unrivalled *rôle* of explorer and discoverer (and amongst societies which had done much in this direction was the Dilettanti Society); but now the Germans were actually wresting from us the laurels which we had won in the exploration and discovery of ancient monuments. Incomparably the most important discoveries which had been made of late were those at Olympia by German explorers, although they had not caused the sensation which has followed the excavations at Troy and Mycenæ—these again being the work of an explorer of German name. The remarkable discoveries in Cyprus, again, were the work of an Italian, acting as American consul there. So that not only the scholarship of archæology, but the enterprise of archæology, seemed to be passing away from us into foreign hands. The lecturer next explained, by means of an illustration on the wall, how the Greeks rendered a mythological story in sculpture, choosing as his example the continuous sculptured frieze of the Choragic monument of Lysicrates, which represents the incidents connected with the attempt of the Tyrrhenian pirates to carry off Bacchus into Italy. The Choragic monuments were small, and were used for the purpose of depositing the tripods which were accorded to the owner or trainer of the chorus which had been the most successful in musical or dramatic competitions, there having been a whole street of these monuments at Athens. The Homeric hymn, which was read by Mr. Colvin, narrated how the sailors bound the god, how he broke the withs or chains with which he was bound, and changed himself into a lion, a well of wine at the same time bubbling up in the midst of the ship, and vines and ivy springing up and entwining with the ship's tackle; and how the terrified sailors jumped into the sea and were transformed into dolphins. The same story was represented in the frieze, not in strict illustration of the poem, but in the manner most suitable to the special art of sculpture, and the way in which the subject was made to lend itself to the condition and limitations of sculptural art was in the highest degree interesting and instructive. In conclusion, Mr. Colvin said that in the study of Greek art for its own sake the student must necessarily acquire a knowledge of art generally and of its materials and capabilities. He must learn what could be done in marble and what in bronze, and what were the particular virtues and characteristics of other materials, such, for instance, as terra-cotta. Then, again, art had its historical aspect in common with literature. Of course the study of classical art could not be studied apart from classical literature, especially the writings of some authors who wrote what we should call guide-books. Amongst them might be named Pausanias the cicerone and topographer; Pliny, the encyclopædist of natural history and the arts; and Lucian, the novelist and writer of romantic criticisms.

MISCELLANEOUS.

LIGHTING BY ELECTRICITY.

The discovery of electric induction by Professor Faraday in the year 1830 drew the attention of the scientific world to the possibility of utilising motive power as a means of generating a current of electricity. Faraday demonstrated before the Royal Society that if a magnetised bar of steel be introduced into the centre of a helix of insulated wire, there is, at the moment of introduction of the magnet, a current of electricity set up in a certain direction in the insulated wire forming the helix, while, on the withdrawal of the magnet from the helix, a current in an opposite direction takes place. He also discovered that the same phenomenon was to be observed if for the magnet was substituted a coil of insulated wire, through which the current from a voltaic element was passing; and further, that when an insulated coil of wire was made to revolve before the poles of a permanent magnet, electric currents were induced in the wire of the coil. It is on these discoveries that are based the action of all magneto-electric machines.

Amongst the variety of patents that have from time to time been taken out, both in England and other countries, for magneto-electric machines, there is no doubt that a large proportion are only slight modifications or re-discoveries of already existing machines. Some idea may be formed of what has been done in this branch of electric science, if we take as types of magneto-electric machines those of Pixii, Saxton, Clarke, Henley, Nollet, Siemens, Wheatstone, Ruhmkorff, Wildo, Pacinotti, Holmes, Breguet, Gramme, and Niaudet. Perhaps, before mentioning the practical application of these machines, more especially as a means of producing the electric light, a few remarks by way of explanation of some of them may not be without interest.

Pixii was probably the first who practically carried out Faraday's discovery and constructed a magneto-electric machine. His machine consisted of a wooden frame, working in which was a small vertical spindle, carrying on its upper extremity a permanent horse-shoe magnet; underneath this, on the lower part of the spindle, was fixed a pinion driven by a suitably arranged bevel wheel, so that, by turning a handle, the magnet was made to revolve rapidly. Directly above the horse-shoe magnet was fastened to the wooden frame an electro magnet; the poles of the two magnets were brought as near as possible together without actually touching. On the magnet being made to revolve, its poles passed those of the electro-magnet, thus setting up a series of reversed currents in the wire of the electro-magnets. As for many purposes it was necessary that the currents should always be in the same direction, to obviate these reversals a small circular commutator was placed immediately below the permanent magnet and fixed to the vertical spindle revolving with it. On this commutator four springs were made to press; two were connected to the ends of the wire forming the coils of the electro-magnet, the other two springs to the two terminals of the instrument from whence the currents of electricity generated are given off. By a very simple arrangement of commutator not needing explanation, it will be readily understood how the two springs connected to the coils of the electro-magnet may, through the commutator, be put into alternate connection with the two springs connected to the terminals in such a manner that the + currents are always directed to one spring, whilst the — are communicated to the other; so that one terminal becomes the positive and the other negative.

The electricity generated by this class of machine is not a continuous current, but rather a series of currents in rapid succession; although, when the machine is made to revolve at a high speed, the currents are generated in such quick succession that they form a sufficiently continuous current for many purposes.

In Saxton's machine both the permanent and electro-magnets were placed horizontally, and made to rotate end to end. The proportional size of the electro-magnet, with reference to the permanent one, was reduced, as it had been found experimentally not to be desirable to have so large an electro-magnet, in proportion to the permanent magnet, as had been given in Pixii's machine, while there was a great advantage in increasing the power of the permanent horse-shoe magnet.

These machines were only adapted to laboratory and scientific experiments, for which purpose fair results were obtained.

Clarke's machines (a name frequently erroneously given to all classes of alternating current machines) is well-known in connection with small magneto-machines, more especially such as are constructed for medical purposes. The machine differs somewhat from either that of Pixii or Saxton. Clarke took advantage of the fact that the greatest strength of a magnet is situated at a small distance behind the poles, and not at the extremities themselves, and constructed his machines in such a manner that by placing the electro-magnets at right angles to the permanent magnet, its poles were made to pass over those of the permanent magnet at the point where the greatest strength was to be obtained. The machines were made in a very compact form; a commutator fixed on the spindle carrying the electro-magnets, by a simple arrangement corrected the reversals of the current generated, so that the electricity obtained at the terminals of the machine was always made to flow in the same direction.

It was not long after the establishment of the electric telegraph in England, that attention was directed to the feasibility of utilising the current generated by magneto-electric machines, for telegraphic purposes. Mr. Henley about this time having made several experiments in this direction, succeeded in bringing out then a great novelty, his instruments for telegraphic purposes, whereby the use of a galvanic battery was entirely dispensed with. It was with these instruments that for some time the Magnetic Telegraph Company carried on their electric communication.

The system was after a time, however, superseded by the use of batteries, it not having been found to be so advantageous in practice as had at first been anticipated. Perhaps one of the simplest forms of magneto-electric machine then used for telegraphy was Henley's so-called thunder-pump, an instrument employed for ringing bell signals for telegraphie purposes. It consisted simply of an ordinary horse-shoe permanent magnet, above which was arranged a small lever. On one end of the lever was an electro-magnet, the poles of which, when at rest, were touching those of the permanent magnet; by depressing the other end of the lever, on which a suitable handle was attached, the electro-magnet was raised from the poles of the magnet, and by this means a monentary current was induced in the coils of the electro-magnet. The wires from the coils were connected to the line, and so to the bell at the receiving station; thus every movement of the handle caused a ring on the bell, by this means calling attention. Modifications of this instrument were also used to work double needle instruments, and were in practical use for a considerable time.

While speaking of the application of magneto-machines for telegraphic purposes, it may be well to say a few words on those of Messrs. Siemens and Halske, and of Wheatstone. One of the most important improvements in these machines since that of Clarke was the Siemens and Halske machine, first brought out about the year 1854. In this, instead of using the ordinary form of electro-magnet, that had up to that time been employed, it was replaced by a cylindrical bar of soft iron. The bar had four longitudinal grooves cut in it from end to end, its cross section resembling a double T. In the grooves, insulated wire was wound parallel to the axis of the cylinder in such a manner that the iron core and insulated wire formed a complete cylinder. The end of the wire was soldered to the axis of the cylinder, while the other was fixed to a small insulated metal ring at the extremity of the axis; on this ring a spring connected to one of the terminals of the machine was made to press, the other terminal being connected direct to the axis. The poles of a permanent magnet were so formed and arranged that they were made to embrace the cylinder, to which they were placed as close as possible without actually touching. This form of machine, while generating a powerful current, had the advantage, from the close proximity of the iron cylinder to the poles of the permanent magnets, that these did not so readily loose their magnetism, as the iron cylinder, when at rest, acted as a keeper to the permanent magnets. Siemens and Halske's well-known form of A B C instrument is worked by the currents generated by a magneto-electric machine of this construction. Some great improvements have lately been made in the machines, more especially those designed by them for electric-light purposes; in these the permanent magnets are replaced by electro-magnets, actuated by currents generated by the machines themselves. Improvements have also been made in the arrangement of the commutator, whereby the evils caused by the inductive spark are in a great measure reduced.

The Wheatstone machine, familiar to most persons in connection with the A B C instruments in general use on private wires in England, as it is from currents generated from these machines that the instruments are worked, differs in many points from any of those already described; as employed for A B C instruments, they consist in attaching to the poles of a permanent compound magnet a set of four bobbins, the soft iron cores (pole pieces) of which are fixed permanently to the magnet, two to each pole. Immediately in front of these cores a soft iron armature is placed, and arranged so as to revolve in front of the cores on the handle of the machine being turned. The cores of the bobbins being fixed to the poles of the magnet, receive polarity from them, thus forming four poles, two of which are south and two north. On the armature in turning passing in front of these poles currents are induced in the wire forming the bobbins, and these, by suitable connections, are made to actuate the needle on the dial of the A B C receiving instrument.

One of the chief advantages of this arrangement is that the wire of the bobbins is connected direct to the instrument without the interposition of any commutator, rendering the liability to failure through faulty contact in the commutator impossible.

The employment of induced currents from magneto-electric machines has not, however, in practice, been found to give such good results for telegraph purposes as at first sight might have been imagined. Currents generated by these machines are at comparatively a high state of electric tension, necessitating, accordingly, high insulation; and this on lines of any extent is found difficult to sustain, so that the employment of this class of instrument has been confined in a great measure to private wires and similar short lines; even with these it is found that the insulation requires a good deal of attention to maintain.

The magneto-electric machine, patented by M. Nollet in 1850, but now more generally known under the name of the Alliance machine, was originally intended by the inventor as a means of decomposing water by the currents so generated; the hydrogen gas, produced after having been passed through camphine, or some hydrocarbon oil, to be used for lighting purposes. The inventor also proposed to form an explosive mixture with the hydrogen, making use of the explosion as a means of obtaining motive power, in a suitably arranged engine. It is more than probable that the Alliance machine would never have been brought to anything like a practical success had it not been for M. Van Malderen, a former pupil of Nollet's.

The Alliance machine, as at present constructed, consists of a number of circular gun metal discs, arranged and mounted upon an iron shaft, running in a horizontal position between the bearings of two frames that contain the machine. Near the circumference of each of these discs are fixed a series of 16 bobbins with soft iron cores, arranged equidistant and parallel to the shaft, free to turn with the discs between the poles of eight horse-shoe permanent magnets fixed in the frame. The poles of these magnets are placed radially towards the centre of the shaft. The faces of the magnets are placed parallel to the discs, so that in each circumference there are 16 poles, equivalent and corresponding to the 16 bobbins. The machines are ordinarily made with either four or six discs, so that in the one case there would be 64 bobbins and 40 permanent magnets, and in the other 96 bobbins and 56 magnets. On the shaft is a pulley by which the machine is driven by means of a band. The bobbins are connected up in series, and one end of the wire is fixed direct to the shaft, the other to an insulated ring on it, or as frequently arranged one part of the shaft is insulated from the other; to these are connected the terminals of the machine.

On setting the machine in motion, it is clear that every time a bobbin passes in front of the pole of one of the magnets, a momentary current will be induced in it, varying in direction according as the pole is either north or south. Thus, in each revolution of the discs as the bobbins will have passed the 16 alternate poles of the magnets, there will have been induced 16 alternate currents. The machine is run usually at a speed of 400 revolutions per minute, so that in each minute there will be 6,400 alternate currents generated (about 100 per second).

One of the chief advantages of this machine is its compactness and non-liability to get out of repair; no commutator is used, the currents generated being a series of reversals. For electric light purposes they have in France until very recently been the principal machines used. At the Hève and Grisnez lighthouses they are still employed, as also at many other places for lighthouse lamps, apparently as alternating current machines giving satisfaction. Probably it is owing to their rather high price that their adoption has not been so universal as might have been expected.

The Holmes machine, first patented in England in 1856, differs somewhat from the one just mentioned in the manner in which the bobbins are arranged; these are held between two brass discs in two or more concentric circles, the bobbins rotating in front of the poles of a number of permanent magnets fixed to the frame and radial to the axis of the machine. By this means the bobbins are passed in quicker succession in front of the poles of the magnets, and so per revolution a greater number of currents generated. This arrangement allowed of the machine being run at a slower speed. A commmutator was placed to direct the alternating currents and cause them to be given off from the machine in the same direction.

Since his original patent, Mr. Holmes has made a large number of experiments and improvements in his machines. This machine was the first one used practically in England for the electric light for lighthouse purposes. On the evening of the 8th December, 1858, it was for the first time exhibited from the high light at the South Foreland, and remained at work until the 30th of the same month, after which it was worked at intervals until the 6th June, 1862, when it was permanently fixed at the Dungeness Lighthouse, and there it has since continued to be used.

In designing his first magneto-electric machine for the Trinity Board, Mr. Holmes had considerable difficulties to contend with. It was made a *sine quâ non* by the Board at that time, that the speed of the machine should be limited to about 100 revolutions per minute, and driven by a direct acting steam-engine, without the intervention of either strap or band. These stipulations made it necessary to make the machines of a much larger size than anticipated. In this particular machine it was calculated that in every revolution 85 pounds of soft iron were magnetised, N—S and S—N 44 times. As the speed of the machine was 110 revolutions per minute, there were, consequently, 4,840 reversals of current per minute.

Great care had to be observed, both in the selection of the steel and manufacture of the permanent magnets for this class of machine, in order that they might take up and retain a maximum quantity of magnetism. In Mr. Holmes' latest patent, to obviate this, he replaces the permanent by electro-magnets, a part of the current of the machine being utilised for magnetising them. The magnets are made to turn while the bobbins are fixed; these are coupled up in such a manner that he is enabled to take off a number of independent currents, and thus supply currents for a number of lights, or other purposes, from the one machine.

Wilde's machine resembles somewhat two Siemens' machines of unequal size, the smaller one being placed on the top of the larger. The current from the small one is used for magnetising two powerful electro-magnets of the larger machine, these replacing the permanent ones ordinarily used in the Siemens'. Very fair results have been obtained from this apparatus, although the same drawback exists in this as in all alternate current machines, from the difficulty that arises in presenting the injurious effects of the inductive spark at the commutator, which, besides burning away the contacts, causes the machines to heat. Many ingenious arrangements have been brought forward to obviate this difficulty; but although they have greatly reduced the ill effects arising from the inductive spark, they have never been entirely prevented.

The Gramme machine differs essentially from those above described in a point of the greatest importance, viz., that instead of its generating a succession of alternating currents, the current is continuous, and in the same direction; hence the difficulties arising from the inductive spark are entirely overcome. The machine is an important advance in the construction of magneto-electric machines. Looking at its simplicity, it seems curious that the idea of utilising the principle involved should not have occurred to some of those who have given so much of their attention to the construction of magneto-electric machines.

To understand the principle on which the Gramme machine is based, we must refer to Faraday's original experiment of a helix of insulated wire and a permanent magnet. From this it is evident that, in passing a magnetised bar of steel through this helix, a current in a certain direction will be induced in the wire of the helix until such time that it has reached the neutral point of the magnet (the centre of the bar). Further, the direction of the current will be reversed during the passing of the remaining portion of the magnet.

Now, by way of illustration, against this magnet, which we will call A, let another similar one, B, be placed with their like poles touching, supposing, so to speak, that there is thus formed one long magnet with a similar pole at each extremity, and the contrary pole at the point of juncture of the two magnets. In passing the compound magnet thus formed through the helix, it will be observed, from what has been above stated, that whilst A is being passed through the helix, a current will be induced in one direction, until it has reached the centre of A, when the direction of the current will be reversed, and remain so until it reaches the centre of B, when it will again be reversed to its former direction.

Now, in the place of the bar-magnet, let us take two magnets bent into half-circles, and place them with their like poles touching, forming thus a ring in which the two poles N and S will be on opposite sides of the ring. The neutral points of the magnetised ring will, therefore, also be on opposite sides, and a line drawn through these would be at right angles to one drawn through the poles, cutting it at the centre of the ring. In passing a helix of wire once round the ring, it will be observed that during each half of the revolution an opposite current will be induced in the wire of the helix, the current altering in direction each time the helix passes the neutral points.

In the Gramme machine, for this ring magnet is substituted a ring of soft iron (usually composed of a number of wires) made to revolve between the poles of a permanent magnet. By this means the iron of the ring becomes magnetised by induction, the poles remaining always in the same relative position to the magnets, at no matter what speed the ring may be made to revolve. The neutral point of magnetism in the ring would, therefore, be situated in a line drawn at right angles to one drawn through the poles. Round this ring of soft iron are wound a number of bobbins of insulated wire, connected to each other in series, so that it forms, as it were, one continuous coil of wire, completely covering the soft iron ring. At the points of juncture of these bobbins connections are made to each strip of a commutator fixed on the axis of the machine. The commutator is composed of a number of metal plates, insulated one from another, and fixed radially to the axis of the machine. The outside of the commutator is turned true, forming a cylinder, presenting on its surface alternate strips of metal and the insulating material used. Two brushes of copper wire are made to press upon this commutator—one on each side. The connections are so arranged that these brushes will always be in contact with the two opposite bobbins that are at the time in the neutral positions with regard to the induced magnetism of the ring, that is to say, at points equidistant from the two poles.

If the ring, with its bobbins, be made to revolve, it is evident that two currents of electricity in opposite directions will be induced in the bobbins, one in one half of the bobbins on the ring, and the other in the other half. These halves being divided by the neutral points of magnetism the currents would be equal, and, consequently, annul one another, were there no connection made with the commutator; but, as the brushes pressing on the plates of the commutator will be thus connected to the bobbins, it follows that, if the brushes were connected by a wire, a current would flow along this wire equal in quantity to the sum of the two currents generated in the bobbins. In fact, the same phenomenon takes place as occurs in two galvanic elements of equal strength when the like poles are joined together (connected up for quantity); the two currents, being equal with, but opposite in direction, annul one another, no action taking place. When, however, the two poles thus formed are connected to each other, a current is generated in quantity equal to the sum of the two elements, which, in reality, it is.

The brushes are connected to the two terminals of the machine, one to each, and regulated so as always to be in contact with the coils, not breaking contact with one until the contact is established with the next one. By this means, when properly regulated, the current is perfectly continuous, and therefore no induction spark takes place.

The Gramme machines are very compact and complete; every attention has been paid in designing them to render them serviceable for continuous work.

In the small machines for experimental use, permanent magnets are used, the poles being brought down and fixed to soft iron pole pieces cut away so as to embrace a large extent of the circumference of the ring. The larger machines used for electro-plating, electric light, and such like purposes, have the permanent magnets replaced by electro-magnets, which are excited from the current generated by the machines themselves. In practice it is found that these electro-magnets always retain a sufficient quantity of residual magnetism to generate a weak current on starting the machine. This current, passing through the electro-magnets, increases their magnetism, and re-acting on the bobbins, increases the current from the machine, which in its turn again acts on the electro-magnets, and so on, till the current has reached a maximum strength corresponding in proportion to the speed of the machine. The speed of the Gramme machines varies from about 500 to 1,000 revolutions per minute, according to the object for which they have been designed.

Niaudet's machine is in principle similar to that of a Gramme machine; the current is continuous. In this machine a number of bobbins with soft iron cores are fixed parallel to an axis with which they revolve. The poles of these bobbins turn between the poles of two horse-shoe permanent magnets, one magnet being placed at each end of the bobbins, in appearance somewhat resembling two Clarke's machines placed back to back. The bobbins are joined up in series, with connection made at the point of juncture to a commutator, similar in principle to that of the Gramme. Two contact springs make the connections to the terminals of the machine.

It is unnecessary to give any further description of the various forms of magneto-electric machines that have been brought out. From those already described a fair idea may be formed of the advance that has been made in this branch of electrical knowledge, with regard to the construction of this class of apparatus. It remains, therefore, to be seen in what manner the electricity generated by this means has been practically utilised.

The earlier machines were little else than philosophical toys, and, excepting for demonstration, were very little used. Probably their first practical application was that for working telegraph instruments. For this purpose up to the present time they have been for certain classes of work in extensive use on short lines. One of the chief objections to a more widely extended use has been, that the currents so generated are at a high state of tension, rendering the insulation of the lines difficult to maintain.

The Gramme machine, with the coils of the ring wound with large wire, giving a continuous quantity current, has been proposed for use in lieu of ordinary batteries for working telegraph circuits. The objections to its use are purely of a practical nature, but until solved they will preclude its adoption for this purpose, although, were it feasible, a great saving both in labour and maintenance would result in all large telegraph offices.

Some of the earliest applications of magneto-electric machines were for electro-plating, but their employment was very limited, and confined only to a few isolated cases. Since, however, the introduction of the Gramme, their use has become somewhat more extended for electro-metallurgic purposes. Their use in connection with the electric light is perhaps the one for which they have proved themselves most valuable. They replace batteries expensive both to work and maintain, indeed, so much that, although the phenomona of the electric light was well understood prior to the introduction of these machines, yet no practical use had been made of it. For lighthouse lamps the electric light has proved invaluable. Mr. Holmes, as already stated, was the first who successfully applied it in England for this purpose. The machine was exhibited at the 1862 Exhibition prior to its erection at the Dungeness Lighthouse. In France, the Hève Lighthouse, near Havre, was the first that was fitted up with the electric light, in 1863; in this case the Alliance machine was employed. In both these instances such good results were obtained that the system rapidly spread. It is now acknowledged to be the best system in every respect in all places where it can be applied.

In utilising the electric light for lighthouses, or other purposes, there are many points that require attention; and it is, perhaps, not the simple matter that might at first appear. Like everything else, it has its drawbacks and inconveniences as well as its good points. Still, whilst for lighthouses, and for many other purposes, it may be economically applied, yet ,with our present knowledge of the subject, it requires a vast amount of further development before we can hope to see our streets lighted up by its means.

To generate the electric current, a motor of some description must be used to drive the magneto-electric machine; the function of the latter, as already explained, being simply that of converting the motive power into electricity. The power required will vary in strength in direct proportion to the current to be generated. For the smallest machines of any practical value for light purposes from two to three horse power is found most convenient, representing about 1,000 candle power.

The usual method of obtaining the electric light, and the principle on which the lamps are ordinarily constructed, is that of employing two carbon electrodes, between the extremities of which a current of electricity is made to flow. In doing this a most brilliant light is produced, depending in intensity upon the quantity of electricity employed. That a uniform and steady light may be maintained, the lamp which consists of some kind of regulator, has to be so constructed that the carbon points are automatically kept at the same distance from one another; so that the resistance of the circuit remains constant. The three principal functions that a properly constructed electric lamp should automatically fulfill are these:—1st. That on a stoppage of the current from any cause the points of the carbon are brought together, completing the circuit ready for action on the current being re-established. 2nd. The carbons, when burning, must be held a short distance apart; and 3rd. The carbons must be brought together whilst burning at the same uniform rate as the combustion takes place, so keeping the distance between them constant.

In fulfilling the above-mentioned requirements, the Serrin lamp has probably given the best results, having passed through the stage of a philosophical toy, and been employed for some years past in real practical work. The principle of this lamp is used more or less in all the varieties of electric lamps, and, therefore, from a short description of it, the method in which the lamps are ordinary constructed will be understood.

The Serrin lamp consists of two carbon holders mado of brass, placed vertically one above the other; the upper one, to which the positive pole is attached, is held in position by means of a cross piece fixed to a vertical rod placed a few inches away from the carbon holders. This rod and the lower (negative) carbon holder, are made free to move either up or down in two brass tubes that are fixed to the top of the case containing the regulating apparatus. On the lower extremity of the rod fixed to the upper carbon holder, is a rack that engages in the teeth of one of the wheels of a small clock work movement. The end of the rod is so weighted that, by its own weight, it has a tendency to drop, and in doing so turns the clock-work; this, in turning, winds up a chain fastened to the lower extremity of the lower (negative) carbon holder; so that by this means, as the positive holder falls, the negative one rises, and thus brings the carbon points closer together. On the last pinion of the clockwork is a small fly, so arranged that a stop in connection with an electro-magnet prevents the fly from turning so long as the magnet is exerting a certain force. This magnet is circuit with the lamp, and thus, as long as the lamp is burning with a certain regulated current, the fly is held from turning; consequently the carbons are held in their position, remaining so until such time as they have burnt away slightly. This will cause an increased resistance from the distance between the carbons being greater, when a corresponding diminution of the current takes place, weakening the force of the magnet; this releases the fly, and allows the carbons to approach one another until the resistance is again regulated, and the magnet sufficient, powerful to stop the fly.

The lamp is very ingeniously arranged, and it would be impossible without diagrams to explain a variety of other details that do so much in establishing its success. Suffice it to say that the lamp is so constructed that, by a neat movement, while there is always a sufficient and surplus force exerted for bringing the carbon points together; at the same time, on the circuit being broken, these carbons are automatically brought together without the possibility of the points getting crushed. When employing a continuous current, the positive carbon is consumed at about the rate of the negative; this is also compensated for in the lamp, so that the light is always maintained in the same position.

One of the inconveniences in using the electric light, is that of the carbons having to be replaced about every four hours. To obviate this, it has been suggested to employ two round discs of carbon slowly revolving, their edges touching, the light being formed between these two edges. This first automatic electric light regulator was, on this principle, made by Thomas Wright, in 1845, afterwards improved by Molt and others, but never sufficiently perfected to render it a success. At the present time, a further modification of the principle by Mons. Regnier, is being experimented upon at Chemin de Fer du Nord, Paris, but with what amount of success it is premature to say. M. Regnier, however, expects to be able by this means to arrange lamps burning for 24 hours without alteration.

Notwithstanding the foregoing remarks may at first sight appear to put great difficulties in the employment of electric light for commercial purposes, the system has of late been introduced with very satisfactory results. It has made considerable progress in advantageous application; more, perhaps, so in France than in any other country, the Gramme machine and the Serrin lamp being the system almost universally adopted.

Among some of the principal places in France where the system is at work on a commercial scale, and apparently with success, are, Messrs. Saulter, Lemonier, and Co., lighthouse manufacturers, Paris, in their fitting and turnery shops; the chocolate works of M. Menier at Noisiel, also at his india-rubber works at Grenelle (Paris), as well as at his sugar refinery at Roye; Messrs. Cail and Co., engineers, Paris, in their locomotive erecting shops; and the Chemin de Fer du Nord for part of their goods station of La Chapelle.

For out-door work there is no question, in many cases, of the advantage of the electric light. By this means an extended area can be readily lighted up, and this in places where gas, probably, cannot be employed.

It is claimed that the cost of working this system is cheaper than that of gas—and, perhaps, in certain cases, this may be the case—but it is very difficult, for obvious reasons, to draw any comparison between the electric light and gas. There is nothing more misleading than a statement of an electric light being of a certain candle-power, when comparing its cost with a number of gas burners. In the one case you have a certain candle power of light concentrated, so to speak, in one small spot, probably not giving the advantage of one-half the light; whereas in the other, with gas, the light being divided, is more diffused.

The deep shadows where so powerful a light as the electric is used, have to a great extent been successfully obviated by keeping the light raised a good height from the ground. When under cover the walls and roof of the building should be kept whitewashed, and one lamp placed in opposition to another; not using reflectors has been found advantageous.

At the La Chapelle Station the lamp (one being at present used) is enclosed in a large lantern, the sides of which are opaque to about half their height, so that the naked light is not visible from any part of the building. Any use, however, of opaque glass, although diffusing the light, must at the same time diminish its candle-power very considerably. With low pitched roofs it is found very difficult to sufficiently diffuse the light.

A few weeks ago, as an experiment illustrative of the value and practibility of the electric light, the Gramme Company in France undertook to light up the Palais de l'Industrie at Paris by this means.

The building, which has a superficial area of about 2·5 acres, was lighted up by two clusters of six lamps each, naked lights suspended from the roof, distant from each end of the building about one quarter the length. The lamps were worked by 12 small Gramme machines driven by two 25 horse-power engines that were placed outside the building. By this means the entire building was sufficiently well lighted up to enable a newspaper to be read at any part of the building. No inconvenience was experienced to the eye when looking at the lights; their height prevented this. The light had a peculiar white appearance, and colours were as readily distinguishable in it as in daylight. The shadows were very slightly stronger than those of ordinary daylight, and by no means marked. As to the lighting up of the building and its practicability, it was a decided success, although with regard to the cost, in comparison with gas, there were no means of ascertaining.

In the above special mention has been made of the Gramme machine, as it has been the one most extensively used for lighting purposes; however, with any of the other machines previously mentioned, probably similar results might be obtained, each one having its own particular points of excellence.

At the commencement of last June, some trials of the capabilities of a recent invention, "the electric candle," as demonstrating its suitability for dock purposes, were carried out at the West India Docks, permission having been granted to the patentees by the Dock Company.

The electric candle is the invention of a M. Jablochkoff, a Russian engineer officer. It consists of two carbons placed side by side, with a strip of kaolin (china clay) insulating them from one another. M. Jablochkoff had found that kaolin, as soon as it became heated, diminished the resistance of the circuit sufficiently to permit of the electric light being formed between the carbons; also that, by the intense heat concentrated at this spot, the kaolin was volatilised; so that, in fact, when the "candle" was once lighted, it gradually burnt down, much in the same way as an ordinary candle.

The experiments at the docks were, unfortunately, not quite so successful as some that have been more recently carried out in Paris, although, in a great measure, they demonstrated the practicability of the invention.

One of the chief advantages claimed by the inventor is that he is thus enabled to divide the circuit into a number of different lights, as the resistance of the circuit is constant, whereas, by the ordinary system, this cannot be done, it being necessary to have a separate machine for each lamp.

The invention is certainly very pretty, and a good deal may be said in its favour; although, as to the practical advantage to be derived from it, with our present knowledge of the subject, and its great superiority over the ordinary system, is an open question.

One thing must not be lost sight of, namely, that the distance to which the current of electricity can practically be conveyed for light purposes is very limited; in fact, about 200 yards is the limit; so that the advantage of dividing the light by means of the electric candle is not so great as at first sight might appear, while the amount of light obtained when the circuit is divided is not so great as when one lamp only is used. True, the light is more diffused, but then a number of lights have to be attended to in the place of one, and the advantage claimed is not evident.

With the electric candle a neat form of lamp is used, which, by means of a simple mechanism, throws a fresh candle into circuit as soon as one has burnt out. The lamp is usually arranged with four candles, each burning about three hours, but the number of candles in the lamp could of course be increased if necessary.

Another plan of electric lights, also the invention of M. Jablochkoff, is that of passing a current of electricity through a piece of kaolin, which is thus rendered incandescent; by this means it is claimed that he can divide the current into a number of lights equal each to that of an ordinary gas burner.

From what has been already said, it is evident that there are a number of useful purposes to which the electric light may be both advantageously and economically applied, but that the time when it will fill the place of our present system of gas lighting, notwithstanding the rapid advance of electrical knowledge, seems as far off as ever.

ADULT INSTRUCTION THROUGH PUBLIC MUSEUMS.

(Subsidised by Parliament.)

The following results, giving important information bearing on public education, are obtained as correctly as possible, from inquiry and Parliamentary returns, in the hope that they may hereafter be officially collected and published periodically, like the Registrar-General's returns. The number of visitors for the month of August, 1877, are stated. When they are counted by sight the letter "S" is used, when by turnstile the "M":—

Institutions.	Amounts voted in 1877.	Number of Visitors in August.	How counted.	Observations.
1. British Museum	£ 109,990	50,166	S	Return refused. Open Mondays, Wednesdays, Fridays, and Saturdays. Closed, except to students, on Tuesdays and Thursdays. (1)
2. National Gallery, Charing-cross	6,976	98,493	S	Open Mondays, Tuesdays, Wednesdays, and Saturdays. Closed on Thursdays and Fridays. Open from 10 to 6. (2)
3. Kew Gardens and Museum	22,622	155,647	S	Open on Sundays and week days. (3)
4. South Kensington Museum	38,922	89,841	M	Open morning and evening till 10, on Mondays, Tuesdays, & Saturdays. Students' days—Wednesday, Thursday, & Friday, 6d. entrance. Open from 10 till Sunset.
5. Bethnal-green Museum	7,600	45,126	M	Ditto. (5)
6. National Portrait Gallery, South Kensington	2,000	..	M	Return refused. Open daily except Sundays. (6)
7. School of Mines and Mining Record Office, Geological Museum, Jermyn-street	8,997	..	M	Open daily, except Sundays and Fridays, and in the evenings till 10 of Monday, Tuesday, and Saturday. (7)
8. Patent Office Museum, South Kensington	..	..	M	Open daily, except Sundays. (8)
9. Edinburgh National Gallery	2,100	17,617	M	(9)
10. Edinburgh Museum of Antiquities	..	19,303	M	(10)
11. Edinburgh Museum of Science and Art	10,998	35,983	M	Open daily (10 a.m. to 4 p.m.) except Sundays, and Friday and Saturday evenings (6 to 9). Students' days—Monday, Tuesday, & Thursday; admission 6d.; other days, admission free. (11)
12. Edinburgh Botanic Gardens	1,750	8,319	M	(12)
13. Dublin Museum of Natural History	1,762	10,988	M	Open daily, & in the evening. (13)
14. Glasnevin Botanical Gardens and Museum	2,224	38,649	M	Open daily, including Sundays. (14)
15. National Gallery of Ireland	2,389	7,894	M	(15)
16. Museum of Royal Irish Academy, Dublin	300	..	M	(16)
17. Zoological Gardens, Dublin	500	14,382	M	Open daily, including Sundays. Number of visitors in July, 15,281. (17)
18. Tower of London	1,590	33,794	S	Open daily, except Sundays. (18)
19. Royal Naval College, including Greenwich Painted Hall	38,051	57,489	S	Open daily, including Sundays. (19)
20. Royal Naval Museum, Greenwich	1,055	16,030	S	Open daily, except Fridays and Saturdays. (20)
21. India Museum, South Kensington	..	3,750	M	Paid for by Indian Government. Open on Mondays, Tuesdays, Fridays, and Saturdays, 1d. admission; on Wednesday and Thursday, 6d. admission. (21)
22. Hampton Court Palace	7,475	45,083	..	Open on Sundays, and on week days except Fridays. (22)

(9) (10) (12) (16) No information as to opening.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,298. Vol. XXV.

FRIDAY, OCTOBER 5, 1877.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

On account of Professor Colvin's absence from England, and his being therefore unable to revise the proofs, it has been found necessary to defer the publication of the second Cantor Lecture on Greek and Roman Art.

PROGRAMME OF EXAMINATIONS FOR 1878.

The Programme for 1878 is ready, and can be had on application to the Secretary. The Society's Examinations now comprise the following divisions:—

1. Commercial Knowledge.
2. Domestic Economy.
3. Fine Arts applied to Industry.
4. Knowledge of Public Museums.
5. Music.
6. Blow-pipe Analysis.
7. Technology of Arts and Manufactures.
8. Elementary.

MISCELLANEOUS.

PHILADELPHIA EXHIBITION REPORTS.[*]

Machines and Tools for Working Metal, Wood, and Stone.

The next report to that last noticed is Dr. Anderson's elaborate one on machine tools, which is pervaded throughout by a perfectly enthusiastic admiration of the American exhibits. None of the countries of Europe were strongly represented, in fact the reporter thought the department "could hardly be regarded as an international competition." Though Dr. Anderson will not allow that we are falling behind, he yet admits that our exhibits at Vienna gave foreigners the impression that we were being passed by the Americans, and that the show we made at Philadelphia will certainly strengthen this impression.

A special feature in this section was that all machine tools were tested for accuracy if their owners wished it. Nearly all the Americans agreed to this, but none of the foreign exhibitors, except one Canadian and one French firm. Some machines were also tested for rapidity of work; for example, a locomotive cylinder was bored out, the ends of the bore recessed, and the flanges turned and faced in three hours and a half. On the whole, the results of the tests were such as to take the judges by surprise. The saws were not tested, time not sufficing for the exhaustive series of trials, which alone it was thought would be of any real value.

Another special feature of the Machinery-hall consisted of the great pair of Corliss engines that drove the machinery, and the arrangement of shafting and gearing by which the power was transmitted. All this gear worked with perfect smoothness and quiet. The spur teeth were all cut by a machine exhibited near the engine, and were so scientifically shaped as to work almost without noise or tremor.

The English display was, for this country, poor, and it was only by the exhibits sent by Canada that the credit of the empire was saved. Both the metal and the wood-working machines shown by the colony showed considerable originality, especially, as might be expected, the latter class. The small cost of material induced a tendency to neglect economy for the sake of speed, and the wood-cutting machinery was, therefore, of a very massive and powerful character. The first English exhibit noticed by Dr. Anderson was that of Messrs. Massey, who showed a number of steam hammers, varying from the smallest size up to five tons. A novel and ingenious machine for transferring patterns to printing rollers for calico, &c., was shown by Mr. Gadd, of Manchester. The pattern is impressed from a steel milling tool running against the roller, or from a block pressed against it. In either case pressure alone is used to produce the copper printing surface. Besides a stone-dressing machine, in which the action of the chisel and mallet is imitated, Mr. E. K. Holmes showed a new and untried coal-cutting machine. The cutter was a very coarse saw, with teeth an inch apart. The machine for the same purpose shown by Messrs. Baird, of Glasgow, had had the advantage of practical trial. In this the cutters were carried on an endless chain, supported by a projecting arm. A machine for painting articles in number was shown by Mr. Roberts, of Bootle. Amongst the extensive display of American circular saws, it was noticed with regret that none were sent from Sheffield.

The German exhibit was neither extensive nor good. The machines that attracted notice were one for cutting small bevel wheels, and a special arrangement for grinding metal surfaces with a fast running emery wheel. Some tools for machine watch-making were also highly commented upon.

In France, the machines sent by Arbey, of Paris, are noticed by Dr. Anderson, almost to the exclusion of any others. His planing machines, with their steel cutters wound vertically on cylinders (like the knives of lawn-mowing machines), were unique. Another machine, for shaping the edges of cask-staves, so that they may fit water-tight, was considered the best of the class, though there were numerous exhibits of cask-making machinery in the United States section.

Belgium showed the actual apparatus by which Mont Cenis was tunnelled. Sweden had an exhibition of sawing machinery, but it was quite overpowered by the magnificent American display of similar machinery. Russia showed great improvement on Vienna, and seemed to have acquired some of the practical knowledge which was wanting to combine with her theoretical knowledge. A noticeable feature in the Russian section was an exhibition of models and machines made by the students of the technological schools of Moscow and St. Petersburg. This collection included lathes, planing machines, parts of steam-engines, valves, governors, &c. Brazil is the only other country mentioned.

It is to the exhibits of the United States that Dr. Anderson devotes the larger portion of his report, though, as he says, that can only note the more salient points in the space at his disposal. He begins by reference to "probably the most exquisite set of machine tools ever made," those employed for machine watch-making by the American Watch Company, of Massachusetts. Several other sets of tools are shown; one for making gun-stocks, another for cutting the wheel gearing for the Machinery-hall, are also referred to. The use of special tools for special purposes was specially remarked by the reporter, and he gives as an instance, a lathe specially constructed for making water injectors for steam boilers. Though no furnaces were allowed to be lighted in the Exhibition, there was a fine show of apparatus for smith's work, in some of which there were remarkable instances of the way in which perfect mechanism can replace skilled labour. Where articles have to be repeated, as in making the interchangeable parts of railway bridges, the bars of iron are brought forward on trucks; the ends of the bar are heated in a furnace, and then put into a set of dies worked by hydraulic pressure.

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[*] Continued from p. 914.

> "A touch of a handle by a skilled attendant causes the dies first to hold firmly and then to set up or shorten and squeeze the hot iron into form. If there is a hole to be made, a taper mandril passes through the dies, driving the red-hot iron into every crevice of the steel mould, the whole operation occupying only a few seconds. In connection with these hydraulic forging machines an accumulator is used, and the cylinders being of large diameter, the hot iron is like soft clay in the hands of the potter, and pieces of work that would occupy a good smith with a couple of strikers for half a day are made perfect at once, and at a small cost; the chief expense for labour being the removal of the bars of iron to and from the smithy. The great expense is in the tools and plant, which could only be incurred in a country where the work is systematised to admit of repetition."

In drilling machines, the Americans have almost a speciality. The Morse twist drill is of course an American invention, and this is only one of many. Their latest improvement seems to be the use of a spiral tube for transmitting power to drills round corners and in positions where the ordinary apparatus cannot act. On a small scale, this arrangement has been employed for some years by dentists, but it is now employed for heavy work. A spiral is also used to stiffen a tube which has to be bent. It is stiff enough to prevent the tube collapsing, and can be readily withdrawn by winding it in its own direction, so as to tighten the coils and reduce its diameter. The use of the emery wheel is, as might be expected, noticed by Dr. Anderson. This is another practical improvement we owe to America. The wheel is there used for much work which is generally effected by planing and shaping machines. The required results are produced "not by the old system of hap-hazard grinding, but by well-defined movement, rendered as certain in its action as the ordinary tools employed in the various branches of engineering." For trimming rough castings, too, Dr. Anderson saw these wheels largely used, and he was much struck by the way in which they did their work.

In one respect "a new departure" has been taken by the Americans in punching metal, and in shearing and detrusive operations generally. This was principally illustrated by the specimens shown by the firm of Hoopes and Townsend, of Philadelphia, and described by Dr. Anderson in the following words:—

> "The articles shown consisted chiefly of nuts and other similar perforated specimens; all were of remarkable beauty, and were given away in profusion. These nuts had two peculiarities, they were of inordinate depth, and showed clearly that they had been punched cold. Visitors, however, did not hail this new fact in practical science, they said it was an impossibility for a $\frac{3}{8}$ in. punch, however good the quality of steel, to penetrate through $1\frac{3}{4}$ in. of cold iron; that whatever might be the explanation, a punch of that diameter could not do it without being broken or crippled.
>
> "In time the secret leaked out, for it was no imposture. The firm, in punching, take advantage of the fluid property of solid cold iron or steel by introducing the element of time into the performance of the operation, giving to the punch only such a load of pressure as it can comfortably sustain, then giving up the reins to nature, when the instrument penetrates at a rate dependent on and in proportion to the fluidity of the mass."

In the wood-working machinery there was very much to command attention. The saw-mill annexe was a most characteristic and important part of the Exhibition. There were circular saws whose velocity was only limited by the resistance of iron to centrifugal force, in one case a driving pulling having actually burst and gone off in pieces through the roof. A band saw 8 in. wide, and running at 60 miles an hour, was also shown, a striking contrast to the saw described a few lines above, "little more than a steel thread."

In conclusion, Dr. Anderson sounds a note of warning to our own manufacturers:—

> "Hitherto we have been justly proud of the perfection of the system and organisation in our cotton manufactories. What Arkwright did for the cotton mill, the Americans have introduced into numerous other branches, watch-making, for example, with equal advantage. In past times, England has been the nursery-ground of the manufacturing system; her factories have been visited, and her system of cotton and other textile manufactures have been copied by all nations; but the time seems to have arrived when we shall have to visit America in the same way, and for the same purpose, in regard to the production of other things, and there is no time to be lost if we mean to hold our own in the hardware trade of the world, at least in regard to the class of things that are required in large number or quantity."

Machines and Apparatus used in Sewing and Clothing.

Mr. Paget's report on this section includes sewing and knitting machines, tailoring apparatus, watch-making machines, &c. It was the first-named class of machines which constituted the principal portion of the group, and to these most of the report is devoted. As might be expected in the native country of the sewing machine (for such America must fairly be considered, despite the prior European attempts of only partial success), the display of these most popular labour-saving machines was extremely complete. Even in European exhibitions, America had eclipsed all rivals in this department, and on her own ground she was hardly likely to find competitors. Besides, there is no original machine now well known that is not American in its origin, and, consequently, all the sewing machines not exhibited by American makers were only copies of American machines. The extent of this industry in the States may be estimated from the fact that the yearly production of sewing machines is calculated at 500,000, while during the last 25 years 2,000,000 machines have been made and sold by a single firm. This enormous business is chiefly in the hands of a few firms. It has developed into an elaborate system, requiring a large amount of capital, both from the long credits given and from the fact that extensive plant is required. The details of the machines are all interchangeable, and this means a complicated and elaborate plant, which, of course, locks up capital. The convenience of this interchangeable system, both to buyer and manufacturer, is so great that firms employing it have a great advantage over others. From these causes the element of competition is greatly lacking; and Mr. Paget foretold what has, it is believed, proved to be the case—that the falling-in of a very important patent during the present year was not likely to make any difference either in the prices of the machines or in the firms making them.

The machines tried were all exposed to very severe tests, it being considered desirable to try them upon work of a more difficult character even than they might fairly be expected to meet with under ordinary circumstances. The result was that comparatively few passed all the ordeals successfully, though the best justified the rigour of the judges by doing so. Some of the machines were tested for easy working by driving them with a loop of cotton in place of the ordinary leather band, and the fact that they passed this test may be taken as a proof both of the nature of the machines shown and of the way in which they were tried. The machine most approved was the new Wheeler and Wilson. The report also commends the recent improvements in the Wilcox and Gibbs, by which the tension of the thread is made automatic, and the size of thread and needle for each sized stitch indicated by the mechanism for altering the stitch. Other machines, whose names are as familar to the public as the two above-named, are also referred to.

more or less favourably. A number of small motors for driving sewing machines were shown, but these did not officially come before the judges of this section, as they were considered among the "motors." They included, it may be noted in passing, engines worked by steam, water, electricity, and hot air. Several knitting machines are mentioned in the report, and various machines for tailors' use are also briefly referred to. Among the exhibitors of watch-making apparatus, the American Watch Company, of Waltham, Mass., were the principal.

THE ECONOMIC USES OF REPTILES.

By P. L. Simmonds.

(*Continued from page* 969.)

An important commercial product of the marine turtles is tortoiseshell, which is highly appreciated in art manufactures, and of which the chief supply comes to this country. Our receipts in some years have reached 30 tons, but the average is about 25 tons. There are usually thirteen large plates on the carapace, called collectively in trade the "head;" four on each side, and five on the back, the last bent in the centre. Of the side plates, the two middle are the most valuable, being the largest and thickest; those on the margin, denominated hoofs or claws, are comparatively of less value. The lamellæ, or plates, as they are called, vary in thickness from one-eighth to one quarter of an inch, according to the age and size of the tortoise, and weigh from four to six pounds or upwards. The larger the animal, the better the shell. The feet, or noses, hoofs, or claws, as they are sometimes termed, are chiefly in demand in China. In a turtle of the ordinary size, about 3 feet long and 2½ feet wide, the largest plates weigh about 9 ounces, and measure 13 by 8 inches, and are ¼ inch thick in the middle. The belly plates, or shells, are not mottled, but of a yellow colour, and are used for the purposes of horn.

Passing from the Chelonians to the Saurians, we find several of these are now utilised.

Herpetologists have made us acquainted with about 2,000 species of reptiles, and established the means of distinguishing those which are harmless and useful from those which are poisonous and useless. Some curious facts may be cited to show the various uses to which many reptiles are now put by man, either as commercial products or for food. We shall find that reptiles are eaten with eagerness all over the world, and neither want of beauty nor abundance of venom protects them against omnivorous man.

The Crocodile family is subdivided into the Caimans or Alligators, restricted to America; the Crocodiles proper, which are more widely diffused over Asia, Africa, and America; and the Gavial, peculiar to the Ganges. In Brazil, the jacare, or common caiman (*Alligator cynocephalus*), is two or three yards long; the *Alligator palpebrosus*, with bony eye-lids, is smaller, but equally ferocious. The pike-nosed caiman (*Alligator nicius*), is that which is found in the United States.

Mr. Henry Kluster, author of "Travels in Brazil," says:—"I have been much blamed by my friends for not having eaten of the flesh of the alligator, and indeed I felt a little ashamed of my squeamishness when I was shown by the same friend a passage in a French writer, whose name I forget, in which he speaks favourably of this flesh. However, if the advocate for experimental eating had seen an alligator cut into slices, he would, I think, have turned from the sight as quickly as I did. The Indians of South America eat these creatures, but none of the Negroes will touch them."

The Rev. Mr. Haensol, in his "Letter on the Nicobar Islands," tells us that "part of the flesh of the crocodile or caiman is good and wholesome when well cooked. It tastes somewhat like pork, for which I took it, and ate it with much relish when I first came to Nancauwery, till on inquiry, finding it to be the flesh of a beast so disgusting and horrible in its appearance and habits, I felt a loathing which I could never overcome; but it is eaten by both natives and Europeans."

The aboriginal natives of Trinidad considered a boiled slice of alligator as a dainty morsel, and Mr. Joseph, the historian, records having tasted it, and found it very palatable.

The eggs of the spectacled caiman (*Alligator sclerops*) are white, rough, and as large as those of a swan; they are deposited to the number of 60 in the sand and covered with dried grasses. The Indians esteem them as food, and also relish the white and savoury flesh of the yacaré, as it is called in South America, although it is dry and coarse. The flesh and fat are occasionally eaten by natives in Africa and other parts. The large eggs are eaten by the natives, but they have a strong, musty odour. Mr. Joseph, in his "History of Trinidad," tells us he has eaten them without knowing what eggs they were, and found them very good.

Alligators are killed in large numbers in the South American lakes and parts of the River Amazon for their fat. Mr. Wallace, in describing an alligator hunt on the lakes of Meziana, an island lying off the mouth of the Amazon, states that about 80 were killed in two days. They are cut open, and the fat which accumulates in considerable quantities about the intestines is removed, and made up into packets in the skins of the smaller ones, taken off for the purpose. The fat is boiled down into oil and burned in lamps. It has rather a disagreeable smell, but not worse than train oil.

More than two hundred years ago the musk of the alligator of Yucatan and Honduras was extracted from that animal. Captain Dampier tells us, "The flesh smells very strong of musk, especially four kernels which are always found about them, two of which grow in the groin, near each thigh, the other two at the breast, one under each fore leg, and about the bigness of a pullet's egg; therefore, when we kill an alligator, we take out these, and having dried them, wear them in our hats for a perfume."

The teeth of the reptile are from four to six inches in length, and are very white and hard. There is no doubt that they might be applied to many useful and ornamental purposes. But there is still another article of no slight importance, which may be extracted from these amphibious brutes. The tail of an alligator measuring 12 feet in length, when boiled down, yields from 60 lbs. to 80 lbs. of excellent oil.

Boots made from alligator skin have come into general use in Panama, many parts of North America, Vienna, and Paris, and are reported to be excellent, from their thoroughly waterproof qualities. The leather resembles the ancient leather body-armour, worn by the Roman soldiers, and in vogue in England until the reign of Edward I., such as we see it depicted in old paintings and historical works. On the Magdalena River the capture of alligators and the preparation of their skins are becoming lucrative branches of trade. Alligator leather has long been utilised for saddles, and there seems no reason why these South American monsters should not become a valuable means of support to the natives.

The skins are taken off the belly part of the reptile, including the underneath portion of the four legs and the whole length of the tail, which is pretty wide and almost flat also: the belly or underneath part of the creature is not protected so strongly by the horny scales as the portion covering the back and upper parts of the head and tail, consequently it is more easy to manufacture into leather. These skins are imported from South America into France and there dressed; they are subjected to the same processes that any other skin would be; in the liming, however, the scales that are on the skins come off in flakes, like small pieces of horn, leaving behind them the corresponding indentations and upraisings in the skin; this grain, so to speak, produces a very pretty effect, especially when the skin is well tanned and nicely curried, as those are which I have seen. Each skin will cut on an average two pairs of boots. The French clickers cut the vamp out of the leg, which being taken off from underneath it, fits the instep of the last naturally, the skin presenting the appearance of having been nicely blocked to the shape of the foot; the four vamps having been cut out from the four legs, the remaining portion of the skin is cut into quarters, and when the boot is finished it presents an excessively handsome and very uncommon appearance.

Excellent shooting and strong winter boots are produced from these skins, as the leather is very tough and thoroughly waterproof, and at the same time not heavy to wear, it being shaved down on the flesh to a nice level and medium substance.

Messrs. W. H. Jones and Son, of Bermondsey, have these skins both black and russet, as in Paris they are used in their russet state for saddlery purposes, and the manufacture of fancy articles, such as pocket-books, purses, &c., besides being used extensively for footgear. At the time of the Paris Exhibition of 1867 they were in great demand, as these boots were then considered the height of fashion, and fetched very long prices.

Since alligator skins were first introduced into Boston, about 20 years ago, by Messrs. Schayer Brothers, quite a large demand has sprung up for them, and some parties are importing and selling them wholesale. They are tanned and curried at Danvers and Roxburg for Boston city trade, and the sale goods manufactured therefrom are sent South. The production takes the shape of men's heavy boots—cavalry style—but I have seen some very elegant drawing-room slippers made of this unique description of leather, which constitutes quite a new, and by no means an uninteresting feature in the trade. The slippers are only made from skins tanned with oak bark, which gives them a russet look, and causes them to appear exceedingly *recherché* when artistically made up in slippers.

These skins were imported last year in barrels and hogsheads from New Orleans city to the extent of 20,000, and the outlook favours a steady increase in the coming year. When his Royal Highness the Prince of Wales visited Boston, some 14 years ago, he was so much fascinated with the alligator shoe that he gave an order to Mr. Rice, the predecessor of Connolly and Power, for two pairs of the best boots that could be produced; one pair of which he at once put on, and had the other pair sent after him to England. The British public are deluded into the notion that the skins imported here are crocodile skins, brought from Africa, and only obtainable in very limited qualities.

The alligator leather is extensively counterfeited, and very fair imitations of it are met with, which are made at Haverhill and other American cities, for Texas and other markets. The special qualities of alligator skins cannot, however, be imitated. The *Journal des Halles aux Cuirs* of September, 1875, stated that about 20,000 alligator skins are now annually tanned.

Bacon, in his "Impressions of Hindostan," tells us that "in the Ganges are found two species of them, one a broad snub-nosed fellow, known in India by the Hindostani name "muggur," is by far the most formidable monster of the two. It is said to grow to the length of 35 or 40 feet in the Sunderbunds; but I have never had the chance to meet with one exceeding 25. The back is guarded with an armour so thick and hard as to be impervious to a rifle ball; a good marksman, however, need not despair of obtaining a specimen, if with a trusty weapon he can manage to get within 35 yards; the eye, the side of the neck, the joint of the fore arm, either in front or rear, are all good points of attack, but one ball will seldom do sufficient execution to secure the beast from escape; three or four shots are generally required to disable him so that the *dandies* (boatman), may engage him with safety. This they perform with great spirit, by casting a noose round his mouth and another over his tail, and while the ropes are held tight, three or four men are upon him and turn him upon his back, or in some instances chop off his tail. Neither action can be effected without risk of injury; for in spite of all efforts to hold him down, unless the brute be very near dead, he lashes out with his tail in a style which, if the blow take effect, would leave a man a very small chance of life. As soon as the animal is pretty well secured, a long knife or dagger is run into his throat, and in ten minutes afterwards all the tit bits of him will be stewing and bubbling in the black fellows' cooking pots. The tail is most esteemed, being much the finest and at the same time most delicate part about him; it really makes a very tolerable beefsteak."

This vicious animal is sometimes very destructive to those who travel in India in the common canoes. They are found in the northern districts of Travancore, measuring from 20 ft. to 30 ft. in length, from 5 ft. to 8 ft. in girth, and 10 ft. in circumference. Musk is taken from the glands of the jaw, which is very fine if well prepared and separated from the flesh, otherwise it will give a very bad smell.

In Scinde these huge reptiles are preserved and protected by some of the native religious fanatics, but we learn from Kurrachee that the authorities have intimated to the Faqueers who own the crocodiles at Muggur Peer, that they will be punished with a heavy fine, and be made to support the people who may be maimed, or the families of those who may be killed, by the animals whose guardianship they claim.

In Siam the crocodile attains a length of 25 ft., with a voracity proportioned to its size. Its flesh is sold for food in the markets and bazaars. Pallegoix ("Siam," vol. i., p. 174) says:—"Un jour je vis plus de cinquante crocodiles, petits et grands, attachés aux colonnes de leurs maisons. Ils vendent la chair comme on vendrait de la chair de porc, mais à bien meilleur marché."

The flesh of the Nile crocodile (*Crocodilus niloticus*) is eaten by the negroes, but it has a musky smell. The skins of this and of the Ganges crocodile (*Gavialis gangeticus*) are now used in commerce for tanning.

Crocodiles are very abundant in many parts of Africa. They are found in nearly all the rivers east of the Umzimvoobo in South Africa, and swarm especially in the waters running into Lake N'gami.

The name of crocodile is so often misapplied that it is difficult to correct it, but the crocodile has not been found in Australia, the alligator being the characteristic reptile there.

The flesh of the alligator is said to be white and delicate, resembling veal. It was a favourite dish among the Port Essington settlers, and among the seamen employed in the surveys of the northern coasts and rivers of Australia. It is, however, believed to have a strong liking for human flesh when that delicacy can safely be obtained.

Leichhardt, in his journey to Port Essington, often met with alligators, but it was not until recently that their existence in the north of Australia became, as it were, familiar to the public. Two of these alligators were recently brought to Sydney in the steamers from Rockhampton. The largest was nearly 12 ft. long, and about 5 ft. in circumference, with ponderous jaws, and altogether a most formidable-looking animal. It was a female, captured about seven miles from Rockhampton, on the Fitzroy river, by some fishermen; it was first caught in a net, but, as it was found impossible to get it alive, it was shot twice in the head with balls from a Minie rifle. On being opened a large quantity of bones of birds, wallaby, and stones, with a lot of congealed blood, were found in the stomach, which led to the belief that it had recently devoured some large animal. She had also 180 eggs, about the size of those of a hen, but without the shell. The back is protected by regular transverse rows of bony plates, raised into keel-shaped ridges, of which there are no less than 280, reaching to the extremity of the tail. The legs are covered with scales like a large fish. The smaller one was shot at Gamba. The blacks are said to be very frightened of these creatures.

LACERTILIA.—Lizards are eaten by the Maoris in New Zealand, and the giant *Cyclodus* is prized by the Australian natives as an article of food. Lizards are dried and sent in packages to be used by the Chinese physicians in their practice.

Lizard leather for gaiters was shown at the Philadelphia Exhibition, in 1876, from the province of Santiago del Estero, in the Argentine Republic.

The meat of the *Amblyrhyncus subcristatus*, Mr. Darwin tells us, when cooked is white, and by those whose stomachs rise above all prejudices it is relished as very good food. Humboldt has remarked that in inter-tropical South America all lizards which inhabit dry regions are estimated delicacies for the table. The eggs of these animals, which are numerous, large and oval, are esteemed by the inhabitants of the Galipagos Islands as food.

Many of the lizard race, as the *Iguana delicatissima*, have long held and still maintain a high rank as articles of luxury for the table; and the flesh and eggs of the teguixin, a larger species of Brazil and other parts of South America, are eaten.

The ugly looking large tree lizard called the iguana, which is like an alligator in miniature, is certainly not very attractive in appearance, and yet by most persons in tropical countries its flesh is highly esteemed, being reckoned as delicate as chicken, and but little inferior to turtle in flavour. The eggs, which are somewhat smaller than those of the domestic pigeon, are pronounced by Sir Robert Schomburgh and others to be delicious. These are deserving the attention of gourmands. One of these lizards will sometimes contain as many as fourscore eggs, about the size of a pigeon's egg, but with soft shells, which, when boiled, are like marrow.

The incessant destruction of the iguanas, for the sake of their flesh, has rendered them very scarce, if not altogether extinct, in localities where they were once abundant. They were formerly so common on the Bahamas islands, that Catesby tells us they furnished a great part of the subsistence of the inhabitants. They used to put them into the holds of the sloops and carry them alive for sale to Carolina, or salt and barrel them up for the use of their families at home. Browne, in his "Natural History of Jamaica," says, "The flesh of this creature is liked by many people, and frequently served up in fricassees, at their tables, in which state it is often preferred to the best fowls."

In Costa Rica, the large iguanas attain the size of small crocodiles, and form a game which the people of the country highly prize. Although often roasted, a frequent native mode is to boil them, taking out the fat, which is melted and clarified, and put into a calabash or dish, into which they drop the flesh of the iguana as they eat it. The iguana and monitor (*Regenia albogularis*) are sometimes employed as food at the Cape Colony, but their flesh, though white, is there thought to be dry and insipid. The skin of the iguana has been tanned in India.

It was long before the Spaniards could conquer their repugnance to the iguana, the favourite delicacy of the Indians, but which the former had regarded with disgust as a species of serpent. But they found it to be highly palatable and delicate, and from that time forward, the iguana was held in repute among Spanish epicures. The story is thus related by Peter Martyn:—"These serpentes are lyke unto crocodiles, saving in bygness; they call them guanas. Unto that day none of owre men durste adventure to taste them, by reason of theyre horrible deformitie and lothsomnes. Yet the Adelantado being entysed by the pleasantnes of the king's sister Anacaona, determined to taste the serpentes. But then he felte the flesh thereof to be so delycate to his tongue, and to amayze without al feare. The which theyre companions perceiving, were not behynde hym in greedynesse: insomuche that they had now none other talke than of the sweetnesse of these serpentes, which they affirm to be of more pleasant taste than eyther our phesantes or partriches."

We come now to the OPHIDIANS. Snakes and serpents one would suppose to be even more repulsive and objectionable as food than alligators and lizards, but tastes differ, and we are told of an innkeeper in some tropical country, who used to inquire of his guests which they would have served, land eels or water eels. Snakes are frequently, however, eaten by civilised and savage man, but not from choice. Mr. Frank Buckland tells us he once eat a piece of a boa-constrictor; it tasted, he says, like veal, the flesh being exceedingly white and firm. A narrative in the "Penny Magazine" describes a supper off fried rattlesnake, which was served up under the name of "Musical Jack." The flesh of serpents was held in high repute by the ancients medicinally, and, when properly prepared, seems to have been a very agreeable article of food, corresponding with the turtle soup of the present day. Vipers are much used on the Continent, whether for food or for medicine, however, I cannot tell. The Italians, however, regale themselves with a jelly made of stewed vipers.

McFarlane, in his "Southern Italy" says:—"Although no Roman or Neapolitan peasant will eat of a tame goose, I have seen great black snakes fried and eaten both in Calabria and Sicily to this day. Celsus recommends vipers as wholesome and luscious; in China they are salted and pickled. The lizards of the American continent are a most delicate dish, and not long since the leguana of the Antilles was brought in large numbers to South Carolina. At home they are raised and fattened upon chicory and rice. Snakes also find a ready market in Eastern countries. The giant of Java, well nigh ten feet long, and of the thickness of a man's arm, infests the pepper plantations, and its venom is fatal; still it is caught and eaten with relish. The huge boa-constrictor is said to furnish an exceedingly fat meat, and the negroes of its native country prefer it to the daintiest food of the white man. The anaconda of Brazil supplies the table of the poor, though the Portuguese only use the rich fat it contains. The natives of South America eat almost all snakes, and the far West has taught many a fastidious palate from over the sea to relish, with the red Indian, the fatal rattlesnake."

Kaempfer tells us that snakes are eaten in Japan, and Anderson states that the Battus of Sumali in Africa eat snakes and alligators.

The flesh and skin of several serpents is employed as Chinese medicine, care being taken to cut off the head and tail, where it is supposed the poison accumulates. The skin of a poisonous serpent, white with black spots, is considered efficacious in rheumatism, leprosy, and paralysis. A species of adder, eight or ten feet long, is eaten by the people, although it is believed to be rather poisonous. A species of serpent from one to three feet long, is caught, and after being gutted and washed, is made into a circle with bamboo pins and dried on a slow fire. It enters into medicine.

The *San Francisco Bulletin* remarks:—"The ingredients of a witch's cauldron, as described by the poet, could not have been more repulsively disgusting than are the articles and compounds shipped to the Chinese physicians of this city from their native country and used as medicines here. There seems to be just at the present time an extra demand for a venomous serpent closely resembling the rattlesnake, of which hundreds are received constantly. A Custom-house official brought a specimen of these cheerful-looking creatures to this office yesterday—a coiled snake of about four feet long, fanged, and with hideous head-scales like a crest. How these animals are taken by patients of Chinese doctors is not known. One would be a fair dose if disguised in a coating of sugar. They may be taken in sections three times a day, as they are desiccated, or they may be boiled down or pulverised, and taken in powders or rolled into pills."

Bonnets made of the skin of the cobra capella were shown at the Paris Exhibition of 1867 by Mrs. Gamble, of Fort Beaufort, Cape Colony, and boots made of snake skins from British Guiana. The skin of the boa (*Python reticulatus*, Schneider), is used for drum-heads, &c., by the Siamese. Fifty skins of the anaconda snake were tanned in 1871 by Schayer Brothers, at Boston, United States, for boot-leather. The largest of the skins was 40 feet in length. The tanning process was similar to that employed in the manufacture of alligator leather. The product being a highly finished quality of leather, glossy, mottled, pliable, and from the appearance of the grain, exceedingly durable. The skins of the doghead snakes are excellent for covering sword sheaths and instrument cases, for which purposes they are much used in the West Indies and in Africa.

The Commission of Inspection of the Permanent Exhibition of the Colonies at Paris, whose duty it is to find a commercial and industrial use for products of all kinds of those colonies, has often in its reports touched upon the constant multiplication of the serpents. Not being able to offer to the Indians and Negroes a reward sufficient to encourage them to destroy these reptiles, the commission looked for an industrial use of the serpent skins, in order to give them a commercial value which would encourage and interest the hunters.

After several ineffectual attempts, the skins are now as well prepared as calf or sheep skins, of which they have the softness and the durability.

In the Colonial Museum, Paris, is a case of skins of the boa, python, &c., tanned and prepared in various ways, and an assortment of various articles made of serpent skins, such as albums, portfolios, purses, canes, whips, game bags, cartridge boxes, shoes, &c.

Among the Amphibians we have frogs and the salamander utilised. Frogs are eaten in many countries, not only in France and the United States, but also in South America, China, and the Indian Archipelago. The species most esteemed is the green frog, or *Rana esculenta*, but the natives of Australia eat the common golden tree frog (*Hyla aurea*). Frogs are considered an excellent good dish by some in Brazil. *Rana halcina*, (Kalm) is eaten in Guatemala. In other parts of South America the flesh of the Surinam toad is eaten. In the Antilles bull frogs are reared for the table, and the hind legs are said to afford excellent eating.

The salamander (*Salamandra maculata*, Lour) is in high repute in China as an aphrodisiac, and is also prescribed against epilepsy. The old Mexicans loved the speckled salamander, and ate it with capsicum, or Spanish pepper; the Spaniards learned the odd fashion, and, as late as the sixteenth century, the ugly creature was brought to their markets and roasted for the table.

ON THE ARCTIC COAL BROUGHT HOME BY THE LATE EXPEDITION.*

By T. Wills, F.C.S.

It will be remembered that one of the results obtained by the late Arctic expedition was the discovery of a seam of coal in the far north, near to the winter quarters of H.M.S. *Discovery*. This ship, the second ship of the expedition, wintered in a bay on the west side of Robeson Channel, lat. 81° 44′ N., long. 65° 3′ W., this bay being now known as Discovery Bay. It was two miles from this place, in Grant Land, that the coal was found, the naturalist of H.M.S. *Discovery*, Mr. Hall, and the Rev. C. Hodson, chaplain, first observing it when returning to the ship in the course of a day's walk on the 21st of July, 1876. I have obtained some of the coal for analysis, and Dr. Coppinger, staff surgeon, R.N., also lately of the same ship, has been good enough to furnish me with a few particulars concerning it.

The coal occurs in the side of a narrow mountain gorge, and a photograph taken on the spot represents the outcrop of the seam on the north-west side of the gorge as viewed obliquely from its bed close to the opposite wall. The coal appeared in the form of a slight saddleback, or perhaps more correctly, a lenticular bed, thickest in the centre, and becoming smaller towards each end. The thickness of the seam at the deepest visible portion was 25 feet, and its visible length 250 yards; neither the bottom of the seam nor the underlying strata were visible at any place; the height from the top of the coal seam to the surface of the ground above the gorge was 30 feet. Overlying the coal was a very friable carbonaceous shale, containing, as Dr. Coppinger remarks, impressions of miocene plants; above this shale was a hard fissile red clay-stone, similar to the red miocene rock of the Disco coal beds, but sterile. The opposite side of the gorge to that in which the coal occurred, consisted almost entirely of a carbonaceous shale, containing numerous impressions of miocene plants, especially the "Sequoia;" the inclination of the coal seam was 10° to N.E. by E. The seam is almost uniform in character, and is very free from clayey veins. The prevailing rock of the surrounding district is a shingly clay-stone of very irregular arrangement, but mainly dipping to the westward, and, so far as could be ascertained, devoid of fossils. The vegetation, considering the latitude, was luxuriant, comprising no less than sixty species of plants, the orders principally represented being Saxifraga, Caryophyllia, Ranunculosæ, &c., &c. The gorge, in the side of which the coal occurs, although forming the course of a stream, appeared, from the nature of the cliffs on either side, to have been formed by a sudden and forcible disruption, giving rise to a fault in the coal seam, which was tilted up into view on the north-west side of the gorge, whereas on the south-east side only the carbonaceous shale was to be found. Nothing, so far as can be ascertained, was known of this coal previously. During the previous autumn (1875) Mr. Hart and Dr. Coppinger had discovered some pieces of lignite in a valley some 10 miles to the westward of the coal district. Although this lignite was supposed to have drifted, its source was never discovered. Coal has been brought home by previous expeditions from high latitudes, but not from so far north as this point. Coal has been obtained from Melville Island, 76° N., and Sir E. Belcher brought home specimens of coal, fossil wood, and shells belonging to carboniferous types from Albert Island, lat. 78° N. The Disco coal beds have also been known for a long time.

On obtaining the sample of coal I was prepared to find it to be a lignite, as cretaceous or tertiary brown coals do occur in these northern latitudes, and more especially as the impressions of miocene plants in the overlying strata seem to indicate a more recent period than the true carboniferous; but, on examination, it turns out that this is not the case, for this coal, in appearance and from analysis, cannot be distinguished from a bituminous coal of exceedingly good quality belonging to the true carboniferous period. I understand, however, from recent information, that miocene plants have been discovered in the strata underlying the coal, in which case there can be little doubt that it is a miocene coal, although differing so greatly from most specimens of such coal. In Switzerland and Germany there occur certain specimens of miocene coal of this kind, which in character and composition approach very nearly to the nature of carboniferous coals. In the specimen I examined, the microscope failed to give any evidence regarding the period of the coal's formation. The coal has a bright, shiny appearance, looking somewhat of a pitchy character; it is very brittle, but possesses a slight cleavage, having sometimes a conchoidal fracture. When finely powdered it is of a brown colour, which is the case with most bituminous coals; here and there small particles of iron pyrites were observable.

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* Paper read in Section B, British Association, Plymouth.

The following is the result of several analyses:—

The coal was air dried when received. Specific gravity, 1·29.

Moisture	2·38
Ash	6·21
Sulphur	·96
Carbon	76·95
Hydrogen	5·43
Oxygen and Nitrogen } By difference	8·07
	100·00

As will be seen from these figures, the coal is of a very good quality, and is very much of the same character as the coal from some English coal-fields. The following is the result, given by Dr. Percy, of the analysis of a mixture of 13 different seams from Chesterfield, Derbyshire, and the two sets of figures are fairly parallel:—

Moisture	2·32
Ash	5·82
Sulphur	1·61
Carbon	77·12
Hydrogen	5·05
Oxygen and Nitrogen } By difference	8·08
	100·00

The Arctic coal gives about 65 per cent. of coke, which exhibits a very slight amount of caking. The ash is white and bulky, and contains silica and alumina with a little free lime, present no doubt in the coal as carbonate, also a very small quantity of iron.

As the coal can be obtained by the simple process of quarrying, I asked Dr. Coppinger if it would be possible for any future expeditions to utilise it; his reply was that certainly the coal might be so used. The distance to the nearest part of the coast is about one mile, distance to Discovery Bay two miles. For various reasons it would not be advisable for any vessels to come nearer to the coal district than Discovery Bay, and in such case the coal might be quarried out into convenient heaps during the summer months (July and August), ready to be dragged down to the ships on large specially constructed sledges as soon in the autumn as sufficient snow had fallen to afford a good surface for the sledges. If at any time ballooning is resorted to as a means of furthering Arctic exploration, this coal could advantageously be utilised for the manufacture of coal gas, an apparatus for the production of which could easily be carried out and fitted up on the spot.

NATIONAL TRAINING SCHOOL FOR COOKERY.

The following letter was lately addressed by the lady superintendent of the school, Mrs. C. Clarke, to the Editor of the *Standard*. It gives an account of the present point of organisation which the school has reached, and was written in answer to some remarks which were published in the *Standard*:—

"The article is written clearly not in a spirit of animosity, but there are some mistakes as to facts. I refer especially to the remarks on the training and employment of teachers, as coming directly under my own supervision. A student has hitherto been admitted into the school to train for a teacher, either on the payment of £12 12s. or on the nomination of the subscribers; the time occupied in such training has been three months. During that time the student is expected to conform to the following rules:—

Rules for Teachers in Training.

1. The teachers in training (during the first six weeks) must be always in their places in their respective kitchens by ten minutes to ten a.m. and ten minutes to two p.m.

2. The teachers in training (during their last six weeks) must always be in their places in their respective kitchens at half-past nine a.m. and half-past one p.m., to get together their utensils, to receive their materials from the heads of their respective kitchens, and to get ready for their pupils to begin at ten a.m. and two p.m.

3. No teacher in training is to absent herself without the express permission of the lady superintendent.

4. The work of each teacher is written out; they are expected to make themselves acquainted with the recipes they have to teach; they should write out a list of the materials and utensils they will require, and have all in readiness before the lesson begins. In the demonstration kitchen everything required should be on or under the counter a quarter of an hour before the lesson begins.

5. In any difficulty the teachers are advised to ask the head of the kitchen for the time being, not one of their fellow teachers; and any causes of complaint should be preferred to the lady superintendent.

6. Teachers are expected implicitly to follow the recipes and the rules for demonstrations.

7. Teachers are to ask the head of the kitchen for what they require, and not to help themselves.

8. Any infraction of the rules is to be reported to the lady superintendent by the teacher in charge of the kitchen, and a proportionate number of marks will be taken off the diplomas.

"These rules have been framed from time to time, as the course for training teachers developed and the need for rules arose. It should be remembered that the National Training School for Cookery is the first school of its kind ever started, and that every step of the way it has come has had to be originated and worked out with great care and patience. No student has ever been dismissed for infraction of the rules, and so such dismissal ever could take place without the sanction of the committee, and then only for grave misconduct. We have found by experience that our teachers cannot give more than twelve lessons a week of two hours each lesson, to do the work thoroughly and without over fatigue; therefore they are not allowed to accept any other engagement without written permission from the committee, and in all cases their hours for work are limited. The staff teachers receive £2 a week all the year round, and their dinner at the school while employed in London, and when sent to reside out of London they receive a further sum of 30s. a week for board and lodging, and all their travelling expenses; three months' notice on either side terminates the engagement. When our staff teachers are all employed we take on a few extra teachers as improvers, at £1 a week, as this fits them to fill good appointments in the provinces, when they offer. These engagements are terminable by a week's notice on either side. When towns employ our staff teachers we charge £5 a week for their services, out of which the teacher receives £3 10s., leaving 30s. profit to the school, in return for which the school is bound, should the teacher fall ill or not give satisfaction, to supply her place; and for eight weeks in the year the teacher receives £2 a week, though she is on leave for holidays. It is only for short terms of engagements that teachers have received as much as £7 a week. Every one of our staff teachers has at some time or other had offers from towns to leave the staff and go for several weeks or months, at a higher rate of pay, but in every case the teachers have preferred the certainty of £104 a year to short engagements at higher pay. We encourage towns to apply to us for teachers, because, though the teacher may hold our diploma, we cannot be held responsible for her shortcomings unless she is under our rule; also, we are anxious to have work to give the students who have trained with us, and who turn out good teachers; while towns, by applying to us for teachers, avoid the expense and delay of training, and the risk of having selected for training a person who fails in the end to make a good teacher.

"Did time and space permit, the other less important points in your article could be as fully and, I venture to hope, as satisfactorily answered as those I have now gone into. The National Training School for Cookery is now closed for summer holidays; when it re-opens on the 1st of October the training for teachers will be considerably extended and improved. We have always courted publicity as to all our arrangements and system of working, and shall be happy to give any person interested in our work the fullest information on all these matters. The object with which the school was started by the committee was the improvement of cookery among the working-classes, and the consequent improvement in the health and happiness of the home life of the artisans, for with simple food, properly prepared, the temptation to drink sinks into insignificance. I hope that in fairness to the work we have already done, and to help forward the work we still hope to accomplish, you will find space in your valuable and much-read paper for this statement of facts."

EDUCATIONAL CONGRESS AND EXHIBITION IN BELGIUM.

There has existed in Belgium for some years an association of *instituteurs*, that is to say, teachers in the elementary schools of the State, which now numbers 1,500 members. It is customary at this season of the year to hold a Congress in one of the chief towns of the nine provinces. This year Mons, the chief town of the province of Hainault, was selected for the purpose, where there are, perhaps, more schools in proportion than in any other town. Additional interest was given by the fact that the new normal school, the most complete in the kingdom for the training of teachers in elementary schools, was opened during the present year. An exhibition of school furniture and educational appliances was also held in connection with the Congress.

The Belgian Society had issued invitations, to teachers both in France and Holland, so that as many as 1,500 teachers were received by the municipal authorities of Mons, on 9th inst. The deliberations began in the theatre on the following day, the provincial inspector being present on the part of the Government, when the members separated into two sections, French and Flemish. The French section expressed an opinion that no child under six years of age should be admitted to the elementary schools, but that *kinder-gartens* should be established throughout the kingdom. The Flemish section approved of the teaching of boys and girls together in the elementary schools, and recommended that the same instruction should be given in both cases, but that certain branches suitable to either should be added. At the general meeting on the following day the opinion was expressed that elementary instruction should be gratuitous to those who applied for it. As to the question what is the best method of examination—competition or inspections often repeated—for ascertaining the value of a school as regards the progress made by the pupils, the Congress renewed the wish expressed at the Antwerp Congress, that a certificate of elementary study should be instituted, only to be accorded to pupils at least 18 years old.

The members were invited by M. Warocqué to visit his collieries at Mariemont and Bascoup, where the coal is brought from the working face underground to the screening sheds on the surface entirely by mechanical means. The visitors were particularly interested in the various schools attached to the collieries, in one of which, a trade school attended by 600 workers, the instruction is given by the engineers of the establishment. Nothing, indeed, is omitted that will aid in the intellectual improvement of the workman and thus enable him to turn his natural ability to the best account. At a *fête* given in the Wauxhall, Mons, a chorus was capitally sung by little boys and girls, pupils of elementary communal schools; and instrumental music was performed by collier lads of 17 to 20 years of age, pupils of the school of music attached to the Colliery of Hornu.

The exhibition held in the Communal School was restricted to furniture and appliances used in the elementary schools of the kingdom. There were desks with various arrangements to admit of easy access; in those for girls a leaf turns up, and has on its under side a cushion to which needlework may be pinned. Some blackboards by Callewaerts, of Brussels, were noticeable for their dead and slightly rough finish which gave an effective appearance to the chalkmarks. Manceaux, of Mons, showed some cheap maps and school books. Many globes, as well as maps, were in relief, and others were made of slate with only the outline traced, for the details to be filled in by the pupil. The anatomical models were well finished; while these and the mineralogical cases, albums of dried plants, and "geocyclical" machines or orreries, gave the idea that they were intended for a more advanced class of pupils, until it was explained that the *méthode intuitive* (answering to our "object lessons") is largely in use in Belgium, to such an extent that an average pupil of the *école primaire* can even name and point out the main bones of a skeleton.

This elementary instruction is begun at the age of 12 or 13; it is not compulsory, but is gratuitous to those who give proof of inability to pay the fees. Besides science, which is entered upon at once by means of the object lessons, the course consists of the two languages, French and Flemish; reading, writing, and arithmetic; the national history; geography, both of the country and general, and drawing.

The new Normal School in the Boulevard Jean d'Avesnes, for the training of elementary teachers, was inspected with much interest. The course of instruction extends over three years, and the fees, not very heavy, diminish as each successive examination is passed. Failure to pass an examination, except through illness or other similar cause, obliges the student to leave. The arrangements for study and recreation are elaborate, while hygiene is not neglected. A portion of the building is set apart as an elementary school, where students in their third and last year give lessons, under the superintendence and direction of the professors.

THE DIRECT PROCESS IN THE PRODUCTION OF IRON AND STEEL.*

In mixing comparatively rich iron ore in powder, with about twenty-five per cent. of its weight of pounded coal, and in exposing this mixture for some hours to the heat of a common stove or of a smith's fire, metallic iron is formed, which, on being heated to the welding point, on the same smith's hearth, may be forged into a horseshoe of excellent quality. The admixture with the ore of some fluxing materials, such as lime or clay, will, in most cases, be of advantage to rid the iron of adherent slag.

The simplicity of this process is such that it naturally preceded the elaborate processes now in use for the production of iron and steel upon a gigantic scale, nor can it surprise us to find that attempts have been made from time to time, down to the present day, to revert to the ancient and more simple method. It can be shown that iron produced by direct process is almost chemically pure, although the ores and reducing agent employed may have contained a considerable per-centage of phosphorus, sulphur, and silicon, and that, if freed from its adherent slag, it furnishes a material superior in quality and commercial value to the ordinary iron of commerce.

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* "Some further remarks regarding the Production of Iron and Steel by Direct Process," paper read at the Newcastle meeting of the Iron and Steel Institute, by C. William Siemens, D.C.L., F.R.S., President.

The practical objections to the direct process, as practised in former days, and as still used to a limited extent in the United States of America and in some European countries, are that—

1. Very rich ores only are applicable, of which about one-half is converted into iron, the remainder being lost in forming slag.

2. The fuel used is charcoal, of which between three and four tons are used in producing one ton of hammered blooms.

3. Expenditure of labour is great, being at the rate of 33 men, working 12 hours, in producing one ton of metal (see Percy). Iron produced by direct process in the Catalan forge is, therefore, expensive iron, and could not compete with iron produced by modern processes except for special purposes, such as furnishing melting material for the tool steel melter.

But, it may be asked, could the advantages of the direct process not be combined with those of modern appliances for the production of pure and intense heats, and for dealing with materials in large masses, without expenditure of manual labour, and cannot chemistry help us to larger yields and the faculty of using comparatively poor and impure ores?

A careful consideration of these questions led me to the conclusion, some years ago, that here was a promising field for the experimental metallurgist, and that I possessed some advantage over others in the use of the regenerative gas furnace as a means of producing the requisite quantity of heat without the use of charcoal and blowing apparatus. I engaged, accordingly, upon a series of experimental researches at my sample steel works, at Birmingham, and, in 1873, I had the honour of submitting the first fruits of these inquiries to the Iron and Steel Institute, in a paper entitled "On the Manufacture of Iron and Steel by Direct Process." Encouraged by the results I had then obtained, I ventured with some others upon some larger applications, the principal one of which has been one at Towcester, in Northamptonshire.

Viewed by the light of present experience, it would have been wiser to have fixed upon another locality, with fuel, skilled labour, and better ores within easy reach; but, in extenuation of the error committed, it may be urged that the site was fixed by force of circumstances rather than by selection, the chief temptation being an ample supply of small Northamptonshire ore at a very low cost. It was, however, soon discovered that this ore, although capable of producing iron of good quality, was too poor and irregular in quality to yield commercial results unless it was mixed with an equal weight of rich ore, such as potter mine, Spanish ore, or roll-scale, all of which, as well as the fuel, are expensive at Towcester, owing to high rates of carriage. It is in consequence of these untoward circumstances that the works at Towcester have not been completed by the addition of rolling mills, the intention being to transfer the special machinery ultimately to existing ironworks when the process has been sufficiently matured for that purpose.

The Towcester Works were visited, in the autumn of last year, by two eminent metallurgists, Professors von Tunner, of Leoban, and Akermann, of Sweden, who have published the results of their observations in separate reports.* The results noted down by Mr. von Tunner are referred to by our past-president, Mr. I. Lowthian Bell, in his paper on the "Separation of Carbon, &c.," which was read in March last, and will be discussed at the Newcastle meeting. The criticisms contained in these publications are conceived in the fairest possible spirit, and form indeed a most valuable record of the progress achieved up to that time, but they furnish me with an inducement to break silence sooner than I had intended, regarding the further progress which has been effected, and the conclusions I am disposed to draw from past experience regarding the direct process of the future.

The leading idea which guided me in these was to operate upon such mixtures of ores, fluxes, and reducing agents, as would, under the influence of intense heat, resolve themselves forthwith into metallic iron and a fluid cinder, differing essentially from the methods pursued by Chenat, Guilt, Blair, and others, who prepare spongy metal in the first place by a slow process, which is condensed into malleable iron or steel by after-processes. but assimilating to some extent to the process first proposed by Mr. William Clay. In my paper of 1873 I described two methods of effecting my purpose, the one by means of a stationary, and the other by means of a rotative furnace chamber, the former being applicable chiefly where comparatively rich ores are available, and the latter for such poorer ores as occur near Towcester.

At the Towcester Works three rotative furnaces have been erected, two of them with working drums 7 ft. in diameter and 9 ft. in length, and the third of smaller dimensions. The gas flame both enters and passes away from the back end of the furnace, leaving the front end available for the furnace door, which is stationary. The ends of the furnace-chamber are lined with Bauxite bricks, and the circumference with ferrous oxides, resulting from a mixture of furnace cinder enriched with roll scale or calcined blackband in lumps. About 30 cwt. of ore, mixed with about 9 cwt. of small coal, having been charged into the furnace, it is made to rotate slowly for about two and a half hours, by which time the reduction of the metal should be completed, and a fluxed slag be formed of the earthy constituents containing a considerable per-centage of ferrous oxide. The slag having been tapped, the heat of the furnace and the speed of rotation are increased to facilitate the formation of balls, which are in due course taken and treated in the manner to be presently described.

These balls contain on an average seventy per cent. metallic iron, and thirty per cent. of cinder, and, upon careful analysis, it is found that the particles of iron, if entirely separated from the slag, are pure metal, although the slag may contain as much as six per cent. and more of phosphoric acid, and from one to two per cent. of sulphur. In shingling those balls in the usual manner the bulk of the cinder is removed, but a sufficient residue remains to impart to the fracture a dark appearance without a sign of crystalline fracture. The metal shows, in being worked, what appears to be red shortness, but what should be termed slag shortness. In repiling and reheating this iron several times this defective appearance is gradually removed, and crystalline iron of great purity and toughness is produced; but a more ready mode of treatment was suggested by Mr. Samuel Lloyd, one of my co-directors in the Towcester Company, in reverting to the ancient refinery or charcoal hearth. The balls, as they came from the rotator, are placed under the shingling hammer, and beaten out into flat cakes not exceeding an inch in thickness. These are cut by shears into pieces of suitable size, and formed into blooms of about 2 cwt. each, which are consolidated under a shingling hammer and rolled into bars.

The bars have been sold in Staffordshire and Sheffield at prices varying from £7 to £9 per ton, being deemed equal to Swedish bar as regards toughness and purity.

It may therefore be asserted, as a matter of fact, that iron and steel of very high quality may be produced from ores not superior to Cleveland ores by direct process, but the question remains at what cost this conversion can be effected. The experimental works at Towcester are, unfortunately, not sufficiently complete to furnish more than the elements upon which the question of cost may be determined, the principle reasons being that the one reheating furnace and a 30 cwt. hammer at the works are not sufficient to deal with the iron produced by the three rotators, that the iron has to be finished at a rolling-mill elsewhere, and that transports weigh heavily upon the cost of production. The principal factor in the calculation of cost is unquestionably the rotator. [A table furnishes the working result of eighteen consecutive charges as taken from the charge-book.] The mixture of ore consisted, for each charge, of 12 cwt. of Towcester ore (containing about 38 per cent. metallic iron) mixed with 8 cwt. of calcined Great Fenton ore, 1 cwt. of tap cinder, 1 cwt. of limestone, and 6½ cwt. of small coal. The time occupied for each charge was three hours fifty-seven minutes, or, say four hours, and the yield of hammered blooms was on an average 6 cwt. 2 qrs. 13 lbs., whereas the metal contained in each charge amounted (by estimate) to 9 cwt., showing a loss of 25 per cent. This loss is, however, partially recovered in using a portion of the cinder again in succeeding charges, but the portion of cinder that may be used again with impunity depends upon the amount of impurities, namely, of phosphorus, sulphur, and alumina contained in the ore. The coal used in the producers amounted to two tons per ton of hammered blooms produced, and in pricing the materials used, and labour engaged upon the work, the table—prepared by the manager at the works—gives £3 8s. as the cost per ton of hammered blooms. To this must be added for repairs and general expenses, and the cost of rolling the hammered blooms into bars, which in the case of Towcester practice are very heavy, but of which an experienced iron-master would form his own estimate. The cost of working the metal in the hollow fires is also not included, and this may be taken to add from 25s. to 30s. to the ton. The refined iron so produced will, therefore, cost from £5 5s. to £5 10s. per ton.

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* Das Eisenhüttenwesen von L. Ritter von Tunner, Wien, 1870.

Other tables give the analysis of irons produced from various descriptions of ores, and Kirkaldy's tests of the mechanical properties of the iron; but it should be understood that these tests were taken with a view rather to test various modes of manufacture than to show high results. Only a small proportion of the samples had been subjected to the refinery process, and the variable percentage of phosphorus may be taken really as indicative of the extent to which the cinder had been removed from the metal.

Another table gives the analysis of slags produced in the process. These are, no doubt, rich in iron, but it must be remembered that in the case of comparatively pure ore, they can be used almost entirely in succeeding charges, and that in the case of ores containing much sulphur and phosphorus, they are the recipients of those impurities—in the same way as the puddling cinder carries off the same impurities in the puddling furnace—and thus serve a useful end.

If rich ores, such as hematites, are available, it is more advantageous to use a stationary furnace, and to modify the process as follows:—

A mixture of pulverulent ore, mixed with a suitable proportion of fluxing materials and reducing agents, is prepared, and from four to five tons of it are charged from a charging platform into the heated chamber to the depth of some 12 to 15 inches. But, before charging the mixture, some coke dust or anthracite powder is spread over the bottom and sides of the chamber, to protect the silica lining of the same. The heat of the furnace is thereupon raised to a full welding heat, care being taken that the flame is as little oxidising as possible. The result is a powerful superficial action upon the mixture, or batch, causing simultaneous reduction of the ore and fusion of the earthy constituents. In the course of two hours a thick skin of malleable iron is formed all over the surface of the mixture, which, on being withdrawn by means of hooks, is consolidated and cleared of cinder under a hammer, and rolled out in the same heat into rough sheets or bars, to be cut up and finished in the refinery furnace or charcoal hearth. One skin being removed, the furnace is closed again, and in the course of an hour and a half another skin is formed, which, in its turn, is removed and shingled; and so on, until, after three or four removals, the furnace charge is nearly exhausted. A fresh charge is then added, and the same operation continued. Once every twelve hours the furnace should, however, be cleared entirely, and the furnace lining be repaired all round.

The shingled metal so produced forms an excellent melting material for the open-hearth or Siemens-Martin process; but if ores both rich and free from sulphur and phosphorus are used, together with roll and hammer scale, which forms an admirable admixture, I simplify the process still further in causing the fusion to take place in the reducing furnace.

The furnace having been charged with, say, five tons of batch, the heat is allowed to play on it for four or five hours, when about two tons of hematite pig-iron are charged upon the surface by preference in a heated condition. The pig metal, on melting, constitutes a bath on the surface of the thick metallic skin previously formed, and gradually dissolves it on the surface while it is forming afresh below, and in the course of from three to four hours the whole of the materials charged are rendered fluid, consisting of a metallic bath with a small percentage of carbon, covered with a glassy slag containing about 15 per cent. only of metallic iron. The carbon of the bath is thereupon brought down to the desired point of only about 1 per cent. of carbon, and spiegeleisen or ferro-manganese is added, and the metal tapped in the usual manner. By these means the direct process of making cast steel is carried to a further limit than I have been able to accomplish before, and no difficulty has presented itself in carrying it into effect. The steel so produced is equal in quality to that produced by the open hearth process as now practised. If light scrap, such as iron and steel turnings or sheerings, are available, these may be mixed with advantage with the batch to increase the yield of metal.

These are, in short, the more recent improvements in the direct process of producing an iron and steel which I have been able to effect, and which I should have been glad to lay before the Iron and Steel Institute in a more complete form than I am able to do at the present time.

GENERAL NOTES.

Patent-office Report.—The report of the Commissioners of Patents for the year 1876 has just been printed. It gives the usual statistics of patents applied for, granted, &c. The number of applications was 5,069, an excess over any former year; of these 1,702 have lapsed, leaving in force 3,367. The number of series of abridgments arranged in subjects is now 90. These all stop at 1866 now, but it is announced that the series will be continued in parts embracing periods of ten years. In the Designs Registry there were 9,239 ornamental designs registered and 286 useful. In the Trade-marks Registry 10,384 marks were lodged in 1876; of these 261 were registered during 1876, and 4,984 by the 31st July last. At Manchester 42,442 marks have been applied for as relating to cotton goods. The surplus income of the whole office for the year is £139,067, the total surplus since 1862 being £1,468,839. The receipts from the Patent-office were:—Stamp duties, £169,992; sales, £2,344; those from the Designs Registry were £4,738; and those from the Trade-marks Registry £8,295.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,299. VOL. XXV.

FRIDAY, OCTOBER 12, 1877.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

THE CONNEXION OF GREEK AND ROMAN ART WITH THE TEACHING OF THE CLASSICS.

By Sidney Colvin.

Slade Professor of Fine Art at Cambridge.

LECTURE II.

In the last lecture I tried to establish the point that the study of ancient art and archæology is, or ought to be, an essential part of classical education properly so called, and that although our own country is proud and justly proud of her classical scholars in philology and other branches of classical scholarship, yet she has not adequately carried on that branch of scholarship which consists in the study, comparison, and explanation of ancient monuments, side by side with that branch which consists of the study and comparison and explanation of ancient texts.

The two important points to which my last lecture was directed were these: first, that the study of the remains of ancient art and archæology, the remains of practical handiwork, gave life to the study of literature, and continually illustrated it and brought home with new force the beautiful stories of the ancient writers; and, secondly, how, independently of literature, and as a separate study, it cultivated valuable faculties, and required very careful and exact special qualities of its own. As an example, to illustrate both of these points, we chose two particular works; in literature, a very beautiful fragment of early religious Greek poetry, the Homeric hymn to Dionysus, and, as a work of art, a frieze very familiar to students of these things, the frieze on the Choragic monument of Lysicrates at Athens, which illustrates, in the way which sculpture thought proper to illustrate, the same subject. And we saw how Greek sculpture, like all true art, was not the literal illustration of poetry, but how it took the same theme and worked it out in a way of its own, and according to its own laws.

In pursuance of our subject, I mean to-day to try and bring home to you how the creations of Greek and Roman art are co-extensive with all provinces of the ancient life and mind. There is no phase of existence in Greece, or in the civilisation which Rome borrowed from Greece, which this study does not illustrate and illuminate; nothing which the ancient Greek, or, following him, the ancient Roman, did, or thought, or suffered, or desired, which has not found an embodiment in art—in the practical works of men's hands—as well as in the written records of their literature. That is only another way of saying what we said at starting, viz., that the essential key to the whole of the Greek genius is that which is known by the ugly word anthropomorphism, that spirit which considered all things alike—whether the external aspects of the world, or the forces of destiny, or those of the human spirit—under human lineaments, conceiving of everything that it is possible to conceive of at all in the likeness of a human being. That being the key to and essential character of the ancient genius, it naturally follows that those embodiments in the human form were so many conceptions of the mind, standing waiting ready to the hand, to be embodied in art. What we are considering to-day is the range and extent of the conceptions that are thus represented, personified—incarnated one may say, for they became as living, real human beings under the creative touch of ancient art—in sculpture, painting, and their subordinate arts. We are not to-day considering the art which is not imitative, which does not embody conceptions of the mind in definite human shape, and therefore architecture, for the present, we pass over. The study of ancient architecture, and of the way in which the genius of the Greeks showed itself in the proportions and in the plan of their buildings, especially in their temples—for the whole of the Greek architecture was concentrated on the temple—is one of the most interesting studies possible, and one which reveals to us the Greek mind in its most characteristic way, but does not for the present concern us.

Coming, then, to a short survey of the range of these subjects to which the Greek imagination, and, presently, Greek art, gave human lineaments, we shall speak both of those representative works of art which we know to have existed, from the fame they had, from descriptions and accounts handed down to us in books, and also of those, unhappily a much smaller number, which still remain. The greater part of those which we know from books have perished long ago; have been trailed off to Rome in the days of the Roman conquest, and have perished there, or have been rifled where they stood by subsequent barbarians.

Of course, in so vast a range of subjects as this, I cannot attempt to illustrate what I am saying with any completeness; but I have a few diagrams, which I have brought to-day and placed here, to illustrate one or two particular points which will arise in the course of our study. The investigation of these types and creations of ancient art is an investigation of two kinds. First, it inquires what creation—the work of art—represents; and next, how each particular type begins and grows, how it starts up in early times, and how we can follow it in the remains that have come down to us, growing, developing gradually from rude, primitive, archaic forms, down to the times of the highest Greek civilisation, when the embodiment is adequate and perfect; and again, when civilisation passes beyond its highest and begins to descend again, how the work of art also begins to go down, and how the consummate form passes into the over-ripe, and so into degeneracy and deterioration. That historical progress will not at all enter into our to-day's study. Our point is to see how the works of ancient handicraft and things produced in painting, sculpture, and a thousand subordinate ways cover the whole range of the ancient life and the ancient mind.

The embodiments which present themselves first to our consideration are those of the twelve great Olympian gods of Greece, gods whose origin and history it is in many cases hard to disentangle, but who by the time Greece was Greece, and Greek civilisation was at all developed, divided amongst them the whole empire of the world in the Greek imagination. You are aware how in these conceptions physical and moral powers are continually intermixed, how originally the sole idea embodied in any god was the physical idea, and how by degrees moral, intellectual, and political ideas became associated with them. And you remember, no doubt, who the twelve great Olympian gods of Greece were. First, the sovereign father of all, Zeus, the god in whom it is probable that originally the physical sky was personified. He holds in one hand the thunderbolt, the symbol of the sudden, destructive, astonishing, overwhelming powers of the sky, and his familiar attendant is an eagle, the eagle of course being in like manner a symbol of things that swoop down suddenly upon the earth from above. Zeus then, who came in the historic times of Greece to be the central father of all the gods, was originally, we suppose, a personification of certain particular powers of the sky. Next associated with him comes the wife of Zeus, Hera. Hera is the goddess of wedded womanhood, she is the sister and wife of Zeus, the deity who assists women in labour, the goddess of birth, the goddess of things especially belonging to women, and belonging to women especially in the relation of lawful married life.

Then, own brother to Zeus, co-equal with him, but a divinity almost purely physical, is Poseidon, the god of the sea. In him the powers of the ocean are incarnate, and, naturally, being a representation favourable to art, he suggests his own types and his own accompaniments. Then, keeping still in the order of genealogy, we have, co-equal in age with these, Demeter. The name of the goddess Demeter, shows that her original signification was purely symbolical. Her name means "mother earth." But presently there passed into the conception of this goddess all kinds of further moral and intellectual meanings—mother earth becomes the place from which life springs up and into which life goes down, and so Demeter becomes the goddess of the dead, and the goddess of death, in the sense in which the earth is the place into which all things go down and are lost. In this double sense she remains one of the great powers of the Greeks.

Then we come to the younger generation, to the children of Zeus. There is Athene, another goddess of the air, a goddess of light and brightness and of the luminous powers of the air. Into association with these physical properties there presently came ideas of intellectual light, of all human art and ingenuity and invention. The list is familiar to many of you, and there is no time to go through it all, of these twelve sovereign powers who divided between them, for the Greek, the empire of the world. They all, of course, had their temples, more or less famous, and their temple precincts, and each temple and each precinct had its images, and these were found all over Greece, and in every region of Greece.

In the beginning, Greek sculpture was essentially subordinate to Greek religion, and therefore had its home in the Greek temple. Sculpture arose from the desire to adorn, with the best perfection possible, the images of the gods. Presently, it developed itself, from thus first endeavouring to make the image of the god worthy of adoration, into other uses; there came to be three classes of sculpture all concentrated about with the temple. First, there was the god himself, the temple image properly so called. That was originally, in the early times of Greek art, a very rough, rude, wooden image, and retained a peculiar sanctity in connection with its original primitive character. Art was unwilling to change it; and even after the subordinate parts of temple sculpture had acquired something like freedom, the old sacred image remained the old sacred image still—a thing rudely cut out of wood, but decked with rich vestments and draperies. But in the course of time the sanctity especially attaching to these rude wooden primitive images passed away, and we find, as Greek art comes to maturity, that it produces generally for these central images of the temple things the most beautiful, the most ripe and mature, that it knows how to produce.

Then, besides the central image of the god—the object of worship in the temple—each temple and temple precinct had a vast number of dedicatory statues of its proper god—statues paid for and set up, that is to say, by private or public worshippers. Private persons or states desiring to propitiate the god in honour of some special occasion, would set up a pedestal, either within or without the temple, with a statue of the god under some special attribute, in thanksgiving for some particular protection or in propitiation of some particular evil. Therefore, following those most sacred statues, the special images set up in the temple for worship, you have the other class of statues, the dedicatory statues, set up not specially for worship, but simply in dedication to the gods either for thankoffering or for propitiation.

The third order of sculpture connected with the temple is that which is purely decorative, which springs from the impulse of art and the need of ornament and beauty alone. The principal parts of the temple which were adorned with sculpture for adornment's sake, were the frieze and the pediments. These enrichments were dictated, indeed, so far as concerned their subject, by the religion of the temple, and celebrated this or that deed or manifestation of the temple's god. Let us make a hasty survey of the most famous and important temples of some of the most famous and greatest gods of Greece, and from that we shall get some idea of the abundance and multitudinousness of these temples and their images, and of the sculptures, both the dedicatory and decorative, which enriched them.

To begin with Zeus, the great personification of the sky, the all-father of gods and men. The great central home of the worship of Zeus was in a place which is now very famous in our ears, in the valley of Olympia, in the western part of the Peloponnesus. From various circumstances, this valley of the River Alpheus, in the west of the Peloponnesus, had come to be the common theatre of Greece, the place where all men of Greek blood met once in four years for the great athletic contests, during the progress of which all warfare was suspended, and every Greek was for once the true brother of every other Greek. Zeus as the thunderer, the god of sudden celestial phenomena, of storms, rains, and atmospheric disturbances, was thought to have his particular residence in some mountains that protect this valley on the north. This great scene of athletic sports of all the Greeks, was also the great scene of the worship of Zeus. The sports were held under this god's especial patronage, and the two aspects of the festival—the religious and the athletic aspect—were inseparable. The great temple of Olympia was long famous, as not only the great centre of the common religious worship of Greece, but as the place most splendidly adorned by the greatest art of Greece. A new temple was raised and new ornaments added to the temple, in the most flourishing period of Grecian history in the 5th century B.C., the age of Pericles at Athens. We know from ancient accounts what the lineaments of the god were like, and what the adornments of the temple were. The image specially set up for worship in the temple was an instance in which all the old traditions—the traditions of rigidity and primitivenes—shad been utterly cast aside, in which the greatest genius of the greatest artists in the world had conspired to make the image the most splendid and consummate that could be conceived. This great image of gold and ivory is most minutely described to us by Pausanius, who tells us how it stood in the middle of the shrine, with a figure of victory in one hand, and with an eagle-surmounted sceptre in the other. Then we are given a long account of the various incredible enrichments in mythological subjects, which were wrought, in the same rich materials, upon the arms and the sides of the chair, or throne, upon which the god sat, upon the sandals of his feet, and upon every portion of the sacred image. This central and memorable statue of the Olympian Zeus has utterly and irrevocably perished, and there is no chance that the excavations now going on will bring to light one shred of its gold and ivory. The image, even if it had not been carried away by depredators, would have been long ago destroyed by neglect and barbarism. These elaborate statues of gold and ivory, put together with infinite art upon a matrix or framework of wood, required constant care; there were officers specially appointed to look after their maintenance. The statue had, in some instances, to be sprinkled with water, and, in some instances, to be oiled, to prevent all this elaborate fabric from springing. Now the only clue we have to the splendour of this Olympian Zeus are a few fragments of Greek art in which the type is repeated. There are certain coins in which we have a sitting figure with the sceptre, with the victory and the eagle, copied from the image of the Olympian Zeus. There are a few heads, like the one known as the Jupiter of Otricclai. Otherwise, the aspect of this chief work of Phidias is irrevocably lost to us, and we have to content ourselves with the accessory and comparatively unimportant parts of the ornaments of the temple. Besides this great central image of the god, honoured and worshipped at Olympus, a great many other statues of Zeus crowded the sacred grove which surrounded the temple. For one thing, almost every state in Greece, and almost every great private personage, who at one time or another wanted to propitiate the god in some special way, would set up here his own special statue; so that among the two thousand or more statues enumerated in the valley of the Alpheus by Pausanias, perhaps more than half were figures in various semblance of this one god Zeus. Whenever anybody was caught cheating at the Olympian games, whenever anybody violated the rules, he was fined, but the money was spent in the purchase of a statue; so that at the foot of that hill (Kronion), which was the natural grand stand of the Olympian games—and which you can see to this day—where all the people stood, there was a long row of statues of Zeus in bronze, arising entirely from these fines of people who had played false at the games. It is to be feared that immeasurably the majority of the Olympian statues, even of those which were not taken away to Rome in the days of the Roman conquest, have perished. Already the discoveries which have been made there have brought to light the pedestals of many of these statues exactly in the state in which they were when Pausanias saw them, but the statues themselves have disappeared. All the things which have in any abundance been discovered belong to the other, the third order of decorative sculpture, which I have spoken of, that which has its origin in the desire of enriching and adorning the temple. From their situation these sculptures of frieze and pediment were not exposed to robbery at the time, and have only come within reach since the destruction and downfall of the temple itself. It is quite certain, I think, that the most precious remains that will yet be found of Greek art will be—what the most precious remains that have hitherto been found are—remains of the same kind, remains, that is to say, not of the great central works of art, not of the images which stood in the temples, not even any great number of the dedicatory statues which stood round about the temples, but of friezes, of metopes, of groups set up in the pediments, which have lain buried, since the temple fell, in the soil where modern discovery has found them. We know very well what the subjects of the pediment sculptures, at the Olympian temple of Zeus, were. On the one side there was represented a race between Hippodainia, the daughter of the legendary king of the soil, and the invader Pelops. One pediment represented this race, and between the two groups there stood the figure of Zeus, the only Zeus we have yet recovered from this famous temple, a mutilated figure, not nearly so well carved as we had hoped. On the other side there was another famous scheme of sculpture, showing a very familiar subject, the fight between the Centaurs and the Lapithæ, when the Centaurs rushed on the women of the Lapithæ, at the marriage feast. A vast amount has been recovered from this pediment, including fragments of both the Centaurs and the women, amongst them ten heads, more or less complete. That is a single typical example of the proportion of what we can, at best, hope to recover of ancient art compared to what was there in the days of its glory.

Passing to the other gods and goddesses of the great Olympian group, there are some more celebrated in temples, and some less. There are only two or three of these gods who were especially associated with festivals and with forms of worship in which the whole of Greece participated on certain anniversaries. The Olympian festival, we have seen, was the festival of all others in which all the Greeks participated. Then the goddess of whom I have spoken, Demeter, the earth mother, had associated with her special rites in which also all the Greeks took part. This second Panhellenic festival was the festival of Demeter at Eleusis. Consequently, that great Eleusinian temple is renowned in all antiquity. What at present remains of it is, first, a few drums and capitals of columns, not belonging really to the great dome of the temple, but probably to later additions; over the whole site on which stood the body of the temple—stands now a modern Greek village, Lepsina. Fifty years ago, an Englishman thought he had found the famous central statue of the goddess at Eleusis. There was a great colossal figure, very much shattered, only a fragment of it above the soil, which this Englishman dug away with great labour and brought to England, and it now stands at Cambridge. But, such is the vanity of all hopes in these things, unless one goes into the study with the very fullest determination not to see in anything more than is really in it—such is the vanity of too sanguine anticipation in these things, that this reputed statue of the great goddess at Eleusis, which would have been one of the most sacred and memorable remains of Greek art possible to conceive, turns out to be no more than a mere architectural decoration, one of some great row of figures like Caryatides, a figure carrying a great basket on its head, and supporting, probably, the architrave of the building. Of that great temple, then, and that great goddess there remains, for the present, at least, until the village is removed and the soil uncovered, almost nothing. We have to seek for the remains which we do possess at other and less memorable sites. One of the most interesting of recent explorations was made on the site of the ancient Cnidus, on the coast of Asia Minor. There was found a kind of private chapel dedicated to these infernal deities—to those earth gods—Demeter and her daughter. This chapel was at the foot of a precipice which runs along just outside the old town of Cnidus, and straight up the precipice there were several niches cut in the rock, and the figure which had stood in one has been recovered, and you may see it now in the British Museum. We must esteem ourselves very lucky indeed when we can recover a type so near as that to the type of what actually proceeded from the Greek hands, of one of the Greek gods, although it is not one that is found at any famous and memorable shrine. There is another goddess (since we can by no means go through them all), whose name will long ago have occurred to you as one of the most celebrated of all, whose type is best known, and whose temples are most familiar, that is the goddess Athene, the especially Athenian goddess of wisdom, of light (physical and intellectual), of all kinds of clearness and wisdom. Where are we to go for the great central temple of the great goddess Athene? Of course. to Athens—to the Athenian Acropolis, and to the Parthenon, its chief temple. What remains of those images of the goddess Athene, which stood upon the Acropolis — either the great out-door image of Athene, the Champion, whose lance and helmet shone for miles over the Ægean as the mariner approached the city, or the gold and ivory image of Athene Parthenos, the virgin that presided within the temple named after it, the Parthenon? All that we have recovered or really know of that Athene of the Parthenon is almost immeasurably little. There is a little figure rudely carved in marble which corresponds to the description we have of her in the attitude and in the position of the shield. There are a few other fragments, and especially coins, upon which we can trace the type of what once this deity was. As to the decorative sculptures of that temple, you knew how they were, at the beginning of this century, brought away from Athens by Lord Elgin, and constitute the greatest treasure for all who wish to study Greek art, those Elgin marbles now in the British Museum. As you go along the great Elgin room, on the right hand side you will find a number of fragments which I dare say, at first sight, look very little indeed. Opposite where the so-called figures of the Fates are placed, there is a fragment of the body of a woman, just one-half of the chest with the two cross straps of the ægis. That is all that remains even of the subordinate ornamental figure of the goddess from the pediment of the Parthenon. That fragment is, for those who care for these things, one of the most sacred and memorable in the world. The remainder of the group from which it comes represents the contest which ended in giving Athene her patronage over the soil of Athens, the legendary contest between Athene and the sea-god Poseidon.

To pass from these great Olympian powers to the lesser powers of the Greek religion and mythology, their name is almost legion. They bewilder almost as much as they enchant our imagination by their very multitudinousness. There is no power of nature itself, and there is no power of the human mind or heart, which is not personified in this way. For instance, there are the powers of wine, of all fertile, inspiriting products of the soil, which were personified in Bacchus and his numerous group of satyrs, fawns, mænads, bassarids, and all the rest. Bacchus was not one of the greater gods, but, in certain regions of Greece he was especially worshipped—for instance, in Arcadia. His worship again was associated with that of the mystic goddess Demeter at Eleusis, and, in another form, with the worship of Apollo at Delphi. In the decorative sculptures of the temple of Apollo at Delphi there were figures of Bacchus, and we have many Roman repetitions of the types of this god created by the later Attic school, of about 380 B.C.; the school represented by Praxiteles and Scopas. And Bacchanalian subjects are among those most commonly found in all minor forms of art, such as wall paintings, vase paintings, and especially the relief sculpture of that later Roman school. These powers of Bacchus and his train lead us on naturally to think of the other nature powers, the powers of rivers, for instance. The great division amongst rivers was this. A river that ran straight into the sea was, in all cases, thought of as a son of Poseidon; and the god of such and such a river, as Alpheus or Achelous, was always a male god, sometimes a compound of man and bull; the energy, the force and rush, the stream and power and roar of the river, were typified to the Greek mind under the likeness of a bull. The Greek imagination continually, as time went on, purified and humanised these hybrid or semi-monstrous conceptions, investing them at least with lineaments purely mortal. The rivers got to be represented simply, at last, by men of various character and type—that is, the large rivers; but all the small rivers and mountain streams which run into the large rivers are always women, female nymphs. Thus, you will find, in a group I shall discuss in another lecture, a god of the river, the Ilissus, and beside him a female nymph, representing the chief of those little springs which supply the Ilissus close to Athens.

Then, there are the winds. The wind figures are variously draped, according to the quarter from whence they come; thus Boreas is generally warmly draped, to show that he comes from the north, from climes where they require warm drapery. Then there are figures, male or female, for every spring, every grove, every mountain, every valley, every division under which the human mind can possibly think of the influences of nature.

And passing from personifications of nature to personifications of the human spirit, we find lineaments more or less appropriate invented for every spiritual and intellectual abstraction that it is possible to think of. The Muses are amongst those which first occur to us. Apollo is constantly associated with a choir of Muses, and each one of those nine has a definite character and type, which occur on innumerable preserved works of art. Other personifications are equally familiar, as, for instance, that of Victory. Victory is one of several personifications to which the Greeks nearly always give wings, as they did to other things which are fleeting and fugitive, which come suddenly, we know not why, and go again suddenly, we know not why. Victory is such a thing, and therefore the type of Victory is nearly always winged. One of the illustrations on the wall is a special Victory, discovered in the new excavations, of which I have already spoken of, at Olympia. We have any number of Victories—more than one in the British Museum. Victory intervenes in every contest; when there is a race there is a Victory hovering near the winner; in war you see one hovering on the side of the combatant who is about to win. Nevertheless, we had not got until lately any great original statue of Victory from the central Greek times. We had the Victory at Brescia, in Italy, which is extremely complete and beautiful, but it is a Roman bronze; and to possess even the best Roman bronze is not the same thing as to possess even the most shattered fragmentary piece of true Greek work of the finest time. There is also in Paris a mutilated colossal Victory of the richest Greek workmanship, found at Samothrace. Last year, at Olympia, the figure before you was unearthed. It was one of the dedicatory statues set up in celebration of a particular exploit. The figure is in the act of swooping down from a rock, and ought to be seen on a pedestal some eighteen feet high, the elevation at which it was originally placed. This statue belongs to the central time of Greek art, and, although not comparable for beauty with the most beautiful of the Elgin marbles, yet the manner in which the gesture and the winged motion is shown, the way in which the drapery is made to flow back from the figure like waves from the prow of an advancing ship, is of the utmost grace and spirit. Think of the winged Victory, then, as intervening in a thousand ways in a thousand contests; and thence may the mind pass on to other winged figures—to Love, which was not always represented in the way which is most familiar to us now. The first figures of Eros, or Love, are those of a youth nearly grown to manhood; it is only in later Greek art that this youth becomes a boy, and a winged boy, a sporting, tumbling, mythological figure, whom you see parodying in every kind of manner the occupations of graver people. You see him sometimes running off with all the insignia of the greater gods, imitating all human sports, and intervening in all human festivities. Again, with regard to Death, Sleep and Death are almost indistinguishable in Greek art; they are both of them winged youths, sad of aspect, and sometimes carrying a reversed torch; but only when the genius carries a sword are we sure that it is really Death. Probably that beautiful figure which many of you will have noticed in the British Museum, sculptured on a portion of a column recovered from the temple at Ephesus, a naked figure with great wings, having beside him Mercury or Hercules, may represent the god of death, but it is not a figure which occurs very often, or which we can recognise very distinctly. You must dismiss from your minds altogether the notion that in any true Greek times death was ever represented as any thing ugly, bogey, or alarming. That conception of it came only later in the history of the ancient mind.

Then there are personifications of a thousand other simple and obvious abstractions of the mind. For instance, Peace and Plenty—Plenty as the offspring of Peace—one of the famous ancient statues of which the best copies have come down to us is a statue of Peace as a mother holding on her arm Plenty in the shape of a small child with a cornucopia.

Let us think, next, of what constitutes a wholly different class, the class of legendary human beings of heroes. Hercules and Theseus are two great and familiar examples, typifying all the beneficient operations of early history, typifying the early purging and purification of the world from noxious forces. Hercules was the stalwart, purifying hero who went about purging Greece of all robbers, evils and mischiefs. His figure is one of the most familiar and one of the most favourite of all. We have great statues, like the famous Farnese statue, which are probably copies from the great artists of the fourth century, such as Lysippus, who particularly delighted in this subject. In lesser works, and especially in vase paintings, you find the same hero, a thousand times represented, sometimes in a grotesque and sometimes in a serious form. Just as Hercules was made the popular hero of universal Greece, so Theseus was more particularly the hero of Athens.

Lastly, passing from gods and personifications of all kinds of natural powers, and of moral and intellectual powers, and again from legendary conceptions to conceptions of real life, we find that even the works of art which we possess lay before us pictures from the whole range of Greek and Roman life, representations both of the public events of history and of private records of daily family life—of marriage festivities, and final scenes of parting and of death. It is impossible to establish any sharp division between what is imaginative and what is real in Greek art, because the Greeks seldom represented real scenes without putting in as actors in those real scenes some one or other of these legendary creatures. Thus, in a scene of marriage, or of wooing, the allegorical representation of love, either as Eros, or the other slightly varied embodiments of Love, Desire, or Yearning, will play a part. And thus the personified victory is at hand to intervene in every contest. But here is an instance of history represented in the art; the intervention of preternatural beings as personifications of the group shown in this diagram is one particularly memorable in Greek history. In 476 B.C., the people of Athens set up a new statue in honour of the two friends, Harmodius and Aristogiton, the two tyrannieides of Athens. Comparing with other dates the two figures represented in this diagram, we can restore with complete certainty these two figures into this group, and can tell that they represent that historical group set up by the people of Athens in a particular year after the Persian wars. That is the way in which they commemorated that great event, the deliverance of Athens in the earlier days, and the slaying of the tyrants by Harmodius and Aristogiton.

Then, apart altogether from the commemoration of special events, there is the vast class of portrait figures and busts. Portrait statuary was a thing not quite natural to Greek art at its beginnings. There are copies of portraits and recorded portraits of Greeks, as, for instance, of Pericles, Sophocles, Euripides, but in that great time portraiture was always in some degree ideal. It is only later, in the time of Alexander and Lysippus, that realistic portraiture comes in. Perhaps the earliest example we have is one in the British Museum, which is probably the portrait of the Carian prince Mausolus.

Going on from portraits, we have representations of religious ceremonies, and sacrifices, and representations of daily life, of hunting, husbandry, and marriage festivities, almost without end, but chiefly in the latter works of Greek art; a beautiful class of which numerous examples have been lately discovered—representations of death. At Athens, go along an excavated street, and either side of the street is lined with sculptures in relief of which the diagram upon the wall represents an example. All of these are funeral monuments, and in most cases they bear the name of the person in whose honour they are set up. In almost all cases death is represented in the quietest, most reserved, and tranquil, natural way possible, by some scene of ordinary farewell. For instance, a man takes leave of his dog, which jumps up and fawns upon him as he goes away; or a lady sits in her chair, and her servants bring her some ribbon or veil, which she would put on to go out for a walk. That is the subject in this case. You may always know a servant by this particular coif. This example is from almost the best time of Greek art, and is a singularly beautiful thing in the original. The lady, whose name is inscribed as Hegeso, the daughter of Proxenos, sits on a chair, and the servant stands before her with a box; a ribbon, or the like, she is taking out of the dressing-case is not shown, because it was painted upon the surface, and it is gone. Elsewhere, a mother pats a child under the chin, or lays her arm on the hand of another woman who comes to her, gestures of parting always expressed with the most perfect reserve and delicacy, good-byes of every day that symbolised to the Greek mind the last solemn good-bye of all. These gestures have been otherwise interpreted, and some will tell you that the scenes represent what certainly is represented in Etruscan art—scenes of the dead—that these are not partings of mortal people, but re-unions of people in the under world; that they are scenes representing people meeting in the Elysian fields. But a really close comparison will show that, of the greater number of Attic remains, that is not true. The more we investigate, the more we find that the mystical interpretation of works of that kind, associating them with things occurring in the Elysian fields, will not hold good, but that they belong to the clear, tranquil Athenian genius, satisfied with the things of this world, or, at any rate, not willing to disturb itself with inquiring beyond, and representing the last bitter parting in this delicate, subdued way. No two of these monuments are ever quite alike. There is infinite refinement in all of them that belong to the good time, and most of them seem obviously and visibly in various ways to deal with that one idea.

And so our survey closes. It has necessarily been so rapid that it cannot have given us more than a very crude, and I am afraid muddled notion of the art of Greece, or of what was the multitude and significance of those images which either bodied forth lovely imagined existences or perpetuated deeds of historic fame, or commemorated the circumstances of familiar life. Such as our survey has been, it closes not unfitly with this last picture, which represents the preparation of the Greek lady for her last departure, showing with what gentle and collected thoughts the ancient Greek was ready to leave the world which was so full of glory to him, and bid farewell to that life which he spent in the worship, and almost in the companionship of his gods—of those glad and strong and divine existences, himself only one degree less divine, glad, and strong than they.

The official reports of the Philadalphia Exhibition are now being issued, and may be purchased from Messrs. Lippincott and Co., Southampton-street. Ten groups are already published, at prices varying from 1s. to 6s.. and the remaining 26 groups are being pushed forward as fast as possible. These reports contain the full text of every award decreed by the United States Centennial Commission.

The Swiss *Bundesrath* announces that the construction of the St. Gothard Tunnel is proceeding with increasing rapidity, and will probably be completed within three years.

MISCELLANEOUS.

THE UTILISATION OF SLAG.

On the Progress of the Slag Industries during the Last Four Years.*

By Mr. Charles Wood,

(Tees Iron Works, Middlesbrough.)

It is now four years since I had the honour to read before you a short paper upon the "Utilisation of Blast Furnace Slag."

I am not aware that at that time (with the exception of the use of slag for road metal), there was a single instance in this country of slag being successfully manufactured into a commercial commodity, although, as I have mentioned in a paper read before another society, nearly 60 different systems had been patented or tried, resulting only, in many cases, in disappointment, after enormous expenditure of both time and money.

At the present moment, I can point out nearly a dozen different classes of goods into which slag is being manufactured, whilst the different uses to which some of these products are being applied are very various, and are daily on the increase. I have, at the end of this paper, appended a small list, showing a few of the forms into which blast furnace slag is being made, and to what purposes it is being applied.

In my former paper I showed you how the slag properly prepared might be employed, but I had nothing to confirm what I there stated. I will now try to prove that all I then suggested has been fully realised, and I will show that the manufacture of slag into mortar, cement, building bricks, and a superior concrete (which will set perfectly in water) is now being carried on at Middlesbrough, and, even in these bad times, at a reasonable profit.

In the first place, I may mention that, at the Tees Iron Works, there are three slag sand machines and two slag shingle machines working, and these machines have produced not far short of 100,000 tons, all of which has been utilised in a profitable manner.

In order thoroughly to test the value of slag made by my two machines for the various purposes just mentioned, it was thought advisable to form a company that should take up the manufacture as a specialty, and who could devote the time and attention so necessary to a young and untried industry. This company has now been in operation about two years and a half, and, like most new concerns when attempting the manufacture of a fresh material, it has had to pass through a severe ordeal. The difficulties met with have been numerous. The failure of one machine after another, the loss of time, patience, and money, would have ruined many private individuals, but thanks to Messrs. Gilkes, Wilson, Pease, and Co., and to a few friends in the Slag Company, I have been enabled to pass through the ordeal, and I am thankful to say that neither their confidence, money, nor time is likely to be lost; but that there is every probability that, with a larger output and a revival of trade, their capital will receive a fair dividend.

The Cleveland Slag Company's works are situated near the docks at Middlesbrough, and are now paying between £60 and £70 per week in wages. The most important part of their manufacture is slag bricks for building purposes, made from the slag sand, produced by the slag sand machines at the blast furnaces. This sand is mixed with selenitic lime (General Scott's patent), with an addition of iron oxide, and is pressed in a machine hereafter to be described.

The next article of importance manufactured at these works is a kind of hydraulic cement, made from the slag sand, common lime, and iron oxides. Compared with Portland cement for hydraulic work or concrete, this is the most valuable product introduced for many years, whilst its price is not one-fourth, and the strength little inferior.

Concrete made from this cement, mixed with the shingle produced from the rotary table, is an excellent conglomerate for use in monolithic structures. With this material I have executed some very heavy blast engine foundations—in one case where brickwork set in cement had previously failed. The concrete is now standing in the most perfect manner. The cost of the concrete is only about one-fourth that of the brickwork, and experience has shown that it goes on hardening for months. The building of the Slag Company's works is executed entirely in this material—the walls being nearly 80 ft. high—they were built entirely by labourers, without a single bricklayer, and the cost of the work when finished, including superintendence, did not exceed six shillings per cubic yard. To give an idea of the strength of the walls, I may mention that on one or two occasions we have had to cut doorways through them, and it has taken two good men with steel bars and sledge hammers as much as four days to cut through a thickness of about 26 in.

Mortar is also made and sold in large quantities from a mixture of slag sand, and about 10 per cent. of common slaked lime, and it can be sold at the cheap rate of about 4s. per ton.

The introduction of these various products from slag at first met with a good deal of opposition and prejudice from architects and builders, but the remarkable strength and cheapness of the material soon compelled these gentlemen to admit their error, and I am happy to say that our demand in some instances is now more than the production.

As before stated, the most important branch of the business carried on by the Cleveland Slag Company is the manufacture of building bricks, and, although the process is now very simple, it has been here that the greatest difficulties have occurred. There was no machine made in England that could work the material in the state in which it is produced at the furnaces, without previous preparation; and to prepare the material to suit the brick press meant that the cost of the bricks became so high as to exclude them from the market. A press had, therefore, to be designed that would work the slag sand just as it comes from the slag sand machines directly into bricks, and this being accomplished, success was assured.

In designing this machine, the following points had to be kept in view, viz., great depth of moulds, because the slag sand is very spongy and compressible; an arrangement by which the water could escape from the moulds without blowing the bricks to pieces; great pressure, in order to consolidate the sand in the moulds; safety against over pressure, in case too much or too hard a material should get into the moulds; and great care in mixing the lime with the slag sand in fixed proportions, as well as great regularity in filling the moulds.

These requirements are fully met by the brick press which I shall now describe, and which is, in my opinion, one of the safest, and most powerful mechanical brick presses ever made. The pressure is given by two cast steel cams, which are fixed upon a forged steel shaft 7½ in. in diameter. This shaft, resting on bearings between two strong frames, is put in motion by very powerful double geared spur wheels, the first motion shaft having a fly-wheel upon it to steady and equalise the pull upon the strap. The pressure cams act against rollers fixed upon two steel cylinders or rams. These rams transmit the pressure to the moulds in a table. The table is circular, and contains six pairs of moulds, so that four bricks are pressed at one time, the table remaining stationary during the operation. At the same time the bricks are being pressed, two other pairs of moulds are being filled up with material—whilst the other two pairs are delivering up the four bricks pressed at the previous revolution of the cam shaft. The bricks are pushed out of the mould by smaller pistons acted upon by separate cams.

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* Paper read before the Iron and Steel Institute at Newcastle.

The moulds are lined with changeable steel plates $\frac{3}{16}$ in. thick, and the sand and lime is fed into them by two pug mills. These pug mills are fitted with six knives each, so as the more thoroughly to mix and chop the spongy slag along with the lime. The table is shifted round by a kind of ratchet motion, also worked by a cam on the outside of the framework, and acting upon the weigh bar and levers.

Immediately above the pressure cylinders are two pressure stops, which are held down by the heavy-weighted levers. These levers, therefore, receive the whole pressure put upon the bricks, and in case there should be too much sand getting into the moulds they simply lift up and relieve the strain. The weights can be weighed at option, and thus form an exact gauge of the pressure upon the bricks. The moulds are generally filled so as just to lift the levers in ordinary work. The filling is easily regulated by the set of the knives on the pug shafts, which press the material into the moulds, and one side of the pug mill cylinder is made to open so that the knives are accessible at any moment.

The pug mills are filled by means of the measuring and mixing apparatus placed on the floor immediately above the brick press.

The mixing and measuring apparatus is very simple and efficient, and works without any trouble. The slag sand is tipped into a hopper by large barrows, which are lifted up by a hoist. At the bottom of this hopper there is a revolving cylinder, with ribs cast upon it, which, revolving under the hopper, carries a certain thickness of sand, the thickness having been previously regulated to the requirements of the press.

The slag then falls upon a sieve, which separates any large pieces of slag in a solid state, and at the same time allows the falling sand through the sieve to fall like a shower. The lime is fed into a separate hopper, and is regulated very much like the feed of corn into millstones. The lime then passes down a shoot, which forms part of the slag sand sieve, where it meets the shower of sand—falling together with it—thus getting thoroughly mixed. As before stated, this lime is selenitic lime, and is prepared upon the works.

The bricks, when taken from the brick press, are placed upon spring barrows, holding fifty each. They are then taken and stacked in sheds, where they are allowed to remain about five or six days, after which they are simply stacked outside in the weather to harden. The per-centage of loss is very little, not amounting to two or three per cent. In fact, when once the bricks are upon the barrows, there is little or no waste.

Each machine is capable of turning out about 10,000 bricks per day, and, since starting, we have sold about 4,000,000. Large quantities are shipped to London at a cost of 17s. to 18s. per 1,000 for freight; in other words, about 10,000 tons of slag sand has been consumed for this purpose alone. The following are a few of the advantages of these concrete slag sand bricks, viz.:—Being pressed, they are perfectly uniform in size and thickness; they are much cheaper than ordinary red bricks, compared in weight with which they will weigh one ton per thousand less, then there is this further advantage that there are no wasters or halves. For inside work there is a great saving both in bricklaying and mortar, more especially when plastering; the walls being of a uniform thickness; and the bricklayers like them, because they can do more work with less labour, the bricklayer's labourer finding he has a ton per thousand less to carry, as well as considerably less mortar. Another remarkable property of the slag bricks is that the joiners can drive nails directly into them without splitting, and thus, for skirting and doorwork, they are saved much trouble in plugging the walls · finally, the longer the bricks are kept the harde get.

I can now confidently say that for many months past we have been steadily working away at the various products mentioned in this paper, and that with the exception of a little outlay for the purpose of increasing our output, we have laid out no money upon experiments or works.

The task, however, has been a severe one. When I designed the mill, I brought to my assistance some of the most experienced millwrights in England—men accustomed to machinery for manipulating hard an gritty substances; and yet there is scarcely a piece machinery on the works, with the exception of the engine and shafting, that has not either been abandoned, re-designed, or rebuilt, in order to adapt the machines to this peculiar material, the extraordinary cutting nature of which seem to destroy everything with which it came into contact. In proof of this, I may mention two facts, viz., that in six hours' working, the fields and furrows in a pair of French burr millstones, intended for Portland cement grinding, were completely obliterated, whilst the hardest steel bars in a Carr's disintegrator were cut completely through after six or eight days' constant running.

The position of an engineer and an inventor under these circumstances—standing as he does between failing machinery and the angry directors of a limited company, in times like these—is one which has only to be experienced to be thoroughly appreciated; but, thanks to Messrs. Gilkes, Wilson, Peace, and Co., and to one or two practical men among the directors, I have been enabled, through their aid and confidence, to carry the thing to a successful issue.

In addition to the works and progress made by myself at the Tees Iron Works and the Cleveland Slag Working Company's Works, I must not forget the labour and success obtained by my friend Mr. Henry Hobson, engineer at the Moss Bay Iron Works, Cumberland. Mr. Hobson has taken a path different, as far as I know, to any of his predecessors, inasmuch as in making bricks he first of all pulverises the solid slag, and uses no lime whatever. By this system the slag is taken from the solid slag balls, made from hematite Bessemer iron, and broken into pieces sufficiently small to pass under very massive edge runners, where it is ground or crushed by the sheer weight of the runners into small dusty shingle. It is then passed by elevators into French burr millstones, and ground into powder.

From the stones it passes directly into the brick press without any admixture of lime or any other aid except that of being well damped with water before pressing. This brick press also has a rotary table, and the material is fed into the moulds recessed therein by hand. The pressure given from above by a self-acting cam, put in action by the continuous rotary motion of the table, the bricks come out well pressed and are of excellent shape, and there appears to be no doubt about the quality. At the same time, they have a great many wasters. The bricks are very heavy, and the cost of grinding the slag entails a heavy and expressive plant, with, I fear, a large amount of wear and tear. The large amount of lime in the slag made while producing Bessemer iron seems to be sufficient, when treated in this way, to reunite the pulverised slag and to "set" in a most remarkable manner. I can only account for this setting property by supposing that the slag, when pulverised in the dry state in which it comes from the furnace, takes up a large amount of water, and forms a hydrated compound of silicate of lime and alumina, and thus reunites the mass in the same way as Portland or Roman cement.*

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* I have given an analysis of an average sample of Bessemer and Cleveland slag at the end of my paper for reference.

On the other hand, this excess of lime is often very dangerous, as the slag, after exposure to the air or an excess of moisture, often swells and falls into powder, and bricks made from it are liable to fall to pieces. This, however, is not the case with Cleveland slag, nor, I think, with any except with that made from hematite ore with an excess of lime.

The next process in successful operation is that known as Woodward's, and, although a revival of a very old method, I must certainly give that gentleman, and those who have worked the thing out at the furnaces, a great deal of credit for their perseverance, and for the success at which they have arrived. I must also, in all honesty to them, say that most of their manufactured articles are of a very serviceable nature. They are, however, only employed for footpaths, roads, &c., being totally unfit for building purposes. As at present worked, the process is not at all complicated, but only certain qualities of slag are suitable, and at times when the furnaces are "changing" the number of wasters is enormous, while the works have sometimes to be stopped for days. The slag is run direct from the furnaces into moulds ranged round the outside of a large rotary table. The machine or table remains stationary whilst each separate mould is being filled, the table is moved by hand, thus constantly presenting empty moulds to the stream of molten slag. As soon as the slag becomes set in the moulds a catch is knocked away, and the bottom of the mould drops down upon a hinge and the brick or block falls out. It is then taken into annealing ovens, where the temperature is raised to nearly a white heat, after which it is allowed to cool. The high price obtained in the market for these goods enables the company to meet their expenses, but, I believe, up to the present time they have not done more than this. The goods they produce are very hard, uniform in size, and look well when laid; but they are liable to crack, particularly in winter, and as before mentioned there are many objections to their ever being employed as building material.

At the Leeds meeting of this institute last year, Mr. Bashley Britten introduced to your notice his novel system of making glass from blast furnace slag. Mr. Britten, it will be remembered, proposed to take the molten slag in a ladle from the blast furnace and to pour it into a Siemens furnace, where certain additions of carbonate of soda and silica are added according to the quality of the slag used and the glass to be produced.

I am very glad to learn from Mr. Britten that the extensive experiments which have been carried on during the year have proved perfectly successful, and that, under the title of "Britten's Patent Glass Company," for which Mr. Herbert Canning is the secretary, large works are being built at Finedon, in Northamptonshire, where in a few months they will be ready to manufacture large quantities of glass bottles. These bottles on the tables are made entirely by this process.

I have now only one more product from slag to mention. It is that of slag wool, or, as it is sometimes called, silicate cotton, from its great resemblance to cotton wool. The manufacture of slag wool has often been attempted in England, but I believe only with partial success. I have, however, learned from Mr. Edward Williams that many years ago Mr. Edward Parry made a large quantity of it in Wales, although that, in consequence of the injurious effect upon the men, it had to be abandoned. The manufacture is now carried on at the Tees Iron Works, and I can safely assert, without the slightest inconvenience, either to the men in the yard, or even to the man who makes it.

The process is extremely simple. A jet of steam is made to strike upon the stream of molten slag as it falls from the usual runner into the slag bogies or waggons. This jet scatters the molten slag into shot, and as each shot leaves the stream it carries a fine thread or tail with it; the shot, being heavy, drops into the ground, whilst the fine woolly fibre is sucked into a large tube and discharged into a chamber. This chamber is very large, and is covered with fine wire netting or sieve wire. The steam and air carry the woolly particles all over the chamber—the finest into recesses formed for the purpose; the heavier into the body of the chamber. After each blowing it is selected and taken up with forks and put into large casks or bags for shipment or otherwise. The inside of the chamber represents a most remarkable and curious spectacle after each blowing. The wool, as will be seen by the samples on the table, is of a snowy-white appearance. Slag wool, or silicate cotton, is chiefly employed to cover steam boilers, pipes, &c. Messrs. Jones, Dade, and Co., of London, are the sole agents for its sale, and they have taken out one or two patents for its application. The most noteworthy of these is for what they term mattresses, some of which they have kindly forwarded for inspection. These are about 2 ft. to 3 ft. long, and 1 ft. wide, by 2½ in. thick. The mattresses are laid upon the boiler or pipes to be covered, and are secured in the usual way. Its perfect incombustibility, combined with its non-conducting and indestructible properties, give this material many advantages over any other for this class of work.

Table showing the various Forms into which Blast Furnace Slag is being made, and to what Purpose it is being Applied.

Slag Sand.—This is employed for making concrete, building bricks, mortar, and cement; for agricultural purposes and gardening.

Slag Shingle is being used largely for concrete, and for roads and footpaths.

Slag Wool.—For covering steam boilers, steam pipes, hot-water pipes, fire-proof rooms, ice-houses, cisterns, gas and water pipes, as a protection against fire, as well as for filtering chemicals.

Paving Blocks.—Employed for streets and footpaths, stables, coach-house yards, crossings, breweries, and for kerbstones and channelling.

Building Bricks.—Made by pulverising the solid slag and then pressing the bricks in a press.

Glass, by Mr. Bashley Britten's patent process, into roofing glass, bottles, gauge glasses, and many other articles too numerous to mention, for which a pure glass is not absolutely essential.

Analysis of Blast Furnace Slag.

	Cleveland. Per cent.	Bessemer. Per cent.
Silica	36·50	35·00
Alumina	22·95	15·00
Lime	32·68	46·40
Magnosia	5·83	2·00
Protoxide of iron	0·06	0·10
,, manganese	0·32	0·10
Potash	0·59	0·40
Soda	0·37	0·20
Sulphur	1·74	1·50
Phosphoric acid	*nil.*	*nil.*
	101·04	100·70
Less oxygen of sulphur Combined with lime	0·87	0·75
Total	100·17	99·95

The report of the Warden of the Standards states that the assistance of his department has been sought by engineers in an inquiry as to the actual size of the "Birmingham gauge" for wire and metal plates. So far as this department is aware, there is no standard of the Birmingham gauge either at Birmingham or elsewhere. Every maker of such gauges makes them after his own sizes.

The Drapers' Company has made a grant to the Yorkshire College of Science, to enable the college to provide practical instruction in coal-mining.

THE TELEPHONE.

On the evening of Thursday, the 4th inst., at a *conversazione*, held at the Public Hall, Leamington, during the Congress of the Sanitary Institute, one of the attractions of the evening was the exhibition of the telephone, which was explained by Mr. A. Le Neve Foster.

It had been arranged that Prof. Bell would himself have given a description of the instrument, as well as some explanation of its practical uses, but unfortunately, through ill health, he was unable to be present. In his absence Mr. Foster undertook to explain and exhibit the instrument. The telephones were connected by a short line of overhead wire between the Pump-room and the Hall, a distance of about half a mile. The line was one of the ordinary post-office lines.

After giving a short explanation of the instruments, Mr. Foster remarked that, although the telephone had only been now commercially established in America some three or four months, there were already about 1,500 instruments in practical use in America, that the system was rapidly increasing, and replacing for commercial purposes on private wires, to a large extent, the various forms of A B C and other instruments hitherto employed. He stated that the greatest distance in America over which the telephone had been successfully worked was between New York and Boston, a distance of some 240 miles. Whilst in England, at the late meeting of the British Association at Plymouth, Mr. Preece had successfully established telephonic communication between Exeter and Plymouth with most satisfactory results, thus proving the adaptability of the telephone for comparatively long distances.

Col. Reynolds (who, with Prof. Bell, is about establishing the telephonic system in England) undertook the arduous duty of attending to the telephone at the Pump-room and answering the numerous questions that were addressed to him from the Hall, through the telephone, by the various guests assembled.

The telephones used—manufactured by the Silvertown Telegraph Works—were of the type as at present employed for commercial purposes, a description of which appeared in the *Journal* of September 14. These instruments, although small, have been found sufficient to meet the requirements of this class of work. Attention is called by the ringing of a small bell at the receiving station. The bell is actuated by a current of electricity generated by a small magnetic machine at the sending station, thus entirely dispensing with the use of a battery. Two telephones are usually connected in circuit at each end of the line, so that the operator can always hold one to his ear and speak through the other; this greatly facilitates telephonic communication, and prevents delays that might be caused through the operators at each end of the line speaking at the same time.

The exhibition of the telephone, on the whole, was a success, Col. Reynolds stating, on his return to the Hall, that he could distinctly hear, when at the Pump-room, listening at the telephone, the band playing in the Hall, as also the applause of the audience.

OBITUARY.

Major-General Eardley-Wilmot, R.A., F.R.S.—Major-General Frederick M. Eardley-Wilmot died on Sunday, September 30th, at Fox-hills, near Chertsey, aged 65. He was the second son of Sir John Eardley-Wilmot, first baronet, and entered the army in 1830. He served part of the campaign of 1846-47 against the Kaffirs as Deputy-Assistant Quartermaster-General, and also served in Canada. At one time he was Director of Gun Factories at Woolwich, and he served on many Government committees on military matters, and was frequently consulted on scientific and educational subjects connected with the army. His connection with this Society commenced as long ago as 1849, and he was soon elected on the Council. He served first as Captain, and then as Lieut.-Col. Eardley-Wilmot on the Council till 1855, when he went abroad on foreign service. In 1869 he was again elected on the Council, and in 1871 he became Chairman. This office he held for two years, and the energy he devoted to its duties will be fresh in the memories alike of the members of the Council and of the members generally. It was a cause of deep regret to all associated with him when failing health obliged him last year to give up his attendance at the Council meetings. Since then he gradually became worse until his death. His name appeared in the recent list of promotions in the *Gazette*, but his death took place the day before that upon which his promotion would have dated, October 1st. Of General Eardley-Wilmot's private character, this is, perhaps, hardly the place to say much, but this brief notice cannot be closed without at least an allusion to the singularly high-minded and noble nature which ensured him the respect, and, indeed, won him the affection of all with whom he came in contact.

GENERAL NOTES.

Herva-maté Cultivation.—Mr. O'Conor, in his report upon the industries of Brazil, mentions that the cultivation and preparation of herva-maté, which is largely exported from the province of Parma to the neighbouring countries of Uruguay, Paraguay, and the Argentine Confederation, has not yet become an article of commerce for European markets, and this will be regretted by those who have experienced what a capital substitute it is for either tea or coffee. In its nature more fortifying and alimentary, and far more wholesome, it can be bought at a price so moderate that it would easily be within the means of the poorest inhabitants of Ireland or Scotland, and there can be no doubt that if it were once known it would be extensively used in place of the far more expensive and constantly adulterated beverages of tea and coffee. A small sum has been appropriated by the Minister of Agriculture with a view to make this excellent plant known in Europe, and it is sincerely to be hoped that the experiment will be productive of beneficial results.

NOTICES.

THE LIBRARY.

The following works have been presented to the Library:—

The Argentine Republic, by Richard Napp. Presented by N. A. Calvo, Esq.

The Girls' Reading-book, or Chapters on Home Work and Duties, by Mrs. Henry Sandford. Presented by the publishers, Messrs. W. and R. Chambers.

The Visible Origin of Language; or Speech the Expression of Form.

Preventive Medicine in Relation to Public Health, by A. Carpenter, M.D., Lond. Presented by the author.

Report of the 46th Meeting of the British Association for the Advancement of Science, Glasgow, 1876. Presented by the Association.

The Critical Review, or Past and Present. By D. Puseley and Son.

The Law Relating to Gas and Water, by W. H. Michael and J. Shiress Will. Presented by the publishers, Messrs. Butterworth.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,300. Vol. XXV.

FRIDAY, OCTOBER 19, 1877.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

THE CONNEXION OF GREEK AND ROMAN ART WITH THE TEACHING OF THE CLASSICS.

By Sidney Colvin.

Slade Professor of Fine Art at Cambridge.

Lecture III.

This day week we tried to get a survey of the range of ideas which were embodied by the ancient Greeks in their various forms of art.

To-day we come to another consideration. It is evidently a very different thing to know what was the range and extent of the conceptions of antiquity embodied in the works of art, and to know what remains of those works—what vestiges out of that enormous multitude of things—still exist for us to study.

We shall try and go very briefly through the history and the origin of our modern collections, and the distribution of the chief monuments that have come down to us. There are two divisions of this subject. One is the inquiry into the various places where the existing remains were found; and the other is the inquiry where they are now deposited, or "museography," as the Germans call it.

It is necessary, before we begin to discuss the places of discovery, that we should, in some way, classify the varieties of remains discovered; and this is not a very easy classification. You may classify according to the art employed, and say, for instance, sculpture and pottery; these sound like two distinct classes, but when you go into details you find that there is no hard and fast line between them. When you have a vessel of clay upon which figures are raised, or the handle of which is carved with figures in the round, the question arises—is that pottery or is it sculpture? Again, the single class of statuary exists in various forms—in bronze, marble, terra-cotta, and so on; so that there is nothing for it but to be content with a little confusion; and I shall take sculpture to mean statues of all kinds, whether in the round or in relief, and all the minor arts connected with them as one main division, and then painting as the other main division. As early as two centuries ago an inquirer tried to establish a classification amongst these things, and he invented a long word, or rather a string of words rolled into one long word, and called this study epigrammato-numismato - biblio - glypto - icono - toreumato-angeiography.

I will not trouble you with the first member—with the study of inscriptions—which includes an enormous part of the subject, but one which we are altogether leaving aside. "Numismato," or coins, is one of the classes I shall have to deal with; "Icono" means the study of portraits; "Toreumato" means the study of a particularly interesting class of works—those wrought by beating, or chasing upon metal—figured cups and armour, and so on. "Angeio" means the study of vases. Without troubling you with too complicated divisions, let us turn at once to the great classes which are roughly called sculpture, and consider where principally, and at what times, our chief remains of ancient sculpture have been found, where they are distributed, and what are the chief resources of great museums and collections.

Statues, you remember I said last week, were divided, as to the material of which they are composed, into three great classes; first of all, that which was the most precious, honourable, and noble class—statues of gold and ivory, which were exclusively, from the nature of the material, housed in shrines, temples, and covered places. That class has entirely disappeared. Then comes bronze, and, alas! too much of the bronze has also perished irredeemably. Bronze was the favourite material, for statuary in the ancient world, and accordingly, when a Greek talks of a statue, either of a god or a hero, you generally have to understand bronze. In the great crowded valley of Olympia, which was peopled with multitudinous dedicated statues, the numbers of which we hardly dare guess at—in that and in all similar congregations of statues—bronze formed a much larger proportion than anything else. If we read about a Roman triumph, how this or that Roman conqueror trailed off so many statues, and the triumph lasted so many days, we shall always find more bronze than marble statues in the enumeration. Bronze it was, which, from the severity of the material, on the whole, best expressed the genius of Greek art. The art of Phidias, and of the age of Pericles, in the fifth century before Christ, was in the main a bronze art, but, unluckily, bronze has an inconvenient adaptability for being turned into pennies; and whenever bronze has been found by subsequent barbarians, it has been taken and melted down, and disappeared long ago—passed into the current coinage—so that our existing remains of bronze are comparatively few, and comparatively disappointing. Numerically speaking, by far the greatest number of important bronze statues in existence are those discovered on the site of ancient Herculaneum. Herculaneum having been buried very deep, under a thick and almost impenetrable layer, by the great eruption of Vesuvius, nothing of importance was robbed or taken away from it; and at the time that it was opened in the last century, about 1745, a great part of the furniture and luxuries and works of art belonging to the population was discovered, and amongst them a considerable number of bronze statues and statuettes. Of course, as they are things found on a Roman site, the greater part of these are Roman works—copies, that is to say, of Greek things. Therefore, although there is a great store of beautiful statues in the museum at Naples, which have been chiefly brought from Herculaneum, you cannot be sure that any of them are original Greek works of the time, though there are one or two things of extreme beauty, such as the figure of Narcissus. The Naples museum is by far the greatest receptacle of these things—there are more bronzes there than anywhere else. Every now and then a great find of bronze had turned up elsewhere. Not very many years ago, in the Italian town of Brescia, on the site of an ancient temple, a complete bronze figure, over life size, and of great beauty—a winged draped figure of Victory writing on a shield on her knee—was discovered. That was a very precious thing to find, but it does not bring us face to face with the real fountain-head of these things. The type is one which occurs often in Roman art. You may see it on the first course on the well-known sculpture of the Column of Trajan—it is a thoroughly Roman type. Such fragments of true Greek bronze as are found, are, of course, at all times, the most valuable contents of museums. Just now, at Olympia, an interesting discovery has been made, that is to say, the ear and horn, with a small portion of the head, of a very famous bronze cow, dedicated in Greek antiquity. The pedestal has been found, and we know who the artist of the cow was, but all that seems to be remaining is this small fragment of the ear and horn. That, I am afraid, is about the proportion which almost all works in bronze are likely to bear to the old originals. You have all been interested in that splendid bronze head brought to the British Museum. We do not know where that comes from; it has all the aspect of being Greek, and of the great Greek time; the legend is that it was found by a Turkish treasure-hunter in a deep hollow in the mountains of Armenia, beyond Erzeroum. In the British Museum, and elsewhere, where antiquities are collected, you will find a considerable number of small bronzes, chiefly lesser ornamental things, and of immense interest, but not fully enabling us to realise what the real Greek statues of bronze were. We are only too glad of our one or two perfect fragments—such as that brought home from Greece by Mr. Hawkins—a mirror-case with the figures of Venus and Anchises, or of little perfect fragments of broken armour, such as are in the British Museum. We are only too glad when small fragmentary scraps of that kind survive to us. There is another race of antiquity, which, in the working of bronze and in the technical parts of metallurgy, was in advance of the Greeks themselves, and had a pre-eminence in that art which was fully recognised by the Greeks, namely, the Etruscans. A vast quantity of these bronzes do remain, especially ornamental candlesticks, funeral chests for ashes, ladies' dressing-cases, &c., more or less figured, the study of which is extremely interesting, only it is not the central study of Greek art. These artists were of a different race, and their art is of a different kind from the Greek. Their work is of admirable mechanical quality, but, where they most closely imitated the Greeks, there is a want of the genuine Greek spirit. Therefore, in thinking of our remains in bronze, and of the number of them in museums, and particularly in the British Museum, which contains many precious fragments—though there may be still a hope of finding more, the great resource must be the museum at Naples, supplied principally from Herculaneum. On the whole, our treasure in this most precious branch of ancient sculpture is miserably scanty compared with what one would desire.

Then we come to the material of which most of the figures that remain to us are made—marble of all kinds. There was a time in the thirteenth century, when the number of antique sculptures in marble that were known to exist in Europe was very small indeed, when there were hardly any known. One was the well-known piece in the Campo Santo, at Pisa, in that famous burial-ground supposed to be filled with earth brought home from the Holy Land by the Crusaders. Very soon after it was built, certain ancient Roman sarcophagi were set up within it, which, most probably, were found in the neighbourhood. The tradition, however, was that these Roman sarcophagi (one representing the hunt of the Calydonian boar) had been brought from Greece. It is not the Greek kind of work, but Roman; and there is very little doubt that they had been in Italy from the first. These were studied early in the Middle Ages, and were a great help to the nascent art of Europe; making, in fact, the first step towards the European Renaissance. One was used for the sarcophagus of the Countess Matilda, the most honoured name of all Tuscany. During that curious border age between the Middle Ages and the Renaissance, there were strangely mixed feelings in the people amongst whom these antiques were occasionally found. For instance, in the neighbourhood of the city of Siena, an ancient statue was found one day, and it was brought home and set up with great pride and honour. Then, as always happened, they were at war with their neighbours, and were defeated. They then said, "Someone is angry with us for some impiety; we have brought this heathen thing into our borders and that has brought this misfortune upon us." So they broke up the statue into pieces, and made an expedition over their enemies' borders at night, and carefully deposited the fragments of this broken statue in the Florentine border, convinced that it would bring defeat to the Florentines. However, sentiments of that kind did not last long, and by the time one gets to about the year 1400, on the threshold of the modern world, we find all that doubt and hesitation towards the works of antiquity utterly disappear, and a universal enthusiasm and desire to find more, and a universal admiration and acclamation for whatever was found, succeeds to those forgotten feelings.

I think in my first lecture I mentioned, as the fruit of an exploration of this kind, that the archæologist, Cyriac of Ancona, who, in the course of his business travelled all over the Levant, having found some of these things, presently repeated his travels in search of such remains, and brought home with him great stores of gems, copies of inscriptions, and whatever valuable works of art he could find. Almost at the same time, that is to say, before the middle of the fifteenth century, Squarcione, of Padua, the founder of a great school of painters, went to the East, and bought things from merchants, and set up a school with casts from antique figures and originals. Then was the dawn of the collection of ancient marbles. The practice grew apace from that time onward, and at the end of the fifteenth century comes the beginning of the exploration—I may almost say the scientific exploration—of Rome. From the end of the fifteenth to the end of the sixteenth century was the most active time for the discovery of ancient statues in Rome itself. Of course you know that the number of ancient marbles found in Rome far surpasses all that has been found in any other place whatever. The number of statues found in Rome has been sometimes attempted to be calculated, and 170,000 has been named, but it is quite impossible to tell. From the date of which I speak—a few years before 1520—to the end of that century, there went on a most active and eager competition between the great potentates—princes, cardinals, and popes—in this matter. At this time was discovered the famous statue of the Laocoon, the main figures in the Niobe group, the Apollo Belvedere, and so on. Each one was welcomed with immense enthusiasm, and princes, cardinals, and popes vied with each other for the purchase of them. In those days were formed, first of all, the great private galleries, such as the Farnese gallery and those of the Carpi, Cesi, Ludovisi, and Medici, which have since made Rome famous. Presently, the greatest of all these collections—that of the Medici—was transported by that family to Florence, and is now the nucleus, or nearly the whole, of the Uffizj collection. The great thing in that collection is the famous Niobe group (which is of the school of Scopas or Praxiteles), originally found in Rome in 1583, together with other well-known figures, such as the Two Wrestlers. At that time, also, the Popes, who were the first collectors, began to accumulate in the Vatican the Belvedere collection. This collecting activity has never ceased. It had a fresh revival in the latter part of the eighteenth century, but the people who collected then were people of a different race. From about 1500 or a little earlier, down to the eighteenth century or a little later, the great source and centre of the knowledge of our ancient marbles was Rome. After the great Italian princes and cardinals, the next great amateur was an Englishman, in the time of Charles I. Lord Arundel was probably the first, at any rate the first conspicuous Englishman, who took an interest in antiquities, and who sent agents to the Levant and the coast of Asia Minor to bring things, not from Rome or Italy, but from Greece itself. The famous Arundel collection has gone through many vicissitudes, but there still remains at Oxford a collection containing a few precious things first brought together by Lord Arundel. His passion for collecting did not take root in England immediately; it was more than 100 years before it became widespread; but towards the middle of the last century, from the year 1730 onwards, it became the fashion for rich young Englishmen, on the grand tour, to go to Rome, and sometimes even to Greece, and bring home antiques. There are a dozen great houses or more in England stocked with antiques, partly coming from the sale and breaking up of these old Roman collections, and partly from new excavations. The process was of this kind: first of all the great old collections used to be broken up and sold in detail in Rome. Then continual excavations were carried on. There was a regular profession of people who bought fragments of ancient statues, heads, arms, legs, and so on—and restored them, and sometimes with great ignorance of archæology. Nollekens, the sculptor, was engaged in this work, but a man named Jenkins was the greatest of these restorers. It was at that time that all the great English collections, such as that at Holkham-house, belonging to Lord Leicester, those at Woburn, Petworth, Lansdowne-house, Duncombe, Castle Howard, Ince Blundell, Wilton, and many others, were formed. A few of these Englishmen were not content with these things found at Rome but went to Greece, or had agents there, and amongst them was Sir Richard Worsley, the ancestor of the present Lord Yarborough, who formed perhaps the most interesting collection of all, containing a quantity of real original Greek works.

Up to the middle and latter part of last century there had been no regular public national museums. All the collections were in and about Rome, or in England in private galleries. The epoch of museum-forming only began towards the close of the last century. It was only in the eighteenth century, indeed, that the Vatican galleries themselves were in any kind of way publicly installed. First of all, Pope Clement XII. was the founder of the museum of the Capitol, and then Clement XIV., and Pius VI., who installed the famous museum in the Vatican the Pio-Clementino. Presently other countries followed suit, and then came the foundation of the British Museum, which was founded with things belonging to the English amateur, Sloane. The first great addition of marbles made to it were the marbles of Mr. Townley, who had collected in the course of the eighteenth century.

So much for the history of the distribution of marbles. Until about the year 1800 Rome was the great centre for all these things. The Roman Hercules, the Torso, the Apollo Belvedere, works like these gave the standard of excellence, and were supposed to be unapproachable works of art. Other works belonging to the same class—that is to say, to the class of Roman imitations of Greek art—formed the staple of all other collections. But about the beginning of this century the collecting of ancient marbles entered upon quite a new phase. This was owing to the exertions of a man who, at the time and since, has been covered with a great deal of obloquy, viz., Lord Elgin, but who, in the history of human civilisation, deserves a place I am afraid to say how high. The debt which mankind owes to Lord Elgin for his so-called spoliation—which Byron, and many would-be Byrons have, as you know, denounced—in rescuing the pediments and friezes of the Parthenon from inevitable destruction, is a debt which it is not possible for us to estimate. I do not know whether it is familiar to all of you how hard Lord Elgin worked, or how ill, for a long time, was the reward he met with. The origin of his removing the marbles from the Parthenon was this. He was sent out when quite a young man to Constantinople as ambassador, and a certain architect named Harrison thought it would be a very nice thing, Lord Elgin being interested in these matters, to have some casts of certain architectural features—especially from the corner capitals, the construction of which has always been a matter of great interest to architects—from some of the Ionic buildings at Athens. Then came the further notion to take more casts and make more drawings; and, in the course of these proceedings, it became apparent that the pediments and friezes, and other sculpture that remained, were constantly suffering irremediable injury, partly from the barbarism of the Greeks and Turks, and partly from strangers who liked to chip pieces off; and it was evident that if they were to be saved they ought to be removed. Lord Elgin got a firman from the Sultan, therefore, and appointed agents who carried on the work with immense zeal. Certain Englishmen who were there said the removals were done much too rapidly, and without due regard to the safety of the things. Of that we have no positive evidence, but the result was that in the course of a few years 180 cases were packed and filled with all these precious monuments. I cannot follow the history of the bringing of these things to London; it is a strange, romantic history. Some of them went to the bottom, and had to be recovered by divers, years afterwards; they were sent off in that way, whilst Lord Elgin started on his way home. This was in the year 1802, if I remember rightly, when there was war between England and France, and he got stopped and imprisoned. First of all, he was only interned in Paris, but he was afterwards shut up in Melun; and all that time the cases were lying about in various docks and harbours in England, waiting for their consignees to claim them. When Lord Elgin was liberated, he had great difficulty, first of all, in getting all the things together, and then he had an incredible difficulty in persuading the English public, and the *dilletanti* of those days, that the things were worth having. This point rather belongs to our next lecture, which will be on the history of antiquarian criticism, and of the changes of interpretation which these monuments have gone through; and I shall then take the opportunity to say something on the obstinacy with which certain amateurs of the time refused to acknowledge that these, incomparably the greatest and most beautiful specimens of carved marble in the world, were anything but insignificant works. The taste of the people had got so set—they had got so much accustomed to look upon the statues in the Vatican as perfection, such as the Apollo Belvedere and the Laocoon—that it was impossible for a long time to persuade them that they had now something very much more beautiful and higher than anything they had had before. However, one after the other, first of all Canova, and then Visconti, and then Haydon, one after another asserted the supremacy of the new arrivals; and, after long negotiations and bitter disappointment, Lord Elgin got the marbles purchased by Parliament at the price of £36,000, which was, perhaps, half of what they had actually cost him in the various labours of removal. Ever since that purchase, for one thing (as I shall show more particularly next week), the whole of our knowledge, our taste, and our judgment about these things has been extended, improved, and undergone a perfect revolution. But, for another thing which belongs to our to-day's inquiry, the British Museum, in Bloomsbury, has been made the great centre and home of this study. Since the Elgin marbles were brought to London and deposited here, that museum has been the great centre of attraction to all archæologists, and has furnished the great central standard of the consummate excellence of Attic work in the full blaze of Attic civilisation.

Naturally, after a little while, when all the mistakes and foolish talk of people were silenced, and the pre-eminence of these things established, Lord Elgin's example was followed, and further research in Greece itself for genuine works of Greek art began to be carried on with renewed energy. The next important discovery made was that of a group of pediment sculptures almost intact, in a forgotten temple lying out of sight in the island of Ægina, off Attica. These Ægina sculptures are amongst the most interesting and important things we have. They belong to an early time, about that of the battle of Marathon, 50 or 60 years before the Periclean time. By this time the English Government were awake to the importance of the subject, and the British Museum sent out an agent to obtain these things, but somehow or other he went wrong, travelling to Malta instead of to Zante; and as Munich was then very anxious to obtain a good collection, when the English agent found his way to Ægina, he found the Munich Government had made a bargain for them and bought them, and they are there now in the Munich gallery.

That brings us to another museum, that of Munich, which is now, after our own, one of the richest museums in genuine Greek things. Since the purchase of the Ægina sculptures, many other beautiful things have found their way there, and amongst them the famous frieze of the River Gods, which probably came from the temple in Rome, which was ornamented partly by the works of Scopas himself. There is also at Munich another very beautiful work, a copy of the famous statue by Cephisodotos, the figures of Peace and Plenty, Peace being represented as an opulent mother, and Plenty as a child with a cornucopiæ in her hand.

Things went on in the same way. It was felt that Greece was the place to search, and that even subordinate sculpture—not only the capital masterpieces, which had been found really in Greece itself, would bring us nearer to the centre of ancient art than any galleries full of the showy, restored works such as abound in the Vatican, and had until then abounded in all English collections. About 1814 was removed from another almost forgotten Greek temple, that of Apollo, at Phigalia, a wonderful frieze representing the battle of the Centaurs and Lapithæ. This was brought to England and deposited in the British Museum. Since then many discoveries have been made. The Dilletanti Society made explorations in Asia Minor and, above all, at Xanthus, in Lydia, at the famous Halicarnassus; and the result of all these things was to produce a rich, priceless store of sculptures, mostly of a subordinate character, but still genuine, first-hand Greek work. They are in the British Museum, and help to make it the richest of all places for the study of these things.

In the meantime, in like manner, every other capital of Europe established its museum. The Louvre is rich, but not so rich as we are, in Greek antiquities. The original Louvre collection was to a great extent founded on the dispersion, or part dispersion, of one of the richest and most beautiful private collections, the Albani collection. At Berlin they have a good many marbles, but that which especially distinguishes the Berlin museum is the immense collection of casts, bringing together the works which are scattered all over Europe, in this reproduced form for the purpose of study. Of that I shall have something to say in my last lecture.

Every day things are found quite unexpectedly. In digging at Soissons, an old Roman station in France, lately, they found, quite unexpectedly, a group, representing a boy and his *pedagogus*, which evidently belonged to some copy of the original group of Niobe, of which the famous version now in Florence had been found as long ago as 1583, at Rome. Another accidental discovery of this kind was made in the Island of Milos, that figure of Venus which is now in the Louvre, and is so famous. Sometimes by chance, and sometimes by calculation, these discoveries are made, but by far the most important of all the recent additions to our stores of these things are due to careful, intelligent study, as is especially shown in the discoveries which have lately been made, and are still in course of making, at Olympia.

To recapitulate, then, for this particular study—the study of fragmentary works of original Greek marble—the British Museum is incomparably the richest place. I have tried, in this very hasty way, to bring before you the principal sources of the British Museum; that is to say, some of the collections of old Roman things found by English travellers in the last century, then the great Elgin collection, and then the friezes from Phigalia; and, subsequently, the results of a great many researches on the coast of Asia Minor by the Dilettanti Society and by our own Government, together with a good many purchases. Munich is rich in the Ægina marbles in the first place, and by many subsequent purchases at Paris. The Paris, Berlin, and Dresden galleries are, perhaps, of secondary interest to these, but still contain things which are very precious when one thinks of their numerical profusion.

We are rightly accustomed to think of sculpture as the great central art of Greece; but there are minor forms of art which are of infinite value in the reconstruction of the general history of art as well as for their own sake. Coins and gems are two separate classes, each of which has a science of its own—classes in which our existing remains are very vast. They have been collected for a great many years, and every museum of antiquities at all has a more or less rich collection both of coins and gems. One may call coinage a subordinate branch of sculpture, because the type is carved in the die and has to be struck upon the coin; so that in all essentials a coin is a work in relief, only in relief which is stamped from a die instead of being carved.

Innumerable points of history are illuminated by the study of coins. The early Greek coins are not merely valuable for the light they throw on the city which produced them, the particular god or gods worshipped in a particular city; but during all the great ages of Greece, from the archaic art to the latest, in these coins, the whole of the spirit and genius of Greek art is reflected. You may take the coinage of Sicily, or you may take Asia Minor, and find out the way in which the type of each patron god of the town, or hero of the town, or particular event, legendary or historical, connected with it gets represented from the earliest to the latest time. Another thing which makes the study of coins of great value to our own subject, is this—it is a very common thing to find on coins a small figure representing the principal work of art of the city to which it belonged. Thus many coins of Ephesus have upon them small conventional representations of the great temple of Diana of Ephesus. The coins of Cnidus—some of them—have a representation of the Praxitelian Aphrodite, one of the most famous statues of all antiquity. So, in a great many cases, by a close and careful study of what is found on coins, we are enabled to name and identify an existing work of art. We find sometimes, in the corner of the coin, a small representation of a group which we recognise as corresponding to one which we have read of in books, or which we know to have existed at such a town. So that not only on account of its intrinsic interest, but on account of the light it throws on other subjects, the study of coins becomes fruitful. And it is one also, although this rather belongs to my concluding lecture, which can be carried on almost as well by means of reproductions and later types which are almost identical in all details with the originals, as by the study of the originals themselves.

Then we come to gems, and there again is an infinitely wide range of study. We have engraved gems of all kinds, either sunk in the field or raised, called respectively intaglio and cameo, and they are from almost all periods of the world's history. We have Egyptian and Babylonian passing into Greek, and through all the various stages of Greek art we may follow its development in gems. And, just as in the case of coins, so here we constantly find the study of gems gives us a new clue to the meaning of mythology, and gives us fresh subjects to study and to explore. In like manner we find motives which appear on other monuments, and thus enable us to identify them. Of the infinite beauty of the glyptic art, with its almost superhuman subtlety, of the skill with which Greek artists were able to express so much in that stubborn material on that tiny field, there is not time to speak. Besides, accounts of these things cannot convey much idea in the absence of the things themselves. Our own collection lately has been enriched by many great purchases, especially the Castellani purchase. I do not suppose there is any place more fascinating than the gem room in the British Museum, where the light is so arranged as to bring out all the lovely colour of the stone and the exquisite character of the art.

Coins and gems are the two principal products of the arts subordinate to sculptures—the arts of cutting or stamping raised on sunken figures on a small scale; but there have been lately enormous discoveries of another subordinate branch of sculpture, terra-cottas. Great numbers of terra-cotta statuettes have been found lately in several parts of Greece, as at Corinth, Megara, and especially in the necropolis of Tanegra, giving us altogether an immense mass of new materials, not bearing so much on the mythology and religion of the Greeks as upon their ordinary daily habits and ways.

Keeping still before us the same broad division into sculpture and its subordinate arts, and painting and its subordinate arts—Greek painting is a thing far more completely perished than Greek sculpture. At the end of the last century a most curious discovery was made by an Italian nobleman, in the neighbourhood of Cortona. He found that a blacksmith in his neighbourhood had stopped up a window, which let too much draught in near to his forge fire, with an old tile which had on it a face with head and shoulders; and this figure, when it came to be examined, proved to be a most beautiful work of art, done in a manner entirely unknown. The immediate neighbourhood of the furnace flames had not affected it in the slightest degree. It was a specimen of encaustic art, and is now in the museum of Cortona. It is, perhaps, the only remaining example of ancient painting done in that manner. But there does exist an immense store of a certain kind of ancient painting. I have spoken of Herculaneum and Pompeii, and you are all familiar with the enormous multitude of paintings discovered in those buried towns of the Campagna. Probably most of them were executed not long before the catastrophe, because 15 years prior to their total destruction those towns had received a fearful shock, and had nearly fallen into ruin, so that of this series of paintings of mythological subjects and fancy subjects the great part, no doubt, belongs to the 15 years immediately before their destruction in the 79th year of our era. At any rate, all the paintings we have there are of the Roman age, done when the original inspiration of painting had departed. These paintings consist partly in scenes of real life—often the commonest real life—but in a much greater proportion of subjects of Greek mythology. From them, making due deductions and qualifications we can to a great extent arrive at some knowledge as to Greek painting at its best, the nature of the composition, and the way they treated their subjects. Then, there is another department of paintings, which, for the study of Greeek art in general is infinitely more important still than these fresco paintings in the buried cities of the Campagna—that is, vases. Vases were not a kind of antiquity found very early or much esteemed. The attention of archæologists did not really begin to be drawn much to them until the end of the last century, and the great discoveries of them—the multitudinous discoveries—have been made almost in our own time. The habit of the ancient Greeks, men or women, was to have buried with them whatever they loved best, their little household knicknacks and treasures; and since systematic excavations have been made, these painted vessels, which are commonly called Etruscan vases—although they are not Etruscan—are found in numerous tombs and cemeteries at almost every site which has been dug over, not only in ancient Greece but in Sicily, Italy, in Etruria, Campania, and generally in both the western and eastern parts of South Italy. For a long time these were called Etruscan vases, because an incredible store of them was found in Etruria in the year 1828. But the more one closely studies them, the more one sees in the main a uniform spirit breathing through them, and that their character is Greek—that they belong to the Greek world. We can trace the historical changes from the primitive archaic manner to the more and more perfect manner, and then to the over-luxurious, decadent manner; and these historical changes are strictly in accordance with what we know of the main history of Greek art. There is every reason, therefore, to be certain that, with very few exceptions, these multitudinous stores of vases, of which there are thousands in the museum at Naples, and thousands in the British Museum, and hundreds at every other important museum in Europe, were of special Greek manufacture, exported to non-Greek nations—exported to the Etruscans, Campanians, and to others, just as we export our special goods to foreign countries. The Phœnicians, we know, imported a great deal of bronze from Etruria; and in like manner the Etrurians imported a great quantity of these vases figured with mythological scenes—what we are accustomed to call Etruscan vases—from Greece. There is no exaggerating the amount of light which the paintings of these vases throw on the whole circle which we are considering—on the circle of Greek religion and life —since both kinds of subjects are included.

Such, then, very roughly speaking, are the principal classes of objects in Greek art which we have to study, and such is their distribution. You see how infinitesimal the materials are compared to what one would like to have, and compared with the recorded multitude of beautiful works which came from Greece in the three or four centuries of her greatness. Still, the mere hasty enumeration is enough to give one some sense of the immensity of the subject, and to prove that the study, at all events, is not one likely to fall short for want of material.

MISCELLANEOUS.

THE COMING PARIS EXHIBITION.

(FROM A CORRESPONDENT.)

Your readers will probably be interested in hearing from one on the spot, who has always taken much interest in industrial and art exhibitions, something about the plans, progress, and prospects of the great international gathering to be held in the city of exhibitions next spring.

To say that the building is the largest yet conceived for the purpose is to say little; immensity, if it were not unavoidable, would be regrettable; the growing popularity of exhibitions in France, at least, demands that each shall surpass its predecessor in extent, and although smaller but more choice collections would certainly be infinitely preferable, in many respects they would not please everybody, and an element of success would be lost. The grand point is that though immense there is no complication, the plan is as simple, I might almost say as natural, as could well be conceived.

The building which created such interest in 1851 owed much of its success to its simplicity of plan, and consequent grandeur; the view from end to end was unbroken and most striking, and the grand centre of the whole where the transept intersected the nave, and where stood the famous crystal fountain, presented four views such as had never before been seen. The building in which the exhibition was held in the Champ de Mars, in 1867, was a fine structure, but just in proportion to the departure from a simple principal was the loss in effect; the curvilinear form adopted was undoubtedly a mistake, there were no grand vistas, no real centre, and the radiating lines made arrangement extremely difficult. No such mistake has been made this time, all the lines are rectilinear. The Crystal

Palace was on the plan of a simple cathedral; the Exhibition building to be used next year resembles the Escurial; the former had one grand nave and a transept, the latter has eight naves and four transepts and vestibules. The length of the nave of the Crystal Palace was 1,848 feet, if my memory serves me correctly; I have no means of reference at hand; each of the eight naves of the new building is nearly 2,200 feet long; the vista, which includes the two vestibules, is more than 2,360 feet, and each of the transepts and vestibules more than 1,100 feet. The vestibules, in which are the front and back entrances, have the whole of the eight great industrial courts opening into them; the view is perfectly uninterrupted from end to end of each of these courts; only in the middle is there no vista. This is devoted to the fine arts, of which I shall speak presently. The eight industrial courts are all parallel, but they are divided into two series of four each, by the garden, one series being devoted to the productions of France, and the other to the rest of the exhibiting nations. The two series are precisely alike, but the order of the courts is inverted. In each case the outer court, 116 feet wide, is devoted to machinery, and the three inner courts to manufactured articles. The machine courts and the two vestibules are very lofty, the former being lighted by a clerestory at each side, the latter being nearly all glass in front and behind too, above the six industrial courts which have low pitched roofs, half glass. Thus, where general effect is to be obtained, there will be all the light that can possibly be required, while the half-glazed roofs of the industrial courts will certainly be advantageous to the effect of the objects exhibited. The outer portions, that is to say the vestibules front and back, and the two machinery courts which form the sides of the quadrangle, are constructed on massive piers made of wrought iron plates riveted together; the lower industrial courts are built upon light cast iron pillars, which, as in the case of the Crystal Palace, are hollow, and serve to carry off water from the roof. These three courts have between them two corridors, each sixteen feet wide, running the whole length of the building; there are no separating walls in this portion, so that the three industrial courts with their two intervening corridors form one quadranglar building, in round numbers, more than two thousand feet long and two hundred and sixty wide. The effect of these magnificent vistas cannot fail to be magnificent. I almost regret the absence of galleries for the mere sake of the views that would be obtained from a higher standpoint than the floor.

I have said that the view along each of these courts is unbroken; this is the fact, yet the courts themselves are not quite unbroken. M. Krautz has most ingeniously, as I think, introduced a novelty in his plan, namely, two transepts which intersect all the courts yet are not seen until the observer actually reaches them; these are carried up, entirely of glass, and unite with the roof of the courts in a very elegant manner. These two transepts will form charming resting places for the wearied visitors.

In the middle of each of these transepts is the entrance —or, rather, an entrance—to each of the two ranges of fine art galleries which occupy the large portion of the garden, which is about 200 ft. wide. Each of the series of galleries is divided into about seven large and 14 small rooms. In that part of the garden lying between the two transepts is to be erected a special building, not yet commenced, for the contributions of the City of Paris—architectural, archæological, educational, sanitary, &c. I should mention that, beyond the machinery courts, annexes have been added, to give additional space.

A good feature in the plan is the formation of a covered way—by means of a projecting roof—all round the outside of the building, and also all round the enclosed garden.

It is important to state that the whole of the walls and roofs—with a single exception, the half of one of the industrial galleries on the French side—are finished, and a very large portion of the flooring and glazing done.

Little architectural effect has been attempted in the Champs de Mars, and I think this wise. The central entrances, not yet finished, and the pavilions at the four corners—executed in masonry—will have domes, and the glazing of the fronts will, according to the plan, be ornamental, the glass being set in geometric figures.

It is on the opposite side of the river, on the hill of the Trocadèro, that the architect, and not the engineer, reigns supreme. The building—which, during the coming exhibition, is to be devoted to the history of man in all periods, from that of the savage down to the most modern appliances of science, and charms of art, which minister to the well-being, the comfort, and the elegance of civilised life—is afterwards to be another museum, under the municipal authorities. It is a very large and handsome structure, with a façade nearly 1,400 ft. in length. It consists of an immense hall, nearly circular, for concerts—and, possibly, other entertainments—capable of containing 7,000 persons, the half of this structure facing the river; and the exhibition building beyond it, with which it coincides, has a colonnade of many arches, and is to be crowned with a dome and two minarets. From this central building stretch wings with a gentle curve, colonnaded and broken by pavilions, and terminating in other and larger pavilions. Two buildings of considerable size also connect the wings with the centre. The whole of these parts are divided into grand exhibition rooms. The material work is all done, with the exception of the dome and minarets of the central building; the interior of this amphitheatre, with its forest of scaffolding, is an extraordinary sight at present. The buildings on the Trocadèro will make a notable addition to the architectural features of Paris, and will be decorated with a large number of statues, executed by the best sculptors of France.

To complete my attempt to give an idea of the plan and extent of the whole of these palaces of industry and of art, I must mention that the front of Champ de Mars is about eight hundred, and that of the Trocadèro Palace about a thousand feet from the river, and the whole of this enormous space, with the bridge of Jena in the middle, are to be for the exclusive use of the visitors to the Exhibition. In order to achieve this the public roads on the quays are being sunk low enough to allow of their being arched over and completely hidden from sight, this is a heavy job, especially on the side of the Trocadèro, where a tramway as well the ordinary road has to be dealt with. These works also are nearly completed.

The ground enclosed between the two buildings is nearly as large in extent as the Champs de Mars, and with the river bisecting it, or nearly so, will make a noble garden; large trees are being conveyed and planted there daily, plantations of shrubs and flower beds are being prepared, a lake of considerable size is ready, and from beneath the great circular building mounted on the summit of the Trocadèro will fall a large stream of water over a series of cascades, while fountains, statuary, and flowers will be scattered in profusion. In this ground and around the building in the Champ de Mars many subsidiary structures are rising for various purposes, and hundreds of men are employed in changing waste land into a park; the quays are being modified to add to the resources of the Exhibition, the means of ventilation, of the supply of water and steam, and many other supplementary works are proceeding simultaneously; but I have written enough for the present. Let it suffice to say, that not only is the present the largest and grandest scheme of the kind yet conceived, but according to my judgment, is being carried out with such energy, that the question of readiness is already settled.

ADULT INSTRUCTION THROUGH PUBLIC MUSEUMS.

(Subsidised by Parliament.)

The following results, giving important information bearing on public education, are obtained as correctly as possible, from inquiry and Parliamentary returns, in the hope that they may hereafter be officially collected and published periodically, like the Registrar-General's returns. The number of visitors for the month of September, 1877, are stated. When they are counted by sight the letter "S" is used, when by turnstile the "M":—

Institutions.	Amounts voted in 1877.	Number of Visitors in September.	How counted.	Observations.
1. British Museum	£ 109,990	37,908	S	Return refused. Open Mondays, Wednesdays, Fridays, and Saturdays. Closed, except to students, on Tuesdays and Thursdays. (1)
2. National Gallery, Charing-cross	6,976	71,395	S	Open Mondays, Tuesdays, Wednesdays, and Saturdays. Closed on Thursdays and Fridays. Open from 10 to 6. (2)
3. Kew Gardens and Museum	22,622	68,418	S	Open on Sundays and week days. (3)
4. South Kensington Museum	38,922	76,334	M	Open morning and evening till 10, on Mondays, Tuesdays, & Saturdays. Students' days—Wednesday, Thursday, & Friday, 6d. entrance. Open from 10 till Sunset.
5. Bethnal-green Museum	7,600	48,149	M	Ditto. (5)
6. National Portrait Gallery, South Kensington	2,000	..	M	Return refused. Open daily except Sundays. (6)
7. School of Mines and Mining Record Office, Geological Museum, Jermyn-street	8,997	1,985	M	Open daily, except Sundays and Fridays, and in the evenings till 10 of Monday, Tuesday, and Saturday. (7)
8. Patent Office Museum, South Kensington	..	21,170	M	Open daily, except Sundays. (8)
9. Edinburgh National Gallery	2,100	11,096	M	(9)
10. Edinburgh Museum of Antiquities	..	11,321	M	(10)
11. Edinburgh Museum of Science and Art	10,998	30,114	M	Open daily (10 a.m. to 4 p.m.) except Sundays, and Friday and Saturday evenings (6 to 9). Students' days—Monday, Tuesday, & Thursday; admission 6d.; other days, admission free. (11)
12. Edinburgh Botanic Gardens	1,750	6,610	M	(12)
13. Dublin Museum of Natural History	1,762	9,975	M	Open daily, & in the evening. (13)
14. Glasnevin Botanical Gardens and Museum	2,224	36,801	M	Open daily, including Sundays. (14)
15. National Gallery of Ireland	2,389	9,225	M	(15)
16. Museum of Royal Irish Academy, Dublin	300	..	M	(16)
17. Zoological Gardens, Dublin	500	13,986	M	Open daily, including Sundays. Number of visitors in July, 15,281. (17)
18. Tower of London	1,590	31,367	S	Open daily, except Sundays. (18)
19. Royal Naval College, including Greenwich Painted Hall	38,051	43,167	S	Open daily, including Sundays. (19)
20. Royal Naval Museum, Greenwich	1,055	8,690	S	Open daily, except Fridays and Saturdays. (20)
21. India Museum, South Kensington	..	3,375	M	Paid for by Indian Government. Open on Mondays, Tuesdays, Fridays, and Saturdays, 1d. admission; on Wednesday and Thursday, 6d. admission. (21)
22. Hampton Court Palace	7,475	20,326	..	Open on Sundays, and on week days except Fridays. (22)

(2) Open to the public 17 days, from 10 to 6 o'clock. Closed from Monday, 1st October, to Monday, 5th November. Total of nine months ending September 29th, 1,208,028. A decrease from last year.

(7) Closed from August 10 to September 10. Number of visitors in August, 902.

(9) (10) (12) (16) No information as to opening.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,301. Vol. XXV.

FRIDAY, OCTOBER 26, 1877.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

NATIONAL TRAINING SCHOOL FOR MUSIC.

The following are the regulations to be observed in competing for, and the conditions attaching to, the Scholarship founded by Messrs. Novello, Ewer, and Co.:—

1. The scholarship will be called the "Novello Scholarship," and will entitle its holder to a free musical education in the School.

2. The competition will be held at the School in the second week of December next, and will be open to male candidates only, who must be British-born subjects between the ages of 14 and 18 years.

3. The candidates, before examination, must furnish the Registrar with the following certificates:—

(*a*) A certificate, signed by a recognised local professor of music, that they have sufficient musical knowledge and capacity to render them eligible as competitors. (Form No. 3)

(*b*) A copy of register of birth.

(*c*) A medical certificate of their physical fitness for the practice of vocal and instrumental music. (Form No. 4.)

(*d*) A certificate of good moral character, signed by two well-known persons of the locality from which they come. (Form No. 5.)

4. The subjects of examination will include—

(*a*) Reading or reciting in English, and writing from dictation.

(*b*) Performance of vocal and instrumental music.

(*c*) Harmony, counterpoint, and composition.

5. Preference will be given to candidates who shall afford evidence of a special talent for composition.

6. The retention of the scholarship from year to year will depend upon the result of an annual examination to which the scholar will be subjected.

7. Applications for nominations to compete must be made on Form No. 2, which must be filled up and returned to the Registrar. The nominations, with particulars as to the days and hours of the examination, will be sent to candidates in due course.

CANTOR LECTURES.

THE CONNEXION OF GREEK AND ROMAN ART WITH THE TEACHING OF THE CLASSICS.

By Sidney Colvin.

Slade Professor of Fine Art at Cambridge.

Lecture IV.

This day week I tried to give you a sketch or summary of the historical course of antiquarian discovery, and of the accumulation of the materials of this study. Naturally, it has happened that alongside of that gradual accumulation, through several centuries, of the materials, progress has also been made in the methods of interpreting the materials. We know now a great deal better than people did at first how to interpret the works of ancient art, how to explain, understand, and enjoy them, and I want to-day to give you a sketch, following the same historical line as last week, of the development of our methods of study.

First of all, in the early days of the Renaissance, in the days when Cyriac of Ancona was traversing Greece and the Levant, and in later days than that, throughout the fifteenth and sixteenth centuries, the scientific study of archæology cannot be said to have existed. The rapid and wonderful recovery of ancient monuments was at first like the equally rapid and wonderful recovery at the same time of ancient books and manuscripts. It was attended with more enthusiasm than judgment. In the re-discovery of ancient books, in practising themselves in the reading of classical languages, in the composition of poems and histories in Latin, the Italians, in those early days of the Renaissance, seemed to themselves to be literally reviving antiquity, to be going to live again in the ancient world, to be going to use the languages, and to renovate and bring back to ancient earth again those ancient times. So it was with the study of ancient art. It was studied in a certain sense with a passionate enthusiasm and admiration, but not with a scientific and exact knowledge of what it was, and what the particular pieces discovered meant from the point of view of the original artists. These things impressed the imagination of their discoverers as new forms of beauty; but they wanted to restore them; and in their own works of art they adopted them as models, and reproduced them in a thousand ways, but with free variations of their own. Thus, among early discoveries of antiques were many sarcophagus reliefs with Neptunian subjects of Tritons and Nereids, and many others with Bacchanalian subjects of Fauns and Maenads. These we find over and over again copied by the great engraving artists of that time, copied freely and with imagination—not copied so much as adapted and transformed into new compositions, in accordance with the spirit of the time. Their imagination was awakened, but they did not feel the need of patient investigation, to see what such an antique was in its original form, and proceeded at once to some enrichment of it by restoration, and by reclothing it in what seemed, to their hasty apprehensions, the ancient spirit. Therefore, there began to be a trade of restorers. The great restorer of all was one Montorsoli, and Michelangelo himself was employed on certain statues. And so the Renaissance took a kind of crude delight in ancient monuments; but not the kind of delight we have now-a-days, in keeping them sacred as objects not to be meddled with, but to be studied with all the resources in our power, in order to find out with precision what they were and mean. As the men of the Renaissance proceeded to handle and to repeat their antiques in this enthusiastic, free, unrestrained way, altering, adapting, re-clothing with their own imaginations the things they found, so, also, they had a way of interpreting them which was very different from ours. The classical literature which they were full of, the classical past which occupied their imagination, was not the literature or the past of Greece nearly so much as that of Rome. To the people of the fifteenth and sixteenth centuries, old Roman history and Roman antiquity seemed like a part of their own antiquity and history. The history of Rome, and the legends of Rome, were familiar to all; the great masterpieces of Greek literature were only familiar to a very few of the especially learned. Antiquarians rushed at once to Roman interpretations. Or, rather, they interpreted the works of art which they found in two ways, that seemed contradictory. For one thing, the moment they found anything that seemed beautiful and wonderful, they were very prone to assume at once that it was the work of some of the great, famous artists that were known through ancient literature, the work, for example, either of Phidias, or Praxiteles, or Scopas; but although they had this hasty way of identifying whatever they found with the most illustrious Greek names, they had that other habit which seems incompatible with this, but which was still more prevalent, of explaining everything, not by Greek, but by Roman history. Thus there is that famous figure of Mercury, the Hermes of the Greeks, fastening his shoe when he is about to be sent on an errand by Jupiter. They were not accustomed to the idea that ninety-nine out of a hundred of all works of Greek and Greco-Roman art are representations of Greek mythology. They naturally thought of Roman history, and said, this figure, preparing to start on a journey suddenly, was Cincinnatus summoned from the plough to save Rome. Similarly, there is one of the things early discovered in Rome, and one of the most beautiful now there, an elaborately draped, reclining woman, with her arm flung over her head, wearing two armlets partly injured (but they are now restored) in the form of snakes, one on either arm. To us, who have other things to compare with this figure, and who know what the nature of such representations was likely to be in ancient art, it is not hard to interpret that well-known figure. There is no doubt at all what it is. It is an Ariadne lying in her abandonment on the island of Naxos, after being deserted by Theseus; but to the Renaissance Italian, who thought first of Roman history, he looked simply at the form of the armlet, and called this Cleopatra; and so it has been known, and is still, in the ordinary guide-book account of these things. Similarly with many other figures. There are ancient records of a group which was set up on the Acropolis, that is to say, outside the wall of the Acropolis at Athens, by a king of Pergamos about 200 years B.C., in commemoration of a great historical victory, a victory of his people over the invading Gauls, or Galatians as we call them now, in Asia Minor. We know from ancient authors that this group existed, and there is a very famous figure which undoubtedly belonged, if not to that group itself, at any rate to an analogous subject of conquered Gauls, viz., the figure commonly known as the "Dying Gladiator." The early interpreters, thinking still of Rome, finding this reclining figure leaning on one arm, bleeding from a wound, called it the "Dying Gladiator," and associated it with the Roman gladiatorial games. There is another group which happens to be made of the same marble, and in all technical points exactly like it, in a private collection at Rome, the Villa Ludovisi, of a similar Gaulish warrior in the act of suicide, stabbing himself, while just beside him is the corpse of his wife, who has been already stabbed. The old interpreters, not having the ancient literature relating to the subject in their mind, thinking only of the literature of Roman legends, gave one of two interpretations to this man stabbing himself with the slain woman besides him. Either, they said, it is Virginius who has just stabbed his daughter and then stabs himself, or else, turning to the history of the old Roman empire, and a particular conspiracy that happened in the age of Claudius, they said it is the representation of Arria, who sets her husband an example of fortitude. Those are examples of the hasty, mistaken interpretations of the early students of these things, which have remained in popular currency, in many instances, to our own day.

But as the study of antiquity got a little clearer, still the same idea prevailed. We find the same mode of interpretation, not by Greek authorities, but by Roman authorities, and particularly Ovid, or by passages of some other Roman poet. Coupled with that was the supposition, which is an entirely erroneous one, that the poets were the great and only inventors in the early world, that it was they who told the story, and then the business of the artist was (just as the business of the modern artist is to illustrate a novel) to take the subject which a poet had given, and by sculpture, or painting, to illustrate that. One of the most interesting and entertaining monuments of that mode of interpretation is an English book published in the last century, which had a great reputation in its day, and which is a monument of elegant English scholarship of the time, the "Polymetis" of Spence. In that book the scene is laid in a refined country circle of society; the owner of the house in which the action and the conversation take place is represented as having his grounds laid out with temples, corridors, and buildings, and as having grouped in these temples and corridors casts and reduplications of well-known ancient works of art. In this way Spence goes through almost all the then known existing works of art, and brings to bear on their explanation a vast range of Roman literature, of Ovid especially, but scarcely ever touches the Greek authors at all. He makes his work an entertaining book, but on a basis now utterly obsolete. First of all, we know that the prevalent stock subjects of ancient art are not subjects of real life and real history at all, still less of Roman life and history, but inventions of the Greek mind, the whole legendary range of Greek mythology; and the great mass of late Roman art, such as are the things which have been chiefly found in Rome, are copies and echoes of these Greek ideas. That is one main point which later criticism has established. And another is that the artists and writers do not hold the same kind of relation to one another as they were supposed to do by the mode of interpretation I have described. Ancient artists did not hold the same relation to ancient poets and historians that a modern illustrating artist holds to a modern novelist or poet. The work of art is not, in that strict, literal way, an illustration of the poem, but it is an embodiment of the same idea as the poet embodies in his own way, under other laws—the laws of the particular art of the sculptor or painter. You are, most of you, familiar with the great work of historical criticism which for the first time laid down broadly and clearly, in a way that can never be contested, the foundation of this distinction. Of all the ancient works of art that were likely to seem to people to be a literal illustration of literature, the famous group of the Laocoön was perhaps the most striking. Everybody was familiar with Virgil's incident of the destruction of Laocoön and his children by serpents in the Æneid. It was so familar to everyone that it was obvious and natural immediately to connect with this episode in Virgil the famous marble group of the Laocoön and his children strangled by serpents. A great German of the last century, Lessing, took this particular point as the centre of his study; he compared the Laocoön group with the poem in Virgil, and showed, in the most masterly criticism which had ever been produced, that it is idle to look in a work of that kind for a literal illustration of the thing as it has been conceived by the poet, and that the way to study sculpture is to regard it as having been independently conceived by the sculptor, and worked out according to the laws and methods of his own art.

Now, I tried to bring home by an example—and a very pointed example it is—the necessity in our study of remembering this point. The example was taken from the frieze which goes round the Choragic monuments of Lysikrates, at Athens, and which represents the victory over Tyrrhenian pirates, in connection with the Homeric hymn describing the same event. We then saw that this Attic frieze was not, in our modern sense, an illustration—that in it certain points of the legend which did not lend themselves to sculpture were altogether neglected, and other points which were the natural language of sculpture were introduced; that the idea was interpreted not in the poet's, but in the sculptor's way. Lessing arose, and established that distinction between these two branches of art, and that was only one of the immense services wrought in the eighteenth century, and especially in the latter part of the eighteenth century, to the scientific study of antiquities. The study of such antiquities altogether had received an immense impulse from various events which happened in the eighteenth century. First of all, by the dramatic re-discovery of Herculaneum, leading up, subsequently, to the re-discovery of Pompeii. These cities, buried under the ashes of Vesuvius, yielded their treasures in a way that naturally appealed to and struck the mind of Europe. That was one thing which gave an immense impulse to this study in the last century, and another thing which, perhaps, on the whole, did most of all for the really accurate study of art, especially of Greek art, was the expedition of two Englishmen, Stuart and Revett, to the coast of Asia Minor, and especially to Athens. For the first time properly trained architects and draughtsmen went and examined, and measured, and drew in Athens; and their work has been followed up in our own century by illustrious successors; the work they began in 1752 has been followed out by men of our own time, as by Mr. Cockerell and by Mr. Watkiss Lloyd. Coupled, then, with the rise of a learned and serious criticism in Germany, coupled with the eager movement of men's minds on the discovery of those ancient buried cities, we have to think of this scientific expedition, for that is the proper name of it, of Stuart and Revett, in which they drew and measured accurately and authentically the buildings and sculptures of the Parthenon, and other Athenian monuments, as a third great impulse given to this study in the eighteenth century. There is also a mass of minor impulses. I spoke last week of the enthusiasm with which young English noblemen collected and bought very often bad things, and stimulated what was a mischievous manufacture, and putting together of heads, and legs, and disjected portions of Roman statues in Rome; but still, with all that, we acquired a great many precious things. At that time, in 1734, in the first half of the eighteenth century there was formed a society especially for the study and collection of these things, the Society of Dilettanti, which has existed from that date to this, and in the course of its career has done excellent work.

Besides Lessing in Germany, the great pioneer of the criticism of these things, there was another great German who laid the foundation of the history of ancient art, just as Lessing may be said to have laid the foundation of its criticism. Winckelmann laid the foundation of the history of ancient art. You know how he made his way from the Court of Saxony, where he was librarian, to Rome, fired by an unbounded enthusiasm of these things; and how the result of his labours was to bring together for the first time a coherent systematic sketch, founded partly on what we know from literature, and partly on the existing monuments, of the history of the actual growth and development of Greek art. His work can never be wholly superseded. Partly the fire and enthusiam which led him, in spite of all difficulties, to devote his life to this study, partly the genius and insight of the man, which enabled him from the works of Roman art to divine the course and history and character of Greek art, and partly his colossal literary learning, have justly made his name the greatest founding name in the history of ancient art. But there was one thing in Winckelmann's way which made it quite impossible that he should advance the study to its final point. He did not know the works of original Greek art. What he knew was the things which were then collected in groups in the Vatican and elsewhere in Rome, the works discovered especially in the fifteenth and sixteenth centuries in and about Rome, which had ever since their discovery been established and accepted as the canon of beauty, and greatness, and perfection.

In Winckelmann's days the Laocoön, the Apollo Belvedere, and certain works of late Greek art, or of Roman art imitated from the Greek, stood in all men's minds irrecusably as the great and perfect types of ideal art. Winckelmann was not able to go beyond his age. His criticism of the Apollo Belvedere moves one to this day with its beautiful thought, its lyric fire and enthusiasm, but it is wanting in a certain discrimination which could only be supplied by the study of real works of Greek art. A work like the Apollo

Belvedere, striking and beautiful in a certain sense though it may be, has yet precisely those qualities which are not the qualities of the great Greek art of the great Greek time. The first and perhaps the chief difference is, that it has a certain artificial and theatrical bearing which is very different to the consummate unconscious majesty of the time of Phidias; but beyond that, there is the mechanical character of the execution, which belongs not to the greatest age of art, but to an age of clever imitators. If we examine sculptures of this class, though they exhibit much mechanical smoothness of finish, still, if we compare them with the things we now know, and have to compare them with, namely, the Elgin marbles, we find that they have not that infinite richness, minute diversity, and preciousness of surface which belongs to the great Phidiac time. It is rather an empty mechanical smoothness, leaving out a great deal of the reality of nature. Thus, in the mind of Winckelmann the leaving out and softening down of nature came to be accepted as part of the grand style; it came to be regarded as necessary that work should be more or less empty and superficial, that the natural varieties of the surface of the skin, of the surface of the flesh parts, of the impression of the bones under the skin—it came, I say, to be considered indispensable to the grand style, that these natural details and varieties, which really give half its preciousness and beauty to sculpture—should be left out. That was a great and fatal error, and an error that only one thing could possibly remedy. That one thing was the event which, as we heard last week, happened in the early part of this century, the bringing over of that rich collection of the existing remains of the work of Phidias, the sculptures from the decorative parts of the pediments and frieze and metopes of the Parthenon at Athens. In speaking of the transference of the Elgin marbles to London, I spoke of the opposition which Lord Elgin met with, and the clamour and outcry which was raised at the time by certain so-called great authorities in England against his marbles. These so-called great authorities, having their minds and eyes full of the comparatively shallow Roman work, would not accept the true Greek, and declared they were of no value. For ten years this struggle was kept up, until those who were really competent to speak—such as Visconti, Canova, Haydon, the enthusiastic painter, and others—succeeded in persuading people that there was something in them. Then, by degrees, several eminent sculptors, such as Flaxman, Chantrey, and others, all agreed in asserting their pre-eminence, and so, by degrees, the revolution of taste was effected. The consequence of bringing here these Elgin marbles, and of the eyes of sculptors and students being accustomed to them, was a greater advance in the study than had ever been made before. It was the placing of the study on an altogether new footing. We were for the first time brought face to face with the real work of Greek art in its greatest time, and we were able to realise what that was; to realise what that character—defined by a late Greek writer, with signal felicity, as "a perfect mixture of the two qualities, greatness, or grandeur, and exactness"—really was. With that the study was placed on a new basis, and since that time many new aids to the study and improvements of method have, one after another, succeeded. It is in Germany that the study has found its most clear and best exponents. The great successor of Winckelmann in the nineteenth century, who grasped the whole range of the study as far as it could be grasped in 1835, and who wrote a famous handbook which to this day remains the A B C of the subject, was K. O. Müller. He has had a goodly army of followers, whose names time would fail to mention, and who are still carrying on the study with an activity to which in England we have no parallel; but there are a few names, and amongst them are some of the greatest of men who among us have systematically studied ancient art; but in our Universities we look absolutely in vain for a systematic study of this subject, and it is in order, I believe, to awaken in some degree an interest in it, that I have been asked to give this sketch of the study here. Then, besides the devotion of a number of men of learning and fine insight to this study in Germany, and a few such men here; besides this great concentration of energy and power upon the study, continual new material has been discovered. That great discovery of vases which began in Campania in the latter part of the last century has contributed much. I told you how the English ambassador, Sir William Hamilton, was the first great excavator and collector of vases, and how his work was followed up by innumerable discoveries in Italy, Sicily, and the coast of the Mediterranean during the last sixty years. The recognising of this or that coin as miniature types, which we can compare with accounts in ancient literature, being the reproductions in small of famous works of ancient art, has been another great aid. Coins, gems, and vases, and small objects in terra-cotta, these minor objects have been daily, one may almost say, discovered and examined by scholars, and analysed in relation to the major works of art and to the literature of the subject, from the earliest to the latest periods.

Now I wanted, as giving some life and colour to to this rapid sketch of the gradual improvement in the methods of archæology, so far as is possible by the very second or third hand method of diagrams, to show you the way in which such and such a monument was interpreted. For that purpose, I have taken an example which can easily be verified by yourselves, namely, the remaining fragments of the sculptures of the western pediment of the Parthenon at Athens. You know, all of you, in the Elgin Room of the British Museum, the magnificent fragments of the Parthenon pediment. Perhaps those on the eastern side are the most beautiful and the best preserved. But still we know less about that composition and its interpretation than those on the western or left-hand side of the room. I shall tell you by-and-bye from what materials the approximate restoration of the composition, as it appears in this diagram, has been effected. This figure in the corner, representing the Ilissus, is the last figure as you go along the right. That is almost complete. The next two, the male and female, the woman on her knees starting in an attitude of alarm at the contest going on in the centre, and with her arm round the neck of the sitting man, for some reason or other, were not brought away by Lord Elgin; they are injured, but are still in their place in the pediment at Athens, Of the next three figures that appear in the diagram.

there is nothing at all preserved, or, if anything, they are the merest fragments. The two great contesting figures in the middle have in like manner disappeared, but for fragments. Athene, the special Goddess of Athens, the Queen of Light and Wisdom, is here engaged in a contest with Poseidon, the God of the Sea. Of these two great contesting figures, the arms, a portion of the breast and ægis of Athene, and two portions of this heroic, colossal torso of the Sea-God—one great block, almost as much a specimen of geology as of art—only remain; but enough of it remains to show its indescribable grandeur. One block is at the British Museum, and another at Athens. These horses are problematical. We know there was a team there, but whether they were horses, sea-horses, we cannot say; every part of the horse has entirely disappeared. Of this charioteer, a beautiful fragment of the body, with the arms, remains. Then, next, we come to this woman with the child, and another female figure; and of these, I think, again, I am right in saying that nothing remains. Then we come to the reclining figures in the corner; the whole upper parts are shattered and lost, but what remains is in the British Museum—the lower parts of the figures. But these destroyed, defaced, crude fragments are enough to enable us—with the help of our other variously acquired aids to knowledge—to realise what the grandeur and exactness of Phidias means. Any student of art has only to look at, and touch, and examine one of these memorable fragments, worn as it is, to realise the perfection and grandeur of the workmanship. Our other materials for the reconstruction of the composition, besides the remains themselves, are these. You know how this wonderful building, the Temple of Athene at Athens, had survived all the storms of ages, and stood in amazing perfection and beauty up to quite a late time in history. It was not until the year 1687, one September evening, that the great destruction happened. There was then a war between the Venetians and the Turks. The Venetians had carried on a successful war against the Turks, and had made themselves masters of the Morea; and it seemed as if they were going to hurl the Turks out of Greece, if not out of Europe. They laid siege to Athens; the Turks entrenched themselves within the Acropolis, and the Parthenon was made the powder magazine. A deserter from the Turkish camp told the Venetian leaders that the powder magazine was there. The Turks thought that possibly the besiegers would spare this temple, the church, as it had been, of the Byzantine Christians. But they did not spare it, and on that September evening, a shell struck in that powder magazine, a great explosion happened, the sides of the building were shattered out, and the whole of the columns were overthrown, with the exception of a few at either end. In that great destruction, of course, a vast quantity of the sculpture was also destroyed, but a considerable portion still remained. Then there were horribly clumsy attempts to bring some away. These horses, which had always commanded an immense amount of admiration, were removed. The conquering Venetian General determined to bring them home in triumph, just as the four bronze horses had been previously brought home from Constantinople, which now adorn the Place of St. Mark, at Venice. He got workmen and ladders, and they went up and tried to bring down these horses, but so clumsily, that they fell and were shattered to pieces on the pavement below.. However, fortunately, twelve or fourteen years before this great destruction, people had been there who had seen the sculptures in their place, and made drawings from them. Two drawings of this pediment, as it was a few years before, were made, both by Frenchmen—one by Jacques Carrey, whose drawings are still preserved in Paris, and the other by an unknown architect or clerk employed by the French Ambassador, the Marquis de Noailles. The drawings were completed with the exception of these horses, for there is a great gap on both drawings where should be placed these horses, or hippocamps. There is also a figure of a dolphin which does not appear in this diagram.

These figures being what you see, let us proceed to the interpretation. Pausanias, our great authority for ancient works of art, who travelled about Greece in the 2nd century after Christ, and tells us what he saw, has described this in a tolerably accurate manner. Of course, there was in old times a great mass of literature relating to these things, quantities of books, of which that of Pausanias is the only remaining example, describing works of art with exactness, and criticising them. About many temples, for instance, those just discovered at Olympus, Pausanias gives very full details indeed; but about this Parthenon, curiously enough, he is very brief. He tells briefly what was the subject of its front or eastern pediment, and also of its rear or western pediment. Over the front was the birth of Athene, and over the rear the contest between Athene and Poseidon for the country. Athene and Poseidon respectively desired to be the patrons or tutelary deities of Athens, and in the contest each of them produced gifts in support of the claim to this tutelary position. The gift produced by Athene was the olive, a thing most useful and held most sacred in Greece; whilst the gift produced by Poseidon was a spring of salt water, by which is symbolised the sea, the source of the commercial riches of Athens. However, the olive was preferred, and Athene won. That, in a very bald form, is what is given us as an account of the contest by many ancient authors. It was regarded by the Greeks a real historical event, of which actual, tangible memorials remained, and might be seen. There was an olive tree, which was the sacred olive tree supposed to be created by Athene; and there was the salt spring supposed to be the Thalassa, gushing with salt water, produced by Poseidon. Both of these were enclosed within the precincts of the ancient and most holy temple of Erechtheus, on the Acropolis. Of the course and details of this legendary contest, the most particular account we have is that given by a late writer, who describes it thus:—That in the days of Cecrops, King of Athens, the gods began to desire a partition of the earth, and that each one should have a special country, of which he should be the tutelary deity, and should receive especial worship; that, at that time, in this desired partition, Poseidon was the first who came to Attica, and claimed his right; that he struck the soil of the Acropolis, and produced the salt spring; that after him Athene came to claim her right, and produced the olive; that a contest arose, and a tribunal of the twelve gods was called in to decide the quarrel; and the country was adjudged to Athene because of the evidence borne by King Cecrops, who proclaimed that Athene had been first in producing the olive. Then it adds that, after this contest, because the olive was preferred, and because Athene was chosen by the tribunal tutelary goddess of Athens, the rival claimant was enraged, and, determined on vengeance, came up with the horses of the sea, and overwhelmed the country, especially what is called the Thriasian plain, a low-lying district near to Salamis. There are a few other versions of the story, especially one by Ovid, giving it a slightly other turn, but in the main that passage gives us the incidents of the story which come into the interpretation.

Beginning with these central figures, there is no doubt at all that we have here the figures of Poseidon and Athene in the attitude of strife. Then, proceeding more in detail into the interpretation, what incident of the combat is presented there? Even in Greek figures of which the whole is preserved to us, the exact interpretation is often difficult. The Greek artist does not represent incidents as we do—his art is not realistic. The Greek senses and perceptions were much finer than ours; all that they asked was that the deity or figure represented should by some attribute show who he was, and that the particular action in which he was engaged should be no more than adumbrated or indicated. Again, the form of the pediment space dictated how the figures should be placed in various attitudes, stooping or reclining, and if there was such a group on one side, there must be such another on the other side to balance it, and maintain the general symmetry. All that imposes restraints and conditions which make the precise expression of the dramatic purpose much harder than it is in modern art. Various interpretations have been given as to the moment of the strife. Our time is rather short, and I shall deal chiefly with that which has, on the whole, been most accepted. It is this—that the strife is over; that probably here, between the parting combatants, were introduced, not only Athene's olive tree, but also the water spring which Poseidon produced; that Athene is stepping back to her chariot; that Poseidon is in the attitude of enraged retreat; what the exact gesture of his arm or her's was, we cannot tell; it is pretty certain, however, that his trident was directed downwards; they were not in an attitude of direct combat one with the other, because that the greater gods should be so represented in actual conflict would be irreverent and undignified.

Now for the other figures. It is quite clear the twelve great gods are not there as judges. We can see that here is on one side the following of Poseidon, and on the other the following of Athene. Poseidon's charioteer would be his wife, the sea-goddess, Amphitrite. Then, when you see among the train of the sea-god the form of a woman and child, we can be pretty sure who they are likely to be. There was a princess of Thebes, Ino, who had a son named Melicerte, who, in a moment of frenzy, rushed to a certain precipitous cliff beside the Saronic gulf between Athens and Corinth, near Megara, and plunged over into the sea with her son. They became afterwards the tutelary deities of mariners, and were known as Palæmon and Leucothea; in that transformed sea state they were worshipped by mariners as deities. Following on these, we see that, according to the drawing, there was a great, dignified sitting figure of a robed matron, with a smaller figure of a naked woman on her knees, and near that a figure of a child. We know that no power is likely to be represented naked except the goddess of Love, Aphrodite. We know also, that Aphrodite was born of the sea, that she would naturally be found along with her son Eros, the god of Love, and in the lap of the sea-goddess, Dionè or Thalassa. We shall not go wrong, therefore, in interpreting the figures of Poseidon's following. But now to come to the chariots and attendants of Athene. It is a very common representation, when any two powers, or deities, were in conflict or contest, that the victorious one should be attended by the figure of Victory, and very often Victory is the charioteer. Most probably, therefore, this charioteer is Victory. In many cases the charioteer is accompanied by the god Hermes, and probably the figure behind the car represents that god. Then we shall not have much doubt about these three figures, the two women and the child—the naked boy, in the attitude of alarm, rushing to his mother. When, in connection with any scene in ancient mythology—especially one which has to do with anything happening in Attica—we see three associated figures of this kind, two women and a boy, those are sure to be two particular goddesses, who are associated with a youthful boy god, and the great seat of whose worship was close to Athens, namely, Demeter, or Ceres, and her daughter Persephone, and the accompanying figure the boy-god Iacchos, the special boy-genius of the orgies and mysteries of Eleusis.

About these figures at the end there has been much discussion. Some interpreters will have it that this is probably the Attic King Cecrops and his wife, while others of equal authority say that they are probably figures of the powers worshipped in the Acropolis, the god of health and the personification of health, Æsculapius and his daughter Hygieia. About the two reclining figures in the two corners there can be very little doubt indeed. In the pediment angles the two river gods were placed, figures personifying the rivers of the district, the Ilissus and the Cephissus; and it is natural to suppose that these river deities would be distributed according to their proper geography, and that each figure should be nearest the stream which he represented.

I ought to say that, by an excellent authority, a different interpretation has been placed upon this group. The incident has been supposed to be, not the central incident of the strife in which Athene, having been declared victorious in virtue of her creation of the olive, the two parties separated apart each to their respective chariots, but the moment following the conflict, of which I have already spoken, the revenge of Poseidon. You remember that when he had been beaten, in his wrath he rose with his power and flooded the Thriasian Plain. The rival interpretation is that here we have a representation of Poseidon, having advanced as god of the sea, flooding the Thriasian plains against Cecrops, and that Athene is in the posture of checking the advance of Poseidon in that revenge. The main reason, which I confess to my mind is conclusive against that interpretation, is that it is not likely that the artist would have taken such a subordinate incident rather than the central moment of the strife.

It is remarkable that, of all the minor works of art which have a resemblance in any degree to this composition, the one which offers most resemblance at the same time seems most to lean towards the latter interpretation. This is a beautiful vase with figures in relief, preserved at St. Petersburg. I have here another diagram representing it. The comparison of the two will, I think, help you to realise the various ways in which it is necessary to deal with every work of art, before you can arrive at anything like a certain interpretation, and will illustrate that which I have called the completeness and complexity to which the study in our time has arrived.

MISCELLANEOUS.

PHILADELPHIA EXHIBITION REPORTS.*

Agricultural Machinery.

Mr. John Coleman contributes a rather elaborate report on the subject. Unfortunately for this department of the Exhibition, the principal English makers had decided not to exhibit. The reasons for adopting this course were three, the heavy tariff rendered American business impossible; the expense of transporting machinery was very heavy; and they were not inclined to supply the American makers with models for them to copy. This policy Mr. Coleman considers but short-sighted. There were at Philadelphia people from all parts of the world anxious to obtain either information or the actual machinery. With regard to these, the Americans had it all their own way, so that the reporter thinks English makers will now find that they have competitors where before the business was entirely in their own hands. The Canadians had a good collection, being incited thereto by the offer of special medals made by the Canadian Government. But without our aid the Americans made a goodly show, as might be expected in a country which had done so much for the invention and improvement of agricultural machinery. In crediting America with the first reaping machine, Mr. Coleman somewhat unpatriotically ignores the strong evidence in favour of Bell, the Englishman, whose machine is now in our own Patent-office Museum, and adopts, as an admitted fact, the very doubtful claim of McCormick. Be this as it may, it appears that in later improvements the Americans have run us very close, if they have not passed us by. One peculiarity of the American trade is mentioned, that the makers generally confine themselves to the construction of a single class of implement; they make this a speciality, and devote all their energies to its improvement. Our own makers, of course, are accustomed to supply the farmer with a variety of machinery. The first class noticed comprises tilling implements. The ploughs generally employed in the Western States are "gang ploughs" and "sulky ploughs," with a driver's seat in the centre of a frame supported on large bearing wheels, the plough bodies being suspended from the axle. The curious fact is noticed that after the War these "riding ploughs" came largely into use, on account of the large number of maimed ploughmen. Many varieties of cultivators and horse-hoes were shown, some of these specially adapted for Indian corn. An expedient, mentioned as original by the reporter, in one of these is the attachment of the tine by means of a wooden pin, which breaks, and allows the arm to fly back, if an obstacle is encountered. This device, though possibly new in practice, has been patented once, if not more times in this country.

That neither America nor Canada has adopted steam culture seems somewhat remarkable. Such, however, is the fact, and it is attributed to the superficial character of cultivating operations, the low price of horses and mules, and the general prevalence of light land. Any exhibition of agricultural implements would probably be incomplete without at least one specimen of a self-moving steam digger. One was shown at Philadelphia, but like its innumerable predecessors, it was presumably better in theory than practice; "the exhibitor was not prepared to test his invention in the field, where, according to all experience, it would not have succeeded."

The next class of machines is naturally composed of those for planting. The corn and manure drills were tested for their powers on level ground, on the side of a hill, ascending and descending a slope, and the results tabulated. The chief point noticed in the American drills consisted in their more regular feed, this being accomplished generally by a corrugated roller delivering to the seed tubes instead of the revolving cup wheel common in English drills. Many of the drills had a distance indicator affixed to them. On the whole, the reporter was of opinion that great progress had been made, and that American drills are superior to ours. In this class also the cultivation of Indian corn brings in a machine of a character unknown in this country. In planting the corn the object of the farmer is to plant in lines about four feet apart each way, and to put three or four grains at each spot, not close together, but a little scattered. This result is attained by first marking out the ground in one direction, by running the planter across the field empty, and then planting in lines exactly at right angles to the first set of lines. In the original invention no device was adopted for making the machine automatic. It requires a boy to work a lever through the action of which the seed is deposited. In a recent improvement the planting mechanism is operated by knots on a rope made fast across the field; other means are also proposed for the same purpose.

Among the harvesting machinery were some curious varieties of apparatus. The "heading machine" referred to by Mr. Coleman is not described, but he contrasts its "clumsy look" with the more finished modern reapers. Probably the fact that such machines are used at all will be new to many of our English agriculturists. The chief point of novelty in connection with the reapers was the automatic binding apparatus attached to some of them. Four of them were tried, and succeeded at least creditably. It may be remembered that McCormick's machine attracted a good deal of notice two years ago at the Agricultural-hall, and the recent trial of these machines by the Royal Agricultural Society will be fresh in the memory of those interested in such subjects. Both with reapers and mowers, the great advance has been in the direction of simplicity of mechanism, and it is curious to contrast the best machines of our modern makers with the elaborate and complicated apparatus of comparatively few years ago. Endless bands for carrying off the cut crop, archimedean screws for the same purpose, long trains of gearing for driving the cutters—all have gone, the last being reduced, in a machine described by Mr. Coleman, to a single pair of bevel wheels, one on the wheel axle and the other mounted on a gimbal joint, so that it "does not revolve, but, when set in motion, makes a series of rapid serpentine vibrations around the face of the other wheel," and drives the cutters direct through an arm.

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* Continued from p. 983.

The thrashing machinery Mr. Coleman thought inferior to our own. Steam power seems to be but little used, large horse gears being generally employed. A patent spring for accumulating the power and preventing shocks from sudden starting of the horses was shown by one exhibitor, and it is favourably noticed by the reporter.

Corn shellers and huskers are necessitated by the Indian corn, and here again we find a class of machine not known in England.

The portable engines shown were mostly American. Mr. Coleman is "of opinion that the best forms of portable engines in this country are greatly superior in efficiency." There was nothing very remarkable among the chaff-cutters, root-cutters, &c. Some corn mills were shown including some minor novelties.

The American plan of dairy farming, on the factory system, was illustrated in a special building, and there were other interesting exhibitions in this class.

Under the head of apparatus connected with laying out and improving farms, were two curious machines for making fences, one for making wooden fences and the other wire. In the latter the fence as made is wound on a barrel ready for transportation. For clearing land steam power is not employed; several manual root and some extractors were shown.

The report concludes with a notice of some miscellaneous exhibits, the principal of which were some new forms of windmills for pumping, grinding, chaff-cutting, &c.

Electric and Telegraphic Apparatus.

Sir William Thomson's report on this subject is very brief. He refers to his special awards and reports for any remarks on the objects exhibited, and merely gives in his report a few general remarks on the scientific departments of the United States. He speaks somewhat strongly as to the advantages of the American patent system as compared with our own, and urges the desirability of lowering the fees and augmenting the term for patents in this country.

CAXTON FAC-SIMILES.

Amongst the publications to which the recent Caxton Exhibition gave rise is a small work in quarto, entitled "Fac-similes, illustrating the labours of William Caxton at Westminster, and the Introduction of Printing into England, &c., by Francis Compton Price, London, privately printed." It commences with a short memoir of our first printer. There are ten fac-similes, and each is accompanied by a bibliographical notice. The fac-similes are—1. An indulgence granted by the Pope's legate, John Kendall, to those aiding in the defence of Rhodes against the Turks, in favour of Simon Mountford and his wife; it is on vellum, and bears date 1480; it is in the British Museum. It has an ornamented initial letter, said to be the earliest known specimen printed in England. John Kendall was Grand Prior of the Order of St. John of Jerusalem in England.

2. Caxton's advertisement, in shape of a handbill, said to be the first "broadside" printed in this country; it is said to have been printed previous to 1480. The original, or rather one copy, is in the Booleian library, and another in the possession of Earl Spencer. It runs as follows:—"If it plese ony man spiritual or temporel to bye ony pyes of two and three comemoracios of salisbur use enprynted after the forme of this preset letter whiche ben wel and truly correct, late hym come to westmonester in to the almonesrye at the reed pale and he shall have them good chepe ⁂ Supplice stet cedula." The "pyes" alluded to were rules of the church of Salisbury for the offices of Easter, Whitsuntide, and Trinity.

3 to 8 inclusive are fac-similes, with red capitals, of the epilogue to the first edition of the "Dictes and Sayengis of the Philosophers," bearing date 1477. It is from a copy in the British Museum. The six pages given by Mr. Price are peculiarly interesting, as having been written as well as printed by Caxton.

9 is the woodcut of the Crucifixion which forms the frontispiece to the "Fifteen O's and other prayers" in the unique copy in the British Museum, 1490-91. It is considered to be the most important example of wood engraving produced in England previous to the year 1500.

10. Lithographic copy of a drawing in a MS. copy of the "Dictes," on vellum, in the library of the Archbishops of Canterbury at Lambeth. This drawing, first copied by Strutt, the Antiquary, is considered interesting as including what is supposed—and, probably, with sufficient reason—to be the only existing likeness of Caxton. The drawing commemorates the presentation, by Earl Rivers, of his book, "The Dictes," and of Caxton, his printer, to Edward IV., the Queen, and Prince; and it has still further interest from including the only known portrait of Henry V. when a boy, and that which is supposed to be a portrait of Richard, Duke of Gloucester.

It may be considered a pity that this interesting memorial of our first printer should be privately printed, and confined to 125 copies.

GENERAL NOTES.

Progress in Teaching Cookery.—There are now two female training colleges which have cookery taught systematically to all the pupil teachers and others in training in them. Whitelands, where the Rev. Mr. Faunthorpe was the first to begin, and Homerton, which has followed. But this at present is the only response to the circular from the Education Department to the training colleges, issued in August last. Sir F. Sandford then wrote: "It is in their Lordships' opinion most desirable to secure that every student, in the course of her training, should receive a larger amount of systematic and practical instruction in cookery than is generally given at present. They, therefore, desire me to suggest for the consideration of the college authorities, whether it might not be expedient either to obtain from the Cookery School at South Kensington, the services, for part of each year, of a trained teacher who could give your students instruction in the subject, or to send some officer of the college to South Kensington, to go through a course of training which would qualify her for teaching the students during their residence in your college. The cost of carrying out either of these alternatives, *i.e.*, either the salary and expenses of a special teacher, or the payment made by your committee on behalf of an officer sent to South Kensington, might be included in the expenditure of the college, which would be recognised by the Department under Article 89A of the Code." It is suggested the Education Department should require that one or other course be followed?

NOTICE TO MEMBERS.

It is specially requested that, in case of any irregularity or delay in the delivery of the *Journal*, notice may be sent at once to the Secretary.

MEETINGS FOR THE ENSUING WEEK.

Thur.…Linnean, Burlington House, W., 8 p.m. 1. Dr. G. King, "The Source of the winged Cardamom of Nepal." 2. Capt. W. Armit, "Note on Australian Finches of the genus *Poephila*." 3. Rev. G. Henslow, "The Self-fertilisation of Plants." 4. Mr. Ed. J. Miers, "Revision of the *Hippidæ* (a group of anomonrous Crustacea)."

Chemical, Burlington House, W., 8 p.m. 1. Mr. W. H. Perkin, "Some Hydrocarbons obtained from the Homologues of Cinnamic Acid." 2. Mr. W. H. Perkin, "An Ethel and its Homologues." 3. Mr. M. M. P. Muir, "Two Methods for Estimating Bismuth Volumetrically."

South London Photographic (at the House of the Society of Arts), 8 p.m.

Sat.……Physical Science Schools, South Kensington, S.W., 3 p.m. Profs. Ayrton and Perry, "Ice as an Electrolyte."

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,302. Vol. XXV.

FRIDAY, NOVEMBER 2, 1877.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

DOMESTIC ECONOMY.

The Report has just been published of the Congress on Domestic Economy, to be taught as a branch of general education, and acting in connection with the Educational Institutions in the counties of Staffordshire, Warwickshire, and Worcestershire, held in Birmingham, by permission of the Royal Birmingham Society of Artists, at their Rooms, New-street, on the 17th, 18th, and 19th of July, 1877. Price, to persons not members of the Society or Congress, five shillings.

The following notes on the Congress have been prepared and suggested by the Birmingham Executive Committee, for consideration of the Annual Congress to be held in Lancashire in 1878:—

I.

Before the termination of the Congress, the following resolution was passed unanimously:—

"That with the view of obtaining practical results from this Congress, it is desirable that the Local Committee and Sub-Committees remain in action until the next Annual Congress, which has been announced by the Society of Arts to be held in Lancashire in 1878."

To give effect to this resolution, the Birmingham Executive Committee have endeavoured to collect the general views expressed at the Congress, which they have embodied in the following notes. These they now issue for general circulation among managers of Public Elementary Schools, and others interested in introducing efficiently DOMESTIC ECONOMY into elementary education, and submit them for the consideration of the next Annual Congress on Domestic Economy.

The Committee purposely abstain, at the present time, from formulating any collective opinion, their object being solely to keep alive discussion upon the important questions raised at the Congress.

II.

1. The annual reports submitted to the Queen by the Lords of the Committee of Council on Education repeat their complaints to her Majesty that the results of the present system of public elementary education are "unsatisfactory and meagre," although the estimated cost of such education has increased from £1,707,055 in 1876 to £1,910,829 in 1877. (See Report of 1876-7.)

2. It was unanimously agreed at the Congress that great changes in the Education Code were necessary, in order to enable Domestic Economy to be properly introduced into elementary education, and to produce generally more satisfactory results, whilst promoting greater economy in the administration.

3. It was urged that the aims of the Code were in great measure misdirected, regard being had to the educational needs of the three millions of children of the wage-earning class, their ages, and the circumstances of their daily life.

4. It was urged that, even before the teaching of reading, writing, and arithmetic was properly secured, undue prominence was given (by the regulations under which the grant was awarded) to grammar, history, and geography, as compared with other subjects of equally great, if not greater, educational value to such children.

5. To remedy this, it was submitted that a selection from a larger number of optional subjects should be encouraged, such selection to be free from all undue official restraints, and the choice of the subjects being left, as much as practicable, to the judgment of local managers of schools, who must know better than any centralised administration what subjects are most suitable to their respective schools.

6. That, as the subjects embraced under DOMESTIC ECONOMY relate to improving the homes and elevating the daily lives of the wage-earning class, they afford the best means of cultivating the arts of reading, writing, and arithmetic, and *preserving the use of those arts in after-life*, and therefore these subjects should be encouraged before any others by payments on results; and they would be well adapted to any half-time system.

7. That, for promoting greater efficiency and economy in public elementary education, the mode of inspection and examination should be reorganised, and a clear division made between the personal inspection, and the individual examination of the scholars, of a school.

8. That H.M. Inspector's annual visit to a school should have for its object inquiring (according to instructions formally laid down and published) into the discipline (including gymnastic drill, not military, which should be specially examined), organisation, the general efficiency of the class teaching, and the teaching power of the staff.

9. That the individual examination of the scholars should be independent of this official visit of the Inspector, and should be carried out, as far as practicable, by written papers, under regulations such as those adopted by the Science and Art Department for the examination of drawing in public elementary schools.

10. That writing from dictation and arithmetic by the scholars in Standard II,* and upwards, and all the optional subjects should be tested by results sent up from each school, and referred to special examiners on the same principle as the examinations are conducted by the Science and Art Department, and that the subjects, such as botany, physiology, &c., already undertaken by the Science and Art Department, should be examined in only by that Department.

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* A higher standard might be taken at first,

11. That each subject embraced in Domestic Economy should be kept separate for the purposes of examination, and grants be earned on each subject.

12. That Needlework should be tested by work done in the presence of superintending authorities, and sent up from each school to qualified examiners.

13. That examination in the practice of Cookery should be conducted by qualified official examiners, who should visit local centres annually for that purpose.

14. That Singing should be tested by results ascertained by qualified official examiners, who should visit schools or local centres annually for that purpose.

15. That, for simplifying the machinery for conducting the examinations referred to above, all schools should, as far as practicable, be examined in the same subjects, in all parts of the country, simultaneously.

16. That the Inspector, his assistants, or other competent recognised authorities, should superintend the examination by papers, examine in reading, read the passages for dictation, and see that the regulations for the conduct of the examination are being strictly carried out.

17. That the written report of the Inspector's official visit should be forwarded to the Education Department, to be considered in conjunction with the examiners' reports on results, and upon both of these grants should be earned by a school.

18. That the scale of grants (Code, Art. 19) should be re-adjusted, so as considerably to reduce the grant on attendance, and proportionately increase the grant to be earned on the reports of the Inspector and the Examiners.

19. That, as the clause requiring 250 attendances as a condition of presentation for examination (Code, Art. 19 B) acts prejudicially to education, it should be modified, with proper safeguards, so as to provide that *all* the scholars present on the day of examination shall be examined, and be eligible for earning grants for their school, on the understanding that the failure of those who have not made a given number of attendances, or have not been a given length of time under instruction, should not be statistically recorded against a school.

20. That Women should be eligible for appointment as inspectors.

21. That Women should be appointed as examiners in needlework, clothing, household matters, &c.

22. That Military Officers, non-commissioned officers, or pensioners should inspect military drill.

23. That the Medical Officers of Health already appointed, throughout the country, might be employed, with efficiency and economy, in reporting upon the fitness of the school buildings, their ventilation, heating, sanitary arrangements, &c.

Managers may obtain copies of the Notes on application (with an addressed halfpenny postage wrapper enclosed), to the Honorary Secretaries, Birmingham, or to the Secretary, Society of Arts, Adelphi, London, W.C.

(By Order)

E. F. M. MacCarthy, M.A., } Hon.
Eliz. A. Mathews, } Secretaries.

Birmingham, 8th October, 1877.

CANTOR LECTURES.

THE CONNEXION OF GREEK AND ROMAN ART WITH THE TEACHING OF THE CLASSICS.

By Sidney Colvin.

Slade Professor of Fine Art at Cambridge.

Lecture V.

We have thus far gained a summary knowledge of three main points in connection with our study. We have seen, first, what the extent of the study was, how completely the whole mind of the ancient Greeks was illustrated in their works of art. Next, we made a single classification of the materials of the study, and saw what are the principal contents of the principal museums, and what the distribution of those various fragments of ancient art which have come down to us, and which furnish us with the materials for our study. Last week we saw what had been the gradual history of the modes of interpreting these materials—how from very imperfect and unscientific interpretations at the beginning we have progressed, by comparing our various antiquities more and more closely with the texts and with each other, and how the great discoveries of our own century have thrown continually accumulating light on the study, until at last the study has arrived at a high degree of exactness and complexity. Its modern methods I tried to illustrate by a case in point, which comes particularly home to us, namely, the case of the great group representing the contest of Athene and Poseidon in the west pediment of the Parthenon. I say it comes particularly home to us, because the fragments of the original group are in our own possession in the British Museum; and in a sketch of the several essays at the interpretation and reconstruction of that group which have been made, I tried to show you what the present position of the study is.

Hasty and imperfect as our survey has necessarily been, still I hope it has made you feel that, if we are to keep up a classical education at all, then it no longer becomes us to neglect, as we have hitherto neglected, this great part of what a classical education is. If I have succeeded in proving that the study is worthy our pursuit; that it is time to turn round and ask ourselves whether we do not neglect it more than it should be neglected; whether other nations are not infinitely in advance of us in the way in which they prosecute this study; then, I think, it only remains for us to speak to-day of the kind of recognition one would desire of this study in England, and how to set about it.

First of all, necessarily, the central institution for such a study must be a national institution, such as the British Museum. For the most advanced stages of the study, the British Museum must be the great laboratory in this country. The object of an institution like that is to be a receptacle—a laboratory—of all that we can procure for the nation, of all that our wealth, and our power, and our science is able to collect, of ancient monuments of ancient art. And the British Museum has fulfilled its part well. But great and precious as the British Museum is, although it is the headquarters of this study, not only for ourselves, but in great measure for all Europe, still the mere fact of having established there this great laboratory is not enough for us to have done. I suppose if we were to count over the people who go on a holiday to the British Museum, we should not find any great proportion who know how to enjoy what they find there, to whom this great collection of art really means much. We see them strolling ignorantly by, gaping rather than admiring. They came uninstructed and unprepared; they cannot—the majority of them cannot—feel much real delight in what they find there.

Then, the question is, how shall we modify our national education in such a way that that great collection shall be a means of conveying instruction to a larger number of people than it does now? I do not think it can be done by asking that officers of the British Museum shall be there to interpret and explain their own treasures. Those officers have their time, and more than their time, taken up with the complicated duties of custody, cataloguing, and arrangement; and, supposing we were to appoint a new class of officers to lecture and explain, still I do not think that would be the way to do it. People must come in some degree instructed and prepared beforehand. The British Museum, or any great collection of original antiquities, is the central institution for the final and most advanced part of the study; but before people can appreciate that, they must have learned the rudiments of the subject. They must have had study and knowledge of these things made a part of their education. There are many reasons why one desires that the British Museum should be a greater educational machine than it is. One wishes that the public should know better what is meant by things they read in the newspapers when there are questions of great purchases on hand, and one wishes that members of Parliament, and the friends of members of Parliament, should be able to speak on such questions with greater knowledge and authority. But I do not think that these desirable results will be got by mere teaching and preaching within the walls of an institution like that itself. I think they are to be got rather by preparing people's mind beforehand—by educating people, so that they may know what to look for when they go there.

Now, no single national museum of originals, however great, can be a complete educational museum, properly so called. Each possesses its own masterpieces; but, for educational purposes, it is necessary to have all the masterpieces together. Such a museum of things fetched from right and left, where they are scattered over all quarters, is one, not of original art, but of reproductions, in the case of sculpture the only available form of reproduction being plaster casts. Now, it is no good denying that between a plaster cast and an original statue there is a very great difference. The marble of the original has of itself an infinite charm. It has a delicacy and partial translucency of surface, a quality of material beauty and preciousness, which constitutes no mean part, but one of the subtlest parts, of our pleasure in the thing itself. You cannot fully realise all that the sculptor meant by the delicate workmanship of the surface, all the delicate suggestions of the particular character of flesh and tissues—you cannot have all those finer pleasures in the observation of sculpture—except in the originals. A plaster cast, first of all, is in opaque material; it admits no light, it has a dead, unpleasant, dull surface. It is possible, indeed, to do something with this too dull, white surface, and to improve it by a certain treatment. But, with all that, doing the best you can, you cannot get any plaster cast to be other than very different from the original. All these things must be remembered when we talk of these museums of second-hand art. Do not let us deceive ourselves, and say that these things are as good as the originals. They are not at all; only they are the only things we can have, if we wish to bring together what is absolutely necessary for the comparative study of the subject. If we wish to bring together the scattered parts of great works of art from various museums, from various corners of Europe, then the form of casts is the only form in which we can do it. And to do that gives us a collection not only instructive but indispensable. Taking the particular subject of which I was speaking the other day—of the body and chest of that great god Poseidon from the Parthenon pediment, one-half is at Athens, and one-half at the Britsh Museum. To bring these two together, we have simply to depend upon casts. Similarly with some of the very best of other Parthenon groups, some pieces of which are at Athens, and others are here. And in general, to construct the great historical groups of ancient sculpture, we must put side by side, in this, the best form we can, things that are scattered far and wide. For instance, if we wish to illustrate what is the most interesting, perhaps, of all periods in the history of Greek art—its archaic period, or era of struggling and development—we require the examples so widely scattered as a funeral monument preserved at the little village of Orchomenus, in Bœotia; the metopes of Selinus, preserved in the museum of Palermo; the pediment figures from the island of Ægina, now at Munich; certain reliefs from Assos, in the Louvre; the so-called Harpy monument from Lycia, in the British Museum; the figures of Harmodius and Aristogeiton, at Naples; these, and many more, to illustrate that single phase of art, have to be assembled for comparison in the only form, that of casts, in which such assemblage is possible.

Again, in these latter days, great discoveries have been made of the central Attic school of Greece itself. The enterprise of the Germans has recovered from the soil at Olympia, and nearly complete, the great pedimental groups executed by the scholars of Phidias. How can we really judge, balance, and compare the qualities of these things unless side by side with the Parthenon fragments, which we know to have been executed under the immediate eye of Phidias himself, are placed these others, the works of the scholars of Phidias, executed by provincial hands, at Olympia? There are even instances of connexions more important and indispensable than that. We know that there were schools of sculptors in the late time of Greek art, who lived and wrought for kings and dynasts in the outlying provinces of Greece. We know, for instance, the rich and famous kings of Pergamos had their skilled sculptors, and we know of a particular group which was set up to commemorate a particular victory of those kings in the second century B.C. The Gauls, after their defeats in Italy by the Romans, had some of them been pushed out of Italy, others had come from migrations—of which we do not know the history—from beyond the Alps, and a great wave of these displaced Gauls came down upon Greece at the beginning of this second century B.C. One branch broke itself off to the the north of Greece, and went across the Bosphorus to Asia Minor, and there they remained, sometimes acting as mercenaries for this or that king, sometimes marauding on their own account, and so they overran the country for more than fifty years. One of the kings of Pergamos, Attalos, overthrew these Gauls in a great and famous victory, and set up a monument to commemorate that victory. This monument was composed in the manner of Greek art, not only being a representation of the actual victory in question, but also of other subjects which bore on this victory, or were connected with it in symbolism and in meaning. The group consisted, then, of a set of sculptures representing the real overthrow of the Gauls, or Galatians; the mythical overthrow of the giants by the Olympian gods; the mythical overthrow of the Amazons by the Athenians under Theseus; and again, another overthrow, a historical one, the overthrow of the Persians by Athens. These three other legendary and historical victories of Hellenes over barbarians were regarded as the symbolical precursors of that of Attalos over the Gauls. This group was set up at a particular place on the south-east side of the Acropolis against the outer wall; the figures were two cubits or three feet long, and on a recorded night of storm, one of the figures was blown down from its place on the wall, and rolled or fell down in the theatre of Bacchus. Now, it so happens that there exists in various museums in Europe several figures of personages prostrate in battle, about three feet in length. Some of them are at Venice, some are at Naples; one is in private possession, and one in Paris. Now, by getting casts of all of these, and putting them together, we see that here are a set of sculptures of fourteen figures, all corresponding in size and in artistic character. When we come to examine them, we find that several of them represent Gauls; for we know well, from ancient authorities, what the look of the Gauls was, what was their costume in war, what was the peculiarity of their head-dress and of their facial type. Another figure, which belongs to the same set, is not a Gaul; but, by his head-dress, by the cap which he wears, and the form of his trousers, we know that he is a Persian. Another is a slain Amazon. Another is, probably, though it is mutilated, a giant. So that, putting these together, and comparing them with our texts, we can say, with certainty, here are portions belonging to that famous group set up in the second century B.C. by Attalos, King of Pergamos. That is an instance of the kind of way in which these collections of casts, gathered from all parts, are indispensably necessary for this study, and of the importance of being able to place them side by side, and carefully test the correspondence of scattered items, and see their affinity, and so recognise how they belong to each other. There is one statue which for three centuries has been the most famous in the world, the Apollo Belvedere; and another, the colossal Diana with the stag, which is well known at the Louvre. By putting these two side by side, as we can only do in the form of casts, we can see that there is an immediate affinity between them. They are not only brother and sister in legendary godhead, but in a closer sense than that; the type of face is identical; there is a correspondence and a balance of gesture, and an exact facial resemblance, all indicating that these statues, found in different places, existing now in very different localities, belong to each other, and were in all probability either the work of the same hands, or else different remaining reconstructions of the same original group. And, casting about, we have discovered what the group was to which these two were likely to have belonged. It is unnecessary to repeat instances of this sort; I have only wished to show you, by two or three examples, how indispensably necessary a foundation to the comparative study of these things is provided by a museum of well-selected casts.

Such a museum of necessity requires great space. Many of the things are very large. I do not mean the single figures, although there are some, such as the Castor and Pollux of Monte Cavallo, which are by themselves enormous. But for pediment groups and friezes like those of the Parthenon, Ægina, and Phrygalia, it is evident that a vast amount of room is required. By far the greatest and most complete gallery of the kind is at Berlin, and almost every German University is provided with one more or less complete. There was a very spirited and courageous attempt made nearly 20 years ago in England, when the Crystal Palace was first founded, to provide such a museum. The Crystal Palace was intended, as many of you remember, to be a place of culture and education above all things; and immense expense was incurred and great pains taken, in having moulds made of a great many things all over Europe which had not yet been moulded, and in collecting these at the Crystal Palace. Like most of the appliances at the Crystal Palace which had the same object, which were intended as instruments of culture and elevation, this museum of casts was neglected; the public did not care for it; it has, by degrees, partly from injuries in the great fire, partly from being moved out of the way to make room for more attractive things, become very much disregarded. Looking back at the spirit in which that museum in the Crystal Palace was founded, and the reception it has had, one cannot say it has been a success. Then one has to inquire the reason of this failure. Some energetic students, devoted to this subject, are engaged at this moment in endeavouring to promote in London the establishment of a complete museum of this kind on scientific principles. With all my heart I wish them success. I think there can be no better or more desirable enterprise; but, at the threshold of such an enterprise, it is desirable to look back and see if we can understand what have been the reasons of the failure of the only similar enterprise that has yet been tried in or about London. First of all, the set of casts at the Crystal Palace were not thoroughly well selected from a historical point of view. They were selected, to a great extent, from a decorative point of view. It was desired to make as beautiful and telling a show as possible. But apart from these minor reasons for non-success, the great reason, I think, is this, that it was supposed that people would care for these things by themselves, that their mere beauty would attract people, and that they would come to study them. But that was a mistake with regard to the British public. A gallery of casts, however well selected and well arranged, in however beautiful a place, is necessarily rather a bewildering thing. You realise that these are only plaster things; you notice that unpleasantness of surface, and feel as if the things were cheap, and do not feel their value unless there is some one there to tell you—unless the thing is explained, and you know something about it. I think myself that the prime reason of the Crystal Palace collection not having been a success was, that it was too much expected to take on its own account; whereas — at any rate, in the present state of public education—such a collection can never be appreciated unless there is some one there to teach, unless the people whom it is endeavoured to attract are students desirous of being taught, and of learning the historical meaning of these things; that is to say, of taking lessons in archæology. I hold, therefore, that the success of the plan which is now mooted, and which I hope will succeed, depends almost entirely on its being associated in some way with agencies of education—on its being made an educational institution, properly so called. It will never succeed as a mere institution of entertainment. It will never succeed by attracting people who care for the beauty of these things, but who know nothing about them, to go and work at them by themselves.

But all that I have been saying about the comparative uselessness, to the large crowds that go there, of the many splendid treasures in the British Museum—all that I have been saying about the neglect that has befallen the collection of casts in the Crystal Palace, and that would be in danger of befalling any collection of casts that was not associated with special teaching—all that points in one direction, and it points to this, that the teaching of classical archæology, the study of the monuments of the Greeks and Romans, should be made a part of our general education. If we were shown when young the works of ancient art, we should be accustomed to their beauty and meaning, and should be able to go to the British Museum, or any museum that might be formed, and take all our lives an instructed delight in anything we found there. We must begin at the beginning; we must try and get the teaching of archæology, in forms however simple, introduced at schools and universities. Many of our great schools are rich enough to supply themselves with appliances of this kind. There are appliances of all degrees of elaboration and of all degrees of expensiveness. We could not expect a school to furnish itself with a great museum of casts, such as I have been describing, but it might well have a certain number—and some schools indeed have already begun to do so—of picked reproductions of this kind of the greatest works. But there are minor forms with which every school should thoroughly equip itself. For one thing, at any rate, in every school class-room and lecture-room that had to do with classics, there should be models of the principal classical sites. Do you suppose that if schoolboys had a model of the Forum at Rome before them, they would not be more interested in Cicero's speeches which he made in that Forum? So all through the whole cycle of things. Models of sites, for schools, I should principally insist on, and photographs, but a certain number of casts if possible, and especially of portrait busts. When schoolboys are reading about Tiberius or Domitian, do not you think it would make them more alive to the subject to see the lineaments of these people about whom they read. And those lineaments, as they come down to us from the Roman school of portrait art, are the most vivid and striking that any school has handed down to us.

For the wider range of ancient art we must trust chiefly for school purposes to photographs. Many beautiful photographs are to be had comparatively cheap. But then there is another form of art of which reproductions which might have extreme value to schools, namely, coins. By holding in your hand an electrotype reproduction of a Greek coin (and it is really almost as good as the original), you realise so many things at once. You have read perhaps about Olympia, about it being a place in Elis where Jupiter was worshipped. You take up a coin of Elis, and you see the head of Jupiter copied on one side from the Greek type, and on the other side the head of the goddess Hera or Juno. Do not you suppose that realising the use of this coin would bring home to the boy things that had not been brought home to him before? Or when he was shown any Athenian coin with the face of the goddess Athenæ, or in one corner the figures of Harmodius and Aristogeiton, that he would not then remember more vividly and carry about with him all his life in a clearer way the idea of those famous tyrannicides? While the immediate first effect in schoolwork of these things is to impress upon the eye that which the teacher endeavours to impress upon the mind—the lessons which boys learn out of their books—it would have another effect. While the boy would realise that this was the actual coin in use in Greece—that the people in the market-place went and made their bargains with this coin; that this was the half-crown of the period; he would at the same be beginning to learn the secret of Greek beauty and of ancient art.

Then we come to the more advanced study of ancient art in the Universities. There I think we are bound to try and have appliances as complete and as elaborate as possible. The idea of a museum is that of a laboratory of the material appliances for learning, and some how or another this idea seems only to have been an idea lately developed in English University arrangements. Our curriculum at the Universities used to be confined entirely to learning from books; but books, after all, are only one means of learning. Whether it was mathematics, history, or literature, books used to be considered the sole and sufficient appliances necessary. But within the last 50 years, since modern sciences have begun to be recognised, since it has been recognised that a large portion of the study of the human mind is the study of physical nature—since the natural sciences have come up as University studies—it has been recognised that books will not do so by themselves, that you must have chemical laboratories and scientific apparatus; and lately, the Chancellor of our own University has, with admirable generosity, built and furnished in an exemplary way, at his own expense, a complete physical laboratory at Cambridge. We classical students are beginning to see that we want the same kind of thing. We are quite ready to acknowledge that the natural sciences are worthy to take their part beside the old classical and literary and mathematical studies in the University. But there are forms of classical study for which we want our laboratories and our museums too, and I do not think it is at all unreasonable to suppose that we shall be presently heard, and get it recognised that to complete one of our old-established traditional studies we want a properly-equipped museum, just as much as these new students in natural science want theirs. We want a comprehensive museum of ancient art such as they have in several German Universities. Of course, besides the museums, complete libraries of art are wanted, and original collections, so far as possible, of subordinate branches—of coins, vases, bronzes, and the like.

But when we speak of the study being complete, we must remember that even if we were to establish our museums, even if we were to modify our examinations accordingly, still there would remain a sense in which the study would not be complete. To make a finished archæologist you must send him abroad. There are may ways in which this study of classical art is illuminated by a residence in a classical country, in which it cannot be possibly illuminated by a residence at home in a University, be that seat of learning ever so well equipped or endowed with all necessary appliances, be its museum ever so well organised. Germany, the great country of this study, has long ago recognised this, and France has also recognised it, for both the Germans and the French have institutions abroad for promoting the study of archæology. The first of these institutions is now approaching its fiftieth year, the famous Institute of Archæological Correspondence in Rome. That was first started as an amateur society, supported by subscriptions—a company or society, including many foreign subscribers, which had its quarters in Rome, and brought out its yearly publications, records, and illustrations of discovery. That was founded in the year 1829, and this study has been going on in Rome with ever-increasing activity. The publications of the Institute are the great central magazine for modern researches, especially modern discoveries upon the soil of Italy, in this line. Latterly, since the establishment of the German Empire, this Archælogical Institution at Rome has been endowed and supported by the Imperial Government. When that was founded, Rome was obviously and necessarily the one centre where such a foundation was possible. Ever since the Middle Ages, innumerable works of ancient art have been found in Rome, and many more are continually found there, and not only in Rome, but in a hundred out-lying places of Italy, and it is the great centre for traffic in such antiques. Besides, at that time, the native home of these things, Greece, was scarcely accessible, except with a military force. The French went and made certain excavations at the time when the country was seething with the war of the oppressed populations against Turkey. During this internecine barbarous war between the oppressors and the oppressed, the idea of establishing a scientific foundation in Greece was out of the question. But times have changed since then. A portion of the Greeks have now their liberty; Athens in its turn has become the city to which the eyes of all archæologists are turned, and similar institutions to the one at Rome have been established there. First of all the French took the lead in establishing the Ecole d'Athènes, a magnificently endowed institution, presided over for a long time by M. Burnouf, and now by M. Dumont. This is the place to which certain students who have won prizes in their school course in France are sent to complete their studies in this subject. It is a very remarkable thing that the French should have regarded it as a duty of the Government to send advanced scholars out to Athens, in order to have the immense benefits derived from a residence in that place, finishing their studies on the spot, yet that we should have done it neither by the Government, the Universities, nor by private enterprise, because France is not a country where people learn Greek, as a rule. The number of Hellenists is exceedingly small, even amongst scholars, in France, and for ten Englishmen who know Greek fairly well, to whom Greek means something all his life, I do not suppose there is one Frenchman. Still this branch of Greek study has been recognised, and there is even a flourishing establishment at Athens, to which persons who have a special vocation are sent, and where they have an opportunity, and the infinite delight and indescribable advantage, of the completion of their classical studies by a residence there. The same thing has been done, more recently, by Germany. The German Institution at Rome is now approaching its fiftieth year; the German Institute at Athens is much younger. It dates since the establishment of the German Empire. Still, there have been a great number of private Germans continually there, where they have worked very laboriously; but the establishment of the German school is a new thing. These various institutions are so many nurseries for archæologists. Of that kind of institution we possess absolutely nothing. There is no organisation, Government or otherwise, which provides for sending out students who may have that particular vocation, to follow it out, and to learn what only can be learned upon the soil of Greece.

It is a little difficult, in proposing anything of the kind in England, to be sure what is the best practical way of proposing it. It is not energy that we want, it is not perhaps desire for these things, but it is organisation; that is the concentration of energies. There are several bodies, such as the Dilettante Society, or the Society of Antiquaries, within whose scope one might say this kind of thing would come; and there is Government; but then Government has not, as a rule in England, taken upon itself the task which Governments do abroad of providing for the higher education. And there are the Universities, but when we come to look at the funds of the Universities, even when we propose to reform and redistribute their funds and look at what we can afford, we see there are so many subjects wanting more money and new appliances, that the question arises, can we or can we not afford to establish an institution corresponding to the Government institutions of Germany and France. These are the kind of difficulties that meet one when one comes to consider practically an object of this kind. I do not know that I am here prepared to make any positive suggestion on the point, but I am prepared to say that it is an opprobrium and a discredit to our country that we, who have so ancient and honourable traditions of devotion to the study of the literature and languages of ancient Greece and Rome, should have no organisation whatever, no encouragement, no means for sending out students to Greece or Rome, and for enabling them to continue their studies in Greek and Roman antiquities in the places where alone perfection is possible to be attained.

MISCELLANEOUS.

BRUSSELS MAIN DRAINAGE.*

Before the great work of bringing into one channel the numerous and tortuous branches of the Senne—the river that flows through Brussels—and of intercepting the sewage matters, the sewers received not only the rain-fall and the waste water from the houses, but also the fæcal matters, liquid and solid. Cesspools and absorbing wells, which for nearly a quarter of a century were the general rule, have gradually been suppressed; and this desirable state of things has been brought about, or at any rate considerably hastened, by the establishment of a water supply, which was rendered necessary by the infection of the subsoil, chiefly due to the cesspools. The presence of fæcal matter in the sewers was one of the chief causes of the corruption of the water of the Senne, and of the formation of deposits in its bed, which was encumbered with mills, dams, and other obstacles. In times of drought the slight volume of the river transformed the bed into an open cesspool; and during freshets, on the other hand, the water flooded the sewers in the lower part of the city, drove back on to the roads and houses the sewer-gases, and on subsiding left a deposit of the matters held in suspension. The floods also invaded the cellars of a great number of houses in the low-lying districts, gaining admission by the sewers and drains.

The accomplishment of the works has brought about a great change; the narrow lanes and courts, deprived of air and light, which formerly existed, are now replaced by wide streets and boulevards. The channel straightened, widened, cleared of every obstacle from the capital to the boundary between the provinces of Antwerp and Brabant, and arched over where it traverses the city, suffices for carrying off the highest floods from Brussels for several leagues down stream. The sewers have, besides, been cut off from the Senne, and can no longer be invaded by its waters; the numerous drawbacks occasioned by their direct communication with the river have been removed, and at the same time, not only the public roads, but also the cellars of the houses, are now placed out of the danger of inundation.

Among the works included in the scheme of the *Travaux de la Senne*, carried out between 1867 and 1875, those specially relating to public sanitation are as follows:—

Demolition of 1,100 houses in the lower part of the city.

Arching over of the river for a length of 2,151 metres (2,352 yards) and the formation of boulevards on the surface above.

The construction of 17,775 metres (19,439 yards) of intercepting sewers, with works for carrying them over the different branches of the Senne and under the Charleroi canal.

The clearing out to their natural bed and filling up of the tortuous branches of the Senne within the limits of the City.

The construction of 5,600 metres (6,124 yards) of ordinary sewers of ovoid section.

The erection at Haeren of temporary pumping engines for discharging the sewage water into the river, about three miles below the city.

The organisation of a service of flushing by means of sluices.

The cost of these various works, including the purchase of land, the reconstruction of the various bridges, the suppression of several dams and mills, the widening and straightening of the channel, and the opening of a supplementary channel amounts to 27,000,000 francs (£1,080,000).

The arching over of the Senne extends from the south to the north of the city and its environs. It commences immediately above the Boulevard du Midi, under the main sluice, crosses this boulevard, then making a curve extends under the Boulevards Hainault and Central, throughout their whole length, surrounds the church of the Augustins, now used as the general post-office, passes under the Boulevard de la Senne, and crosses the Boulevard d'Anvers, after which it runs in an open channel. The work comprises two aqueducts, separated by a pier forming a longitudinal wall. Each aqueduct is 6·1 metres (20 feet) wide, and has an invert of ·9 metre (nearly 3 feet) rise, side walls 2·5 metres (8 feet 2½ in.) high, and an arch 1·1 metre (3 feet 7 in.) rise. To each of the abutments of the arch, and throughout its whole length, is connected an intercepting sewer, comprising two distinct portions, the *cunette*, or sewer proper, and an arch. The intercepting sewer, set at a lower level than the ordinary sewers, and designed to receive their contents, is 2 metres (6 feet 6¾ in.) deep, and has an invert with a rise of 0·5 metre (1 feet 7½ in.). The upper portion, intended for the passage of the flushers, comprises the arch and two foot-ways extending the whole length. The width of the two intercepting sewers differs according to the different area served by each; that on the right bank is 1·7 metre (5 feet 7 in.), and that on the left 1·2 metre (3 feet 11¼ in.). After passing the Boulevard d'Anvers, the two sewers, while preserving their internal form, leave the Senne at a distance of rather more than a mile from the city; the sewer of the left bank passes under the river, and a short distance further on joins that of the right bank. From this point of junction the single sewer bears the name of *émissaire*, its form being similar to that of the two collectors, but the channel being, of course, larger. This outfall is continued alongside the Northern railway to near the station of Haeren, where, at present, the sewage water is pumped up and the greater part again allowed to fall into the river. The absence of transverse fall towards the left bank of the Senne rendered necessary the construction of separate collecting sewers for the districts of Anderlecht and Molenbeek, having a total length of about 5,000 metres (5,468 yards).

The longitudinal fall of the greater portion of the intercepting sewers of the right and left banks, and of the outfall, is 1 in 3333, though in some parts it is 1 in 2000. Wherever a collecting sewer passes under a watercourse, the invert of the passage and the whole of the collector below it are set 20 or 30 centimetres (8 or 12 inches) lower than the part above. This fall is for preventing any inconvenience from the reduction of area consequent on the suppression of the arch. The whole of the interior is lined with a coat of cement perfectly smooth. The edges of the *cunette*, or sewer proper, are provided with angle-irons which serve as rails for small wagons to run upon; rings are also fixed in pairs, every 25 metres (27 yards) for mooring these wagons. Hand-rails extend along the footways, at a height of 90 centimetres (35½ inches). Every 50 metres (164 feet), on alternate sides, are man-holes with ladders for the flushers; and, at certain main points, easily ascended stairs are substituted for the ladders. Between the arched covering of the Senne and the intercepting sewers connected to it in the town, as well as at the meeting of the isolated collectors outside the town with the various branches of the river, are outlets provided with doors opening from the collector to the Senne; these are intended for giving passage to flood water, which thus finds an outlet in the river without choking the collectors or the sewage works at Haeren. At various points, especially at the main sluice, and towards the upper ends of the various collectors of the faubourgs, are water-inlets, by which may be introduced into the collectors, in case of need, a more or less considerable portion of the river water. The upper end of the arched cover over the river is provided with two large iron sluices intended to maintain a sufficiently high level for diverting the water into the Willebroeck canal, whenever required. The sluices are worked by aid of the town water supply, which, at this point, exerts a pressure of 105 lbs.

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* This notice has been prepared from information supplied by M. Van Mierlos, Directeur du Service des Egouts de la Senne, Bruxelles.

The fall of the intercepting sewers is not sufficient to prevent the sewage water from leaving behind the matter held in suspension; it therefore became necessary to employ some specially designed wagon sluices, which consist of a sloping sluice following the contour of the sewer, and suspended from a truck with four wheels running on the angle-iron rails before mentioned. Some simple mechanism permits the flusher to raise or lower the sluice to whatever depth may be required. When it is nearly at the bottom, the upstream water is kept by it at a certain height above that on the other side of it; and the difference of level, while it causes the wagon to advance, gives a sufficient velocity to the water which passes between the sluice and the bottom of the sewer, to draw along with it any accumulations. There are nine of these wagon sluices altogether, each being worked by two flushers. Owing to the absence of any solid deposit and of all stagnation of the water, no danger to health is incurred by the flushers and supervisors, or even by strangers visiting the sewers.

Although the greater portion of the sewage water is at present allowed to fall into the river, the intention is to dispose of the whole of it by means of irrigation on sewage farms to be established near Vilvorde. Already 38 hectares have been appropriated to this purpose; and, although the land is not considered quite suitable, not being sufficiently absorbent, some vegetables grown thereon and exhibited at the Horticultural Show held in September, at the new Palais de Justice, afforded proof of successful working. Negotiations are now on foot for the acquisition of some more suitable land at Haeren for establishing a sewage farm on a large basis. Only temporary pumping engines are at present employed, which in heavy rains are not sufficiently powerful; but ultimately engines of 600 horse power are to be put up and kept working night and day, the quantity of sewage matter to be raised being estimated at a cubic metre (1·3 cu. yd.) a second. The surface of land ultimately to be irrigated is about 4,000 hectares (9,884 acres); and the height of the layer of sewage water to be annually supplied is 80 centimetres (31½ inches) or about equal to the rain-fall. The quantity of land may, however, be increased or diminished as experience dictates.

The ordinary public sewers, without rails, now existing in the city, are of various types, from the small square drains only 30 by 35 centimetres (11¾ by 13¾ inches) in the clear, to the more modern ovoid section, 2 metres (6 feet 6¾ inches) high inside, which form a portion of the drainage works. This last-named section, the larger diameter of which is 1·33 metre (4 feet 4 inches), will henceforth be solely adopted for all sewers constructed or renewed, the cases being very few when this type cannot be employed. The new sewers of ovoid section are sufficiently large to permit of the flushers passing through them with the greatest ease, even with barrows, and also for the engineers to inspect them without difficulty. A perfectly smooth coat of cement is laid on the inside, thus securing impermeability and at the same time tending to prevent the formation of deposits. On the right bank of the Senne, the sewers generally have a sufficient fall to prevent accumulation; on the left bank, however, the fall being slight, periodical cleansing is necessary. In the case of sewers the height of which is at least 1·1 metre (3 feet 7 inches), the cleansing is effected by the flushers, who bring the solid matter underneath the air shafts, which are about 25 metres (82 feet) distant from each other, and by which they are raised to the surface during the night. Where, however, the sewers are less than one metre high, the cleansing is a matter of difficulty, it being necessary to take up the road, sometimes at every ten metres. In the normal type of sewers, two metres high, the cleansing is effected during the day without bringing the deposits to the surface; they are conveyed underground to the intercepting sewers, where they are received by the wagon sluices, or loaded on ordinary trams and conducted, all the time underground, to the works at Haeren. The drains for receiving the rainfall are in some cases closed by a water seal of 2 to 5 centimetres (¾ to 2 inches), and in others are freely open to the atmosphere. Of both classes there are a great number of types, but they are all provided with a reservoir for retaining mud and large obstacles.

The house-drains and the junctions with the sewers have hitherto been made either with bricks or with pipes of sandstone or earthenware. Various forms of traps have been added for preventing the escape of the sewer-gas; but for the most part they are not satisfactory, the water seal (1 to 3 centimetres = ⅜ to 1 inch) being insufficient. It is on account of the imperfection of these house traps that many of the surface drains are left untrapped; if all the surface drains had a water seal of two to five centimetres, the gas would necessarily escape into the houses.

As the result of investigations made by a special Commission, appointed on the occasion of the last outbreak of typhoid fever at Brussels, the Government has issued some fresh regulations as to drains and their accessories, both inside and outside the houses. Special care is enjoined to prevent the sewer-gas, under greater or less compression on account of the change in the level of the water in the sewers, from entering the houses. One of the measures to be adopted for this end consists in preventing the water from entirely filling up the house-drains at any point, and thus intercepting the circulation of air. Another measure proposed by the same Commission consists in placing the main outfall sewer in communication with the furnaces of the new city gas-works lately established at Laeken, and also with those of the pumping engines to be erected at Haeren, so that they shall take the volume of air necessary for combustion from the whole system of sewers. Fresh air, to supply the place of that withdrawn, is to be introduced into the sewers by apertures provided for this purpose at various points.

The object of the recommendations of the Commission is to arrive at the following results:—

1. To prevent any stagnation of sewage, whether in house-drains, public sewers, or main intercepting sewers.

2. To avoid, as much as possible, the formation of any deposit, and to facilitate the removal of deposits where, on account of the configuration of the surface, its formation cannot be entirely avoided.

3. To ensure the constant flow towards the outfall of the air contained in the whole sewer system, and to burn

the same in the furnaces of the gas works and of the pumping station at Haeren.

4. To prevent any escape of sewer-gas, both in the public ways and in the houses, by properly trapping the ends of all the house-drains.

CALCUTTA BOTANICAL GARDENS.

The annual report, by Dr. King, of the Royal Botanical Garden, Calcutta, for the year 1876-77, has just been received. The introduction and cultivation in India of foreign economic plants is always a special feature of these Calcutta reports, and though there is a good deal of valauble information on this head in the report under consideration, the largest amount of attention is directed to plants suitable for paper making. Foremost amongst these is the bamboo, in connection with which Dr. King refers to the great expectations put forth by a celebrated paper-maufacturer in this country, that in the young shoots of the bamboo he had found a raw material which, by a simple treatment in its native country, could be transmitted to England in a rough dry state for final manufacture here. On this subject Dr. King says, "it is essential to the success of Mr. Routledge's process that the bamboo shoots be quite young and succulent, and the great difficulty which at once presented itself to persons with any knowledge of the modes of growth of Indian bamboos was, that such shoots, being produced in moderate quantity from each clump, and only during a limited season of the year, the proposed paper stock-making machinery must, for a large part of the year, necessarily lie idle. To meet this difficulty, Mr. Routledge suggested that bamboo clumps might, by proper treatment, be induced, after most of their old stools had been cut away, to send up from the stools thus bared, regularly and irrespective of season, crops of succulent shoots suitable for conversion into paper stock. Mr. Routledge's expectations implied a very complete change of habit in the bamboo, for it is pretty well known that bamboo clumps, if entirely cut down, yield for several years but few and small succulent shoots, and, in fact, not unfrequently die. In order, however, to submit the proposed scheme to a trial under my own eye, six clumps of bamboos were cut down last year at the beginning of the rains (*i.e.* between the 10th and 20th June), when the buds of the young shoots of the season had completely formed and were nearly ready to burst through the soil. Soon after the cutting of the old stems, these buds developed into shoots, which grew with characteristic rapidity. These were allowed to grow until they began to show symptoms of becoming hard, and on 21st July they were all cut down. They were at once weighed with the following results:—

Clump.	Number of young shoots.	Weight in pounds.
No. 1	11	166
No. 2	7	102
No. 3	6	78
No. 4	9	100
No. 5	5	42
No. 6	12	192
Total..	50	680

This gives an average of 113 pounds of wet young shoots per clump. The time of cutting was the most favourable that could have been chosen, and the crop of shoots yielded was probably as good as it would have been had the clumps remained untouched by the knife. Judging from the size of the clumps, I calculate that at most 80 similar clumps could be grown on an acre of land. This allows an area of 576 superficial feet to each clump, and such close planting would probably necessitate manuring. Taking the yield of these six clumps as an average, and excluding all loss from death and accident, the yield on an acre during the first year of cutting would therefore be 9,066 pounds of fresh young shoots. It must not be forgotten that freshly cut bamboo shoots are extremely succulent, and that the amount of dry paper-stock that could be got from them would bear a very small proportion to their original weight. An additional difficulty that attends the scheme is that, since only fresh succulent shoots will answer, and these are of too high specific gravity to float, the cost of land carriage to the factory (a very heavy one in Bengal) would have to be incurred. The cut clumps above referred to were well cared for; leaf mould and tank soil were laid round them, and, as compared to similar clumps in the forest, they had the great advantage of immunity from fire, and from being grazed on by cattle. Since these young shoots were cut, a considerable number of woody twigs have arisen from the bases of the old stems. No fresh young root shoots have, however, appeared. Some such will, doubtless, appear at the usual time, which would be the beginning of the ensuing rainy season. These shoots shall be cut at the time recommended by Mr. Routledge, *i.e.*, when they are just beginning to become hard and woody, and with the cutting of these the crucial part of the experiment will begin," the results of which will be recorded in Dr. King's next annual report.

With regard to baobab fibre from the bark of *Adansonia digitata*, the young plantation, which it seems was made two years ago, is reported as progressing, but it is too young yet to afford any data as to the possibility of cultivating the baobab for the purpose of furnishing paper material with any satisfactory financial results. Dr. King gives it as his own opinion that a plant yielding an annual crop of fibre is, for economical reasons, more likely to answer than one from which a crop can be collected only at distant intervals. In this there seems a great deal of truth, and the dependance upon the bark of a tree for a constant and abundant supply of paper material, more especially when the tree may be of slow growth, seems a very precarious source. The possibility is suggested that among the numerous graminaceæ and herbaceous urticaceæ, and malvaceæ, abounding in the reserves, under the charge of the Forest Department of India, there must be some that would yield in sufficient quantity, and at a low enough cost, a fibre suitable for paper. It is hinted that amongst the wiry grasses so abundant on the Indian sea coast, several might be found to furnish as good a fibre for paper-making as the well-known Esparto grass.

With regard to ipecacuanha, about the introduction and extended cultivation of which such great hopes were at one time entertained, but which recent reports have shown to be unsuited for general cultivation in India, it seems that during the official year under review plants have been distributed to Ceylon, Singapore, Burmah, and the Andamans. It is stated that the peculiarly slow growth of this plant tends to prevent the cultivation of it being taken up with spirit by European planters, who not being colonists, but merely temporary settlers in the East, naturally look with little favour on crops that yield slow returns. The insignificant, straggling appearance of the plant is besides little calculated to excite enthusiasm or even interest among the planting community. These facts make it still more a matter of regret that the profitable cultivation of ipecacuanha as a crop at the Cinchona plantations seem so hopeless, owing to the cold of the winter season, even in the warmest valleys, being too great for a species so thoroughly tropical.

The opinions expressed by Dr. King in former reports as to the unsuitability of vanilla as a profitable culture in Bengal are endorsed in the present report, experiments having been tried with their cultivation not only in thatched sheds, but also in the open air under the shade of mango trees, and these experiments having failed, in consequence of the premature dropping of the fruit, the result has led to the confirmation of these opinions.

Seedling plants of the Para rubber tree, *Hevea brasiliensis*, originally sent from Kew to Calcutta, have been re-distributed to different parts of India, notably to Assam and to Burmah, in the hope that in the moist equable climate of the southern parts of the latter country, a suitable home may be found for this valuable tree.

INDIAN AND CHINA TEAS COMPARED.

Consul Medhurst, in his report upon the trade of Shanghai for the year 1875, institutes a comparison between the teas of India and China, which is highly favourable to the former. Fifteen years ago, he says, the growth of tea in India was regarded in the light of an experiment rather than as a movement destined in a short time to furnish one of the main staples of the country's exports. Much less was it anticipated, when the first plantations under European management were laid down in Assam, that the competition of the Indian would affect the development of the China leaf, but such has been the case. From 1,300,000 lbs. in 1861, the export from Calcutta has advanced to 25,000,000 lbs. in 1875. When we consider that, fifteen years ago, China held the monopoly of tea production, these figures show not only what a formidable rival Indian tea has already become, but they almost lead one to fear that if no change in the mode of cultivation or packing takes place, it is only a question of time when China will be ousted from the field entirely. The statistics relative to Indian teas also show us that the consumption in Great Britain during the last four months of 1875 exceeded the whole quantity imported in 1868. It is an ominous fact for China teas, that whereas up to last year the increased demand for tea in Great Britain was shared by China and India both, last year the consumption of China tea was for the first time stationary, the whole increase going to the credit of India. Precisely analogous is the condition of China tea in the United States. Here we find nearly one-half of the consumption to be Japan tea, while fifteen years ago it was exclusively confined to China.

That the soil of China is worn out and incapable of producing a tea fit to compete with the produce of Assam it is difficult to believe. The cause of the poor quality of late years lies rather in hasty preparation, with a view of bringing the teas early to market, and in the unsystematic way in which the different processes necessary to convert the raw leaf into the tea of commerce are carried out. Small proprietors, petty farmers, to whom the cultivation of the tea plant is mostly a secondary object, grow 50 lbs., or 500 lbs. weight of leaf, and carry it off on their backs to that market in their neighbourhood which looks the most promising. Failing a satisfactory offer in one place, they even transport it to a second place; the unfired leaf spoiling fast meanwhile, by the unnecessary exposure to the air, and the prolonged interval between the picking and firing. The packers themselves are simply speculators, mostly strangers in the district, who hire a house temporarily, and collect the leaf in little boxes from the growers. Thus the leaf from the different districts is mixed; pure, one-flavoured tea is scarce, and the packing lacks uniformity in all but defectiveness; if lead is dear, it is eked out with stout paper; if wood is scarce it is planed so much thinner, until chests containing 1 cwt. of tea are little better than bandboxes; hence the outside package splits, and the inside lead becomes rent and torn. These remarks apply equally to green tea, which is being supplanted by the Japan, as is Congou tea by the Indian leaf. In Japan the tea is also packed by foreigners, although they do not own any plantations. They own their own firing-houses in Yokohama, Nagasaki, and Kobe; and as these places are almost in the centres of tea districts, but few middlemen come between them and the producers. The result is thorough packing and firing, and good keeping quality in the tea, although, even in Japan, the intermixture of leaf by the natives before firing cannot be entirely prevented. We have to look to India for the perfection of tea culture; there planting, picking, and firing is all in one hand, and the needful capital outlay to produce a good result is not spared. In China, these desiderata are absent altogether, and the proceeds are in the primitive and unscientific style dear to the natives of the country. Nothing, it may safely be advanced, but the introduction of European capital and enterprise into the tea districts will save the foreign tea trade of the country from decay. But had foreigners free access to the country, matters would be changed entirely. Not only would the existing leaf be systematically picked, and not left at times to grow old in the shrubs, at times to spoil after picking, while the owner is haggling for the last cent, but many a barren hillside would be cleared of its jungle, and employment given to thousands of half-starved peasants.

Attempts, isolated it is true, have been made by foreigners to perfect the system of packing tea by personal supervision, in the interior, but they have been generally unsuccessful, except in the case of brick tea, which is made in some of the black tea districts under the eye of Russians from Siberia, who show more readiness in adapting themselves to Chinese ways, and whose Government gives them every protection. Were permission given to foreigners to buy or rent land in the interior, a few well-ordered plantations would in time reform the Chinese methods by their example.

NOTICES.

NOTICE TO MEMBERS.

It is specially requested that, in case of any irregularity or delay in the delivery of the *Journal*, notice may be sent at once to the Secretary.

MEETINGS FOR THE ENSUING WEEK.

Mon.... Farmers' Club, Caledonian Hotel, Adelphi, W.C., 5½ p.m. Mr. G. M. Allender, "The Products of the Dairy."
Society of Engineers, 6, Westminster-chambers, 7½ p.m.

Tues.... Zoological, 11, Hanover-square, W., 8½ p.m. 1. The Secretary, "Reports on the Additions to the Society's Menagerie during the months of June, July, August, and September, 1877." 2. Lieut.-Col. R. H. Beddome, "Description of New Reptiles from the Madras Presidency." 3. The Marquis of Tweeddale, "Notes on a Collection of Birds made by Mr. A. H. Everett in the Island of Luzon, Phillipines. 4. Prof. W. H. Flower, "A Further Contribution to the Knowledge of the Existing Ziphioid Whales, Genus *Mesoplodon*."

Thur....Royal Historical, 11, Chandos-street, W., 8 p.m. 1. Dr. B. W. Richardson, "Introductory Address." 2. Rev. A. H. Wratislaw, "John of Jenstein, Archbishop of Prague (1378-1396), and Thomas à Becket, Archbishop of Canterbury; an Historical Parallel."

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,303. Vol. XXV.

FRIDAY, NOVEMBER 9, 1877.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

CHAIRMAN OF COUNCIL.

General Cotton being at present unable, on account of the state of his health, to discharge the duties of Chairman, Mr. William Hawes has consented, at the request of the Council, to act as Deputy-Chairman during General Cotton's enforced absence. The usual opening address at the commencement of the Session will therefore be made by Mr. Hawes, on the 21st instant.

FIUME AND HER NEW PORT.

By George L. Faber,

H.B.M. Vice-Consul at Fiume.

A Word to the Reader.

[Fiume, the chief, indeed the only port of the kingdom of Hungary, is but little known to the English public; and the few passing tourists have been surprised to find themselves in one of the cleanest and neatest of harbour towns, faced by glorious scenery, almost rivalling that of far-famed Parthenope. Moreover, at this moment in England everything Austro-Hungarian has acquired, with a view to political contingencies, an especial importance and an interest which did not belong to it a year or two ago.

I have, therefore, little doubt that the following paper will be well received and extensively read. It was drawn up, at my suggestion, as a pendant to "The Port of Trieste, Ancient and Modern" (*Journal of the Society of Arts*, October 29th and November 5th, 1875), by Mr. George L. Faber, who, as Her Majesty's Vice-Consul for Fiume, has the best opportunities of studying local conditions. He begins by borrowing from the excellent monograph of Dr. Joseph A. Lorenz ("Topographie von Fiume und Umgebung vom naturwissens chaftlichen, historisch-statistischen und sanitären Standpunkte, etc. Wien. Carl Gerold's Sohn, 1869); which has appeared in Italian as well as in German; and whose value will be recognised when publishers choose to give us a "serious" hand-book for the Adriatic. Mr. Faber then describes the new port at full length; and here the matter may be considered original, having been supplied by the engineer officers in the Austrian service.

Mr. Faber's opinions concerning the railways lately opened at Fiume are those of the community in general, and they have already been ably expressed by M. Louis Frankovich, formerly her Majesty's Acting Consul for Fiume ("Reports of her Majesty's Consuls during 1876." Part II., pp. 111-112. London: Harrison). They are, it will be seen, opposed to the theories of Mr. Thomas A. Welton, F.S.S. This practised student of statistics speaking of my paper, "The Trade of Trieste," based upon the pamphlet of M. Franz Rziha ("Die Bedeutung des Hafen's von Trieste für Oesterrich," *Journal of the Society of Arts*, Sept. 15 and 22, 1876), objects as follows to the main idea of the Austrian engineer, namely, that trade would flow back to Trieste were the network of her railway communication made complete:—

"Ordered cargoes always go where the owner wants them; it is only market cargoes which can be influenced by inducements. When few lines of railway existed, Trieste must have received cargoes upon order sufficient to supply the district with which she dealt. Now that railways are many, it may have become a wiser and a less speculative proceeding to look to market cargoes for supplies of valuable articles, like coffee, even if these market cargoes all go to the north. To some extent, it may be feasible (!) to catch vessels at Suez, and direct them to Trieste; but the chances are, that market cargoes will continue to come to this end of the world (London) in such quantities that it may better suit the Bohemians, for instance, to try in the north than to bring in articles *via* Trieste. Besides, by dealing with London, or any other large mart, the necessity of holding extensive stocks is saved; purchasers, taking their requirements from hand to mouth, economise capital, and they need not buy a whole cargo of anything. This is a growing tendency in English trade, fostered by the use of the steamer and the telegraph."

Theoretically, there is nothing to object to in these words; practically, much. The present object of all the great Adriatic ports is to deal direct with the East, and Mr. Magniac (the *Times*, May 19, 1877) has shown how much the Suez Canal has injured British trade—a fact known to any officer of the "P. and O."—by the advantages it has offered to our southern rivals. But what is the use of importing either ordered or market cargoes direct to Fiume, for instance, if a vast railway monopoly compels the trade, by preferential tariffs and other contrivances, to flow into the northern channel, *via* Trieste? The fact is, Mr. Welton, familiar with the complicated conditions of "high commerce," would apply its lessons to a comparatively primitive stage; and the latter practically rejects them, and will reject them, probably, for another generation.

Richard F. Burton.

Trieste, July 11, 1877.

P.S.—The few explanatory notes which I have appended to Mr. Faber's careful and conscientious study are signed with my initials, in order that readers may not hold the author responsible for the opinions of an "outsider."]

Section I.—*Historical Notes on Fiume.*

The peninsula of Istria splits the Adriatic Gulf at its northern extremity into two parts, in this point somewhat resembling the Red Sea. The north-western or main branch heads in the Gulf of Trieste, whose port is distant some 80 miles by sea. From the southernmost point of the peninsula the eastern bifurcation, which mostly concerns us, extends in a north-easterly direction, forming the Gulf of Quarnero, about 40 miles long; and here, at the northern head, lies the port of Fiume, in N. lat. 45° 19′ 19″ and E. long. (Gr.) 14° 26′ 43,^{5}″. The site is thus S.E. of Trieste, and distant 79 miles by rail, 46 miles by road, and nearly 120 miles by sea.

Fiume is built at the foot of the mountain range trending south-eastwards along the eastern shore of the Adriatic. This offset of the Julian Alps is known under the general and collective geographical name of Dinarian Alps (Dinarisches Gebirge); but its natural form and appearance have given it the popular names Carso, or "Karso"* (Karst), and causes this particular part to be known as the "Liburnian Carso" (Liburnische Karst). It is the background of the ancient Liburnian Sea, now the Quarnero Gulf; or, as it was also called, the Sinus Flanaticus, *alias* Flanonicus, after the Flanates inhabiting its shores; hence, too, the name of their chief port Flanona (*hod* Fianona), a little Istrian harbour north of the Arsa mouth.

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* The origin of the word is disputed. Philoslavs trace it to "Hrast," an oak, its principal growth. But the word is considered too modern by the classicists, who would find it in the Keltic *Caer*, a stone, which best describes its surface. Hence, finally, the Carnic tribe and the provincial names, Krain, Carniola (Cragna), and Karinthia. The *Karstegebist* is divided into the maritime (Seekarst), and the highland. For full particulars see "Das Karstgebiet Militar-Kroatiens, &c. Verfasst von Joseph Wessely, &c., Agram, Albrecht, 1876.—R. F. B.

The comitat (county) of Fiume extends over a superficial area of 161,830 hectares (625 square miles), and is bounded by the frontiers of Istria and Carniola on the west and north; and by Croatia and the military frontier on the east and south-east. It embraces the whole seacoast as far as the port of Novi included. The greater part of the comitat lies on the Carso plateau, between two and three thousand feet above sea-level. From its high and barren plain rise several peaks, such as the Snjesnik (snowy) group (6,000 ft.), on the west, with the Sijeme, the Mlecni, and the Bitoraj ranges (1,600 to 3,000 feet above the plateau) on the east. The surface slopes gently towards the Kulpa (Colapis river) valley on the east, and rapidly seawards, forming three distinct terraces, or platforms, before the shore is reached. This peculiar formation of the range gives a most picturesque appearance to the coast generally, and especially to the town of Fiume, which is built on the hill-side, close to the sea-shore, at the head of the bay.[*] The latter, seen from the town, looks like a beautiful lake, the front view being closed in by the chain of islands, of which Veglia and Cherso are the principal, whilst on either side the coast land rises to a height ranging between 3,000 and 6,000 feet.

Fiume (river), derives its present Italian name from its situation at the mouth of the Recina torrent, also called the Fiumara,[†] the only river deserving the denomination which flows into the Quarnero. It is supposed to occupy the site of one of the ancient Liburnian towns, "Tersatica," which was destroyed by Charlemagne (A.D. 799). Fiume was known at a later period by the name of Vitopolis, and still later as (Civita) Sancti Viti ad Flumen, in German, St. Veith am Pflaumb,[‡] from which it has inherited its present name.

Of the ancient history of Fiume little or nothing has been preserved, all documents which might have tended to clear up the subject having been burnt by the Venetians, under Angelo Trevisano, in 1509. This much is, however, certain, that the Phœnicians first settled on our shores more than 3,000 years ago, and laid the foundation of commerce with the Mediterranean. They were followed by the Pelasgians, or Pelasgi, one of the earliest tribes that occupied Greece; to them are ascribed the cyclopean structures still found in Greece, Epirus, Italy, and on the western shore of Asia Minor. Their language was the common congener of Greek and Latin; they were an agricultural people, and they possessed considerable knowledge of the useful arts. The Tyrrhenian Pelasgi were, according to Müller, the remnants of the ancient Pelasgi, who preserved their nationality when the great body amalgamated with other tribes. The Etruscans, who succeeded them, were a sub-race of these Tyrrhenian Pelasgi,[§] and, with the Rhaetians[||], were called Tyrrhenoi and Tyrsenoi by the Greeks, and Tusci or Etrusci by the Romans. They occupied that portion of Italy which is separated from Liguria (the Genoese) by the river Macra (Magra), and from Latium by the Tiber, the greater part of which forms the Tuscany of our day. They became a civilised, polished, and highly prosperous nation; but they fell at last beneath the superior power of Rome, and never recovered their defeat at Lake Vadimonis (Lago di Bassano) by Papirius Cursor, B.C. 310, and subsequently by Cornelius Dolabella, B.C. 283.

The Greek colonies, which established themselves on our shores, and monopolised the commerce for centuries, were at last ousted by the Liburnians, an Illyrian race of great ability and courage, which for a length of time held dominion over the Adriatic Gulf. Liburnia constituted the coast district of Illyria between the rivers Arsia (*hod.* Arsa) and Titius (*hod.* Kerka), which separated it on the north from Istria and on the south from Dalmatia. The Liburnians were celebrated for their skill in navigation, which has been retained to this day by the coast people; they constructed vessels remarkable for swift sailing (*Liburnæ rates*), and it was to craft of this description that Augustus was mainly indebted for victory at Actium (B.C. 31).

The country was at length subdued by the Roman empire under Augustus, B.C. 28, and the natives were frequently employed at Rome as sedan or litter bearers; the islands off the coast then went by the name of *Liburnides* or *Liburnicæ Insulæ*, and the country was found sub-divided into small self-governing districts, which, continued under the new dominion, were known as "civitates." One of the latter, called, as has been said, after the "Flanates," and bounded by the Arsia on the west, was separated by the Recina (Fiumara) on the east from Croatia; it is mentioned by Strabo and Pliny as the river Eneo.[*]

There is no doubt that Fiume lies on that part of Liburnian territory known as Civitas Flanates, and everything tends to prove that it is built on the very site occupied by the once famous Tersatica.

After the breaking up of the Gothic Empire, Dalmatia and Istria were occupied by the Byzantine Emperors; the Croats immigrated in the seventh century, and settled in the country lying between the Arsa and the Cettina (the classical Tilurus), under the supremacy of the Eastern Empire, which administered the seaboard by its own officials. The relative position of Croatia to Byzantium is thus described by Gibbon:—

"The Croats, or Chrobatians, are the descendants of a mighty people, the conquerors and sovereigns of Dalmatia. The maritime cities, and of these the infant republic of Ragusa, implored the aid and instructions of the Byzantine Court; they were advised by the magnanimous Basil to reserve a small acknowledgment of their fidelity to the Roman Empire, and to appease, by an annual tribute, the wrath of these irresistible barbarians. The kingdom of Croatia was shared by eleven zoupans, or feudatory lords, and their united forces were numbered at 60,000 horse and 100,000 foot. A long seacoast, indented with capacious harbours, covered with a string of islands, and almost in sight of the Italian shores, disposed both the natives and strangers to the practice of navigation. The boats, or brigantines, of the Croats were constructed after the fashion of the old Liburnians; 180 vessels may excite the idea of a respectable navy, but our seamen will smile at the allowance of 10 or 20, or 40 men for each of these ships of war. They were gradually converted to the more honourable service of commerce; yet the Slavonian pirates were still frequent and dangerous; and it was not before the close of the tenth century that the freedom and sovereignty of the Gulf was effectually vindicated by the Venetian republic. The ancestors of these Dalmatian kings were equally removed from the use and abuse of navigation; they dwelt in the White Croatia, in the inland regions of Silesia and Little Poland, 30 days' journey, according to the Greek computation, from the sea of darkness."

When Croatia attained independence in 840, it is uncertain whether the Civitas Flanates belonged to her or not; more probably it remained under the dominion of the Franks, as history shows no trace of a formal transfer. The eastern part of the Civitas Flanates was subsequently granted, in feudal tenure, to the Bishop of Pola, who thus became a vassal of the Patriarch of Aquileja, and, through the latter, of the Holy Roman Empire. This state of ecclesiastical matters continued to the year 1787, although it did not extend to the civil rule.

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[*] The Bay of Fiume is one of the most charming that I have yet seen; and it wants only a Vesuvius to make it a formidable rival to Naples.—R. F. B.

[†] This south-Italian and Sicilian word properly means a winter-torrent; the Hebrew Nachal opposed to Nahar; the Greek Kheimarrhos; the Arabic Wady; and the Nullah of Hindostan. It is thus improperly applied to the Fiume stream, which flows all the year. Recina in Slav is a small reka (river).—R. F. B.

[‡] Pflaumb, again, is not a pure German word, and appears to be a local corruption of "Flumen" or Fiume.—R. F. B.

[§] I need hardly warn the reader that the origin of the Etruscans is still *sub judice lis*, and that apparently no two authors agree upon the subject. I see no reason to question their Lydian derivation.—R. F. B.

[||] Rhaetia, *i.e.*, part of Tyrol and Switzerland of the present day, of which Tridentinum (Trent) is the principal town, ultimately subdued by Augustus.—R. F. B.

[*] So says the original authority, Dr. Jos. A. Lorenz.—R. F. B.

In 1139 Fiume was granted, in feudal tenure, by the Bishop of Pola to the Counts of Duino, and they retained possession of it till the end of the fourteenth century. At that date the family became extinct, after having transferred its allegiance, in 1372, from the see of Pola to the House of Hapsburg. Fiume, meanwhile, had flourished; the cathedral, restored in A.D. 1200, assumed the title and patronage of Beatæ Virginis Assumptæ. This dignity, according to the fashion of the time, was considered only due to a town of episcopal rank. For 28 years between 1338 and 1365, Fiume was mortgaged to the far-famed Frangipani or "Break-bread" family, when it reverted to the Counts of Duino.

Already, after the peace of Constance, Fiume had received (1183) a free charter, as did most of the towns and the strongholds on the Adriatic, in order better to enable them to withstand the aggression of the Venetians. Subsequently (1399) the town was granted by the House of Hapsburg to Count Rambert de Wallsee, husband of the last scion of the Duino house; and, on the redistribution of the family property in 1464, it fell to Wolfgang de Wallsee, who, in 1471, made it over to the Emperor Frederick III. as a domain of the House of Austria.

From 1471 to 1776 Fiume was administered by Imperial governors, entitled "Vicarii Imperiales," according to her own free charter. When Charles and Ferdinand of Austria divided their inheritance at Worms (1522), Fiume was declared an independent province, and her liberties were confirmed by Ferdinand (1530), under the sanction of her charter, which was revoked only in 1836. The Emperor Maximilian conferred on her (1515), the title of "Fidelissima," and in 1659 she was honoured with a special flag by the Emperor Leopold. Charles VI. declared her a free port (*porto franco*) in 1723; and under the same reign she was called upon to sign the instrument known in history as the "Pragmatic Sanction." She was incorporated with Croatia in 1776 under the Empress Maria Theresa, but a protest of her "Patrician Council" again took her from Croatia in 1779, and declared her a *corpus separatum* belonging to the Hungarian Crown. On this footing she remained till the year 1809.

Occupied by the French invader at the commencement of the present century, Fiume was re-taken from them in 1813 by the English, who burnt all the goods and the ships, and who thus ruined many of the most opulent and respectable families.[*]

Fiume fell to the Austrian Government in 1814, and so remained till she was again transferred to Hungary by the Emperor Francis I. in 1822. In 1848, she was occupied by the Croats, and she continued under their administration till 1868, when the differences existing between Austria and Hungary were regulated by the settlement known as the "Ausgleich."

The counter-claim to the possession of Fiume, set up by Hungary and Croatia, led to a somewhat complicated arrangement, which, according to the "Ausgleich," is termed the *Provisorium* or *Interregnum:* by this arrangement the south-western corner of the Comitat Fiume, including the town and port, was separated from the county, and was made over to Hungarian administration. This territory, which has the form of a triangle, is bounded by the Recina (Fiumara) on the east, by the Istrian frontier on the west, and by the sea southwards, it comprises an area of 1·16 square miles (Austrian), and has a population of about 25,000 inhabitants, the town included. It is administered by a civil governor who holds his appointment from the Hungarian crown; his official title is Royal Governor of Fiume and of the Hungarico-Croatian littoral ("Il Governatore Regio di Fiume e nel Littorale Ungarico-Croato"); and he is likewise the head of the maritime government (Seebehörde, Regio Governo Maritimo), whose functions correspond with the Board of Trade. His jurisdiction extends along the Hungarico-Croatian seaboard, as far as the Dalmatian frontier, including the port of Carlopago, but, as the title implies, only to purely maritime matters and to the superintendence of the harbours.

The administration of the maritime region is in the hands of different authorities. The adjoining harbour-town of Buccari, for instance, which lies in the Croatian Comitat of Fiume, being a free port, is not subject to the Comitat authorities, but is under the direct administration of the Croatian Government at Agram. In the same way, Segna (Zengg) and Carlopago are governed directly by the officers of the military frontier (*militärgrenze*); and, though the seat is at Agram, the administration is independent of Croatia, receiving its orders direct from Budapest. The smaller ports, Portore, Novi, &c., are under the local authorities within whose jurisdiction they are situated.

Thus we see how complicated is the form of our coast government, and how difficult it has been to reconcile the various interests. The indefinite *Interregnum*, however, is to last until a settlement is come to between the Hungarian and Croatian Diets. The Magyars have their claim to Fiume, on the grant of Maria Theresa, as a "*Separatum sacræ regni coronæ adnexum corpus*," The Croats contend that it forms an inseparable part of the Comitat of Fiume, and, consequently, of Croatia. Considering, however, that, by the present constitution, Croatia stands in the same relation to the Hungarian Crown (*Separatum sacræ regni coronæ adnexum corpus*) as that claimed by Hungary over Fiume, the question resolves itself into one of mere form, and, the pretensions of the Magyars having been recognised under existing arrangements, they are content to leave matters as they are. At the same time, they are not likely to waive their rights to, or relax their hold on, a possession of which they have every cause to be justly proud; it is their only seaport, and its situation, which offers every natural advantage, has been poetically termed "the pearl in the crown of St. Stephen."

It is only too true that the Hungarians have hitherto reaped but small profit from this much coveted prize; on the contrary, they have lavished money on their spoilt child without prospect of immediate return. To use a familiar comparison, they have built a stable without providing for the horse; in other words, they have built a railway, which costs £180,000 to £200,000 a year to keep in working order, including interest on capital; they are making a harbour, which is, if the truth be told, hardly wanted;[*] and which will, when finished, cost little short of a million sterling. Whether the new port may be required hereafter is another question, which need not be considered, the traffic being first to be provided. This should have been the first step, and the money might have been more profitably

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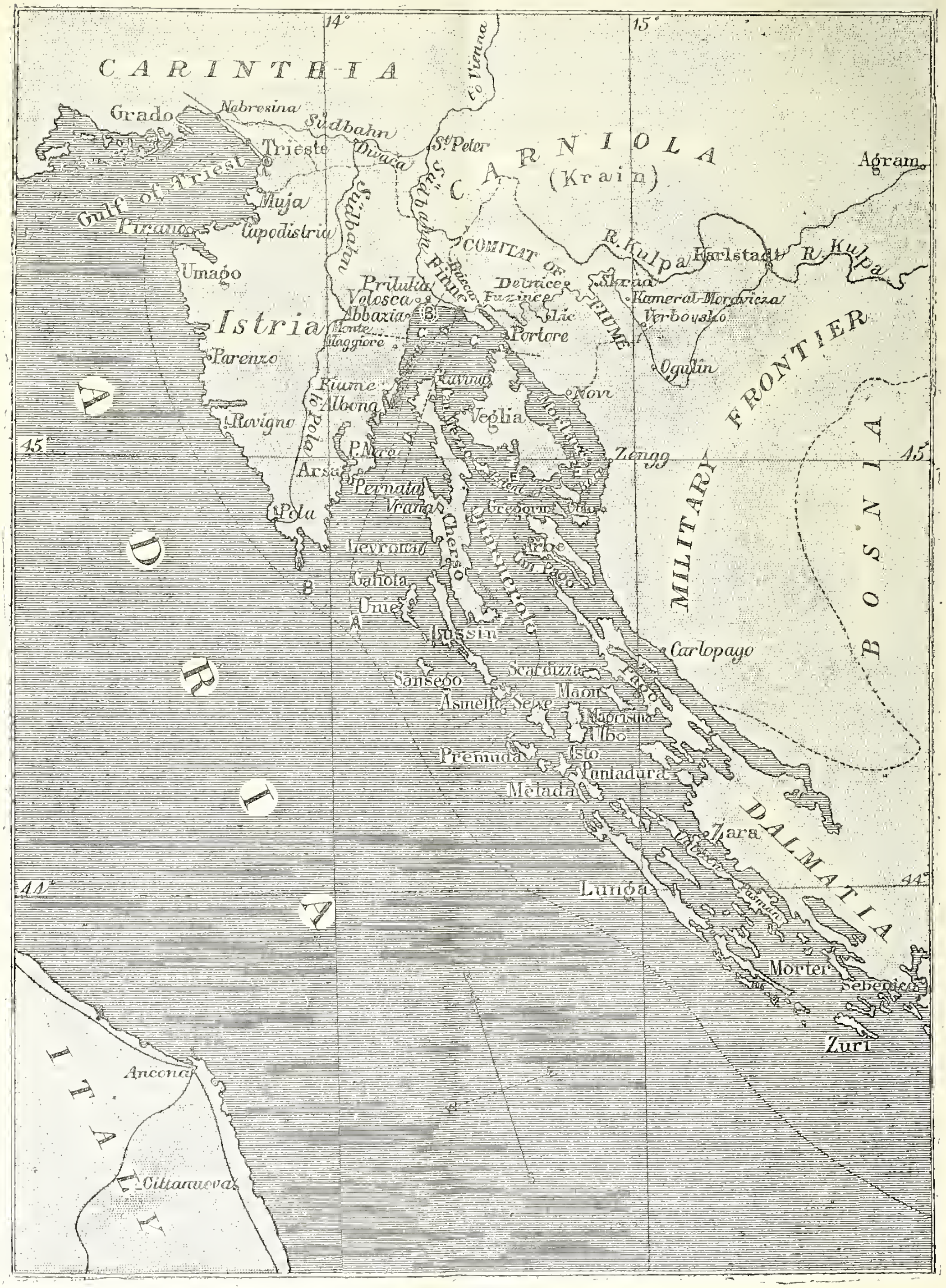
[*] The English did nothing of the kind, and Fiume would be only too glad, like Lissa and the Islands of Dalmatia, to be once more under the Crown of Great Britain. Professor Lorenz should be ashamed of this assertion in the text. But such is national gratitude. You assist foreign nations, and they hate you; you liberate them, you do what they cannot do, and you arouse their envy, hatred, malice, and all uncharitableness for long generations.—R. F. B.

[*] It is not wanted at all; the roads are excellent, and a few simple improvements, such as a floating breakwater of timber, and extended landing quays, with sheds to shelter goods, would have been amply sufficient. But Hungary, the kingdom, must ape Austria the empire; Ireland must do what England does; the poor must rival the rich; and thus Fiume, like Trieste, must build her own expensive and uncalled for new port. It is only fair to own that the Hungarian harbour has avoided the inordinate expense and the inexplicable blunders of the rival "institution" further north; and that if it do no good, it will not, like that of Trieste, severely damage local property, and eventually disturb the position of the town.—R. F. B.



MAP OF FIUME AND THE QUARNERO.

A. Town and district of Fiume.
B. Extent of Tramontana of Priluka.
C-C. Line of section of Quarnero from W to E } as seen in a separate plan.
D-D. Line of section of Quarnero from N to S } as seen in a separate plan.
E-E. Extent of Bora of Zengg.

spent in taking it. Ports are seldom found wanting, especially upon the East Adriatic coast, when there is trade to attract ships; whilst the finest harbour will not invite vessels where no cargo is to be found. This simple fact has apparently been left out of calculation.

Fiume is represented by a member in the Hungarian Parliament; in ecclesiastical matters she belongs to the diocese of Segna (Zengg), whose resident bishop is subject to the Archepiscopate of the Croatian capital, Agram. A bishop also resides at Veglia, who is subject to the Archbishopric of Zara, in Dalmatia.

The islands in the Quarnero are under the administration of the Istrian Government, with the exception of the south-eastern, or those lying south of Segna, viz.:—Gregorio, Golo, Arbe, and Pago, which belong to the military frontier.

Veglia was the seat of the Frangipani family, descendants of the old Roman consular line, who derived their name from the generous act of "breaking" or dividing, "bread" in time of famine. One of this house, by name Cencis, was guilty of the profane violation of the persons of Pope Gelasius II. and of his College of Cardinals in 1118. The last of the long line was decapitated for rebellion,[*] together with Count Zriny, Banus of Croatia, on the 30th April, 1671. The traitors' tombstone, in the parish church at Weiner Neustadt, near Vienna, bears the following inscription:—"Hoc in tumulo jacent Comes Petrus Zrinius, Banus Croatiæ, et Marchio Franciscus Frangepan, ultimus familiæ, qui, quia cæcus cæcum duxit, ambo in hanc foveam ceciderunt. Discite mortales et casu discite nostro observare fidem regibus atque Deo. anno dom. 1671, die 30. Apr. hora nona. Ambitionis meta est tumba."

To the Frangipani family also belonged the castle of Tersato, situated in Croatian territory, close to Fiume, on the other side of the Recina. Now it is the property of the children of F. M. Count Nugent, and contains some objects of interest, amongst others a column erected by Napoleon I. at Marengo.[†]

Fiume possesses some Roman remains in a well preserved gateway, said to be a triumphal arch of the Emperor Claudius II. The old town walls are also preserved in some places. Above the town are the foundations of an old Roman wall, which crosses the Karst plateau, and which can be traced with intervals as far as Laibach, capital of Carniola.[‡] It is said to have been the boundary line between the Eastern and Western Empires, but more probably it formed a line of defence against the inroad of barbarous foes.

Section II.—*Physical Conditions of Fiume.*

Fiume, I have said, is built at the mouth of the Recina, which flows into the Quarnero Gulf, east of the settlement. Although its sources become visible only about 900 ft. above the level of the sea, it is evidently the drain of the wide, barren and storm-wrung plateau. Never dry, even in the height of summer, it offers favourable sites for mills and factories within easy distance, about a mile off the town; 3,000 horse-power and more being available for such purpose. The annual supply is estimated at 850 millions of cubic yards, and the amount of deposit carried into the sea at 600,000 cwts. The latter, by slow degrees, is forming a bar, diverting the course of the stream, on reaching the sea, almost to right angle with the upper line of cliff-bordered bed.

The formation of the Carso prevents the accumulation of water on the plateau; the average annual rainfall (46 to 48 inches), runs off in the form of torrents to the sea. The average temperature of the water is not more even in summer than 45° to 68° Fahr. The uplands are therefore very badly supplied with the element, excepting in places where rain accumulates in natural reservoirs; these, moreover, are few and far between. The seaward slopes are likewise arid, until close to the shore, where limestone springs appear in abundance, extending along the coast from Fiume eastwards for about 30 miles[*]. These fountains supply Fiume and the eastern shores of the Quarnero with an abundance of the best drinking water, which, even in the height of summer, never exceeds 50° Fahr. In the town itself are four public springs, besides many private. The west coast of the Adriatic is not so bountifully supplied, and what water there is reaches a temperature of 60° Fahr. Much of the rain falling on the plateau bursts from under the sea. Of this, sufficient proof is afforded, by the low temperature of the Quarnero. In places these springs rise to the surface after heavy rains, with violence enough to endanger small craft; near Moschenizze the torrent re-appears in a circle of 60 yards diameter, and near Ika, in Istria, there is another of smaller extent.[†]

Another proof of this phenomenon is the Lake of Vrana, Cherso island, which lies in a basin 45 fathoms deep, separated from the sea by a broad ridge, high and stony; it has no apparent affluent or effluent, and the low temperature of the water shows that it flows by some submarine passage from the highest parts of the Istrian Alps; probably from Monte Maggiore itself; the effluent must be of the same character; the level of the lake being 40 feet below sea level[‡].

The mountains north of Fiume are scantily wooded, while those to the east and north-east are almost entirely bare, excepting in the few places sheltered from the Bora or north-east wind.[§] The vegetation of the western, or Istrian coast is, on the other hand, both abundant, varied, and well worth the botanist's study; it extends down to the sea which, not being subject to the Bora, is milder in winter than the northern and eastern shores of the Quarnero Gulf. It is also cooler in summer, being shaded from the afternoon rays of the sun by the high ridge forming the background. Abbazzia, which lies on the coast at the foot of the Monte Maggiore (4,444 Austrian feet high) has on this, and only on this, account, some claim to be called the Austrian Nice.[||] As far as situation, vegetation, and climate are concerned, it bears comparison with the Riviera and with places like San Remo, so much frequented by invalids. Something might be made of the site, if the speculation were properly worked, and a suitable bathing establishment, with accommodation for visitors were provided. At present every comfort is wanting, and there is not sufficient enterprise to take the matter in hand. The bathing is excellent, on a sandy beach, but safety arrangements are requisite, on account of sharks, which of late years have made from time to time, their appearance in the gulf, in pursuit of tunny fish.[*]

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[*] There are widely differing views concerning the fatal end of this noble house, and perhaps the envy and the jealousy of the ruler equalled, if it did not excel, the ambition of the vassal.—R. F. B.

[†] To which, be it said, he had no right whatever. The well-known Count Nugent, an Irishman born, bought the picturesque old castle for a song; and strange tales are current concerning the peculiar way in which he repaired it.—R. F. B.

[‡] I am not aware that any one has traced it; although there are reports that a section is to been seen near the Castle of Schneeberg, in Krain.—R. F. B.

[*] This feature repeats the phenomena of the Cœlesyrian Valley. The rains fall upon nummulitic and hippuritic rocks, which are crevassed and honey-combed from top to toe; and hence the torrents gush out at the feet of the mountains.—R. F. B.

[†] The same is the case in the Syrian waters, near the island of Arvad. Aradus, Ruad, where the fishermen can bale fresh water out of the salt sea. Doubtless this is the reason why the Quarnero abounds in tunny, which come to bathe in the cooler element; and thus we explain the existence of the huge prawn, *Nephrops norwegicus*, which is found, however, at Nile, at Naples. near the Balearics, and in other parts of the Mediteranean.—R. F. B.

[‡] The best proof of its being supplied by a submarine spring or springs, is the fact of its not being salt. I doubt the existence of an effluent; the changes of water-level are very great, and evaporation would readily take the place of an emissary.—R. F. B.

[§] The Bora, generally, is rather an east north-easter (Greco levante) than a north-easter, but it ranges to the north north-east, and varies according to the heights and lay of the coast range. —R. F. B.

[||] The "Austrian Nice" is more applicable to Gorica, Gorizzia, or Görz, in the county of that name, north of Trieste.—R. F. B.

The Croatian Alps, which the railway connecting Fiume with Karlstadt ascends to a height of nearly 3,000 ft., are thickly wooded on the summits; thence, the forests extend as far as the Bosnian frontier, affording an almost inexhaustible wealth of timber, of which Fiume is the natural shipping port; indeed, the chief trade of Fiume is the export of scantling, planks, staves, hoops, &c., and this trade export will be greatly developed when the country is opened up, the demand for timber generally, and especially for staves, being at times almost unlimited.

The Quarnero Gulf is of uniform depth, the bottom forming as nearly as possible a plain; the water varies from 30 to 40 fathoms, and reaches 50 and 60 only in places. The coast, both of the mainland and islands, is precipitous, and forms deep water close in-shore, thus abounding in creeks and bays, where safe refuge and good anchorage grounds are to be found. The tide is almost imperceptible; there is only one flood and ebb in 24 hours, with a rise and fall of 1½ft. to 2ft. in calm weather.

The fishery of the Quarnero is excellent, in regard both to quantity and to variety. It is a source of considerable revenue to the coast people; its produce forms their chief diet, and a large export trade of fresh fish, more especially of tunny, is carried on with Trieste and Venice. Salted and preserved fish is likewise exported to more distant places. The "scampo," a delicious kind of crawfish, is caught here, which has the reputation of not being met with elsewhere, excepting in Norway.[†] It resembles the prawn in taste; it varies from 4 in. to 8 in. in length, sometimes growing even larger; and it is found chiefly in those parts of the sea where fresh water springs abound.

The prevalent winds are the Bora, Scirocco, Tramontana, Provenza, and, in summer, the Maestrale, besides sundry local currents. The Bora is usually described as a north-easter, which blows mostly during winter time, in vehement gusts (*refoli, raffales*) from the Carso, where dense clouds collect; the weather being fine and the sky elsewhere clear, it generally lasts three, nine, or fifteen days. It is not, however, a wind which blows from any given quarter, but varies according to the direction of the mountains, down which it streams at right angles. Thus, along the coast east of Fiume, the mountain chain trends from north-west to south-east, and the Bora blows from north-east. About Segna (Zengg) it becomes an easter, the mountains changing to a due southerly direction, and at some places on the coast it comes from the east south-east. The Bora may, therefore, be described as essentially a land wind, blowing from north north-east, north-east, east north-east, east, and even east south-east. Its chief feature are the vehement gusts, which lash up the sea, and often raise water-spouts, the whole surface of the water being veiled by smoke and sea-dust. It does not extend far from shore, and it is, therefore, in a great degree, local; the western, or Istrian coast, being almost free from it, whilst on the plateau of the Carso it loses all these characteristics, and is nothing but a cold, dry north wind; in fact, the returning Baltic current.[‡] It blows on an average three months in the year, one-third of the winter and one-eighth of the summer; during the latter season, however, it becomes a Borina, a reduced copy of the Bora, cool and dry, but not blowing in gusts.

The reverse of the Bora is the Scirocco, or equatorial current, a warm, damp and unhealthy wind, which rises and falls gradually, and which blows continuously, not in gusts. It invariably brings rain and heavy seas, raising the water as the Bora depresses it.

The Tramontana is a sharp dry blast from the north-western corner of the Gulf; its course being directed by a deflection of the Carso at that point, it seldom extends more than half way across the Gulf. The finest season, from May to August, is that during which this wind blows daily, from daybreak till 8 a.m., and is succeeded in the afternoon by the Maestrale. This is a summer breeze from the north-west: it dies out at sunset and generally gives way to the Borina. When accompanied by the cool morning and evening breezes, it is a sure sign of lasting fine weather; it never exceeds the strength of a fair sailing breeze. The Provenza[*] is a mild, damp wind, ranging from south-east to south-west. The Libeccio or Gherbin, from the south-west, is rare and never lasts long, although capable of raising the heaviest sea, an accident which does not happen more than once in two or three years; as a rule, it is only a good trade-wind blowing during the summer afternoons, several days in succession, instead of the Maestrale.

Besides these five, there are local winds, as the Borinetto (a reduced Borino); the Forian, a south-easter or east-south-easter, which does not reach the northern coast, and which, although at times violent, never lasts long; the Segna (Zengg) Bora, which is the most violent in the Gulf, blowing down the Vratnik Pass, and rendering the harbour of Segna the most unsafe that can well be imagined. This wind does not reach more than half way across the Gulf, but it has completely wasted the exposed north-eastern and eastern shores of the otherwise fertile island of Veglia.[†]

Last of all may be mentioned the Tramontana of Priluka, a local norther, which ploughs down a pass in the north-western recess of the Gulf for the greater part of the summer and winter months, during the forenoon, and at times after sunset, more rarely during the whole day. It hardly ever reaches five miles out to sea, or even as far as Fiume.

Great pains have been taken to disparage the Quarnero from a maritine point of view, and also Fiume as a seaport, in favour of Trieste, which has hitherto had all the success, by means of the Südbahn monopoly.[‡] But this artificial state cannot last for ever, and the trade, which of right belongs to Fiume, will in due course of time find its natural channel, in spite of all endeavours to the contrary. Indeed the consequences of the favouritism by which the trade of Trieste has, for many years past, been artificially propped up become daily more apparent, by a gradual though constant decline in the returns of that port. Fiume can bear to stand on her own merits from a maritime point of view; she can even claim superiority over Trieste in many respects, if only considered in a fair spirit. It may be well to point out here some of the natural advantages which Fiume possesses.[§]

1. For vessels coming up the Adriatic Gulf the distance to Fiume is 40 direct miles shorter than to Trieste.

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[*] At Trieste, the plague of sharks which, of late years, has greatly increased, is popularly attributed to the opening of the Suez canal.—R. F. B.

[†] Before noticed. I am glad to hear that Mr. Faber is preparing a detailed account of the fisheries.—R. F. B.

[‡] The Adriatic, as the map shows, forks at the northern head like the Red Sea, and the two tepid basins—the Gulf of Trieste and the Quarnero—cause a general and regular rise of the atmosphere. The cold and heavy draught from the mountains rushes in to restore the equilibrium: hence the Bora is felt mostly on the slopes, and the gusts extend but a few miles out to sea.—R. F. B.

[*] In Istria "Provenza," is applied to the intervals before the setting in of the Bora or of the Scirocco; and "Contraste" to the contention of the winds when the land is tormented by the Bora, and the sea by the Scirocco simultaneously.—R. F. B.

[†] There are peculiar points concerning the Bora of Signa which require study. Under the Venetians the place was called "Porto Quieto;" and the admirals declared that want of wind often wasted their time for weeks. The mountains behind the townlet have all been disforested, and perhaps this may be one reason for the inordinate fury of the gale. It appears also to have curious electrical conditions raising the sea surface, as if to meet waterspouts.—R. F. B.

[‡] The fault lies with Fiume. Even after she had her own two railway lines, the inveterate apathy and want of commercial enterprise have kept her back, and neglecting the present she will lose the future. As soon as Bosnia and the Herzegovina shall fall into the hands of Austria, the admirable harbours of Dalmatia, the finest in the Mediterranean, will find their proper occupation, and Fiume, which has failed to take time by the forelock, risks a return to her former insignificance.—R. F. B.

[§] Fiume in maritimer Beziehung von Heinrich von Littrow. Fiume, 1870.

2. When once the Faresina Channel is passed, between the Island of Cherso and the mainland of Istria, Fiume harbour is accessible in almost any weather; if, however, the passage is prevented by strong headwinds, vessels can find shelter and refuge on either side, with good anchorage-ground in 20 and 30 fathoms, within a few hours' sail from Fiume. For instance, we have the ports of Medolino (for small ships), Arsa, Fianona and Albona (Rabaz), on the Istrian Coast; the large Cherso Bay, the harbour of San Martino on the south-western coast of Cherso, all offering excellent anchorage ground. The Gulf of Trieste affords no protection from the prevalent Bora, and it is not an uncommon occurrence that vessels already in sight of Trieste have been forced to run before the wind, and to seek refuge in the roads of Pirano, or to anchor in the open off Umago, sheltered by the hills of Salvore. Hence again they have to beat a hasty retreat if the wind suddenly veers round to north, and north-west, or to west.

3. The entrance of the Quarnero is throughout of almost uniform depth, and free from sandbanks and reefs on both sides, and, including the Faresina Channel, it offers everywhere good anchorage-ground. The Gulf of Trieste narrows considerably between Pirano and Grado; moreover, many a vessel has stranded on the sandbanks off the latter port, which it has been found necessary to mark by a light ship.

4. The harbour of Trieste forms the only protection from the south-east, south, south-west, and west; whereas nature has provided Fiume with the most effectual protection, by the situation of the islands and the general configuration of the gulf.

5. The new port of Trieste, now in course of construction, affords only doubtful protection, being open to the most violent wind, the Bora (east-north-easter), and partially so to the Scirocco (south-easter). The Fiume harbour will, when completed, protect ships from all winds.

6. The violence of the Bora is much greater at Trieste, and stops all work in the harbour, on an average, 70 days in the year. This is not the case at Fiume, where a day's work is seldom lost.

7. Another great advantage, which the natural situation of Fiume offers, is the number of islands (upwards of 60), by which the coast is studded, and the various channels thus available for reaching the Dalmatian Coast, as far as Sebenico, a distance of about 150 miles, without issuing into the open. This is highly favourable to coasting vessels, not to mention the advantage from a strategetical point of view, in times of war and blockade.

Section III.—*Railways.*

In former days, Fiume was all-important as an emporium of the trade of Italy and the East, for the countries lying south of the Danube. Till the end of the seventeenth century she appointed her consuls to Ancona, Civita Vecchia, Messina, and other ports. Under Charles VI. a treaty of commerce was made with the Turks, for the purpose of opening up the eastern trade, Fiume being at the same time declared a free port. An Oriental Company was started, to which a monopoly of commerce with Portugal and the East was granted. About the same time a sugar refinery* was founded by the Dutch, and the protection of the Austrian flag was granted to traders settling at Fiume.

In the year 1768, 82 Greek families sought refuge from Turkish Bosnia, and, citizenship having been granted them by the Empress Maria Theresa, they established a trading company, under a charter accorded by Joseph II. This colony subsequently became very wealthy, and to it are due, in a great degree, the growth and prosperity of the town.

In 1800, under Francis I., the Louisenstrasse, a trunk road 76 miles long, was built, connecting Fiume with Karlstadt, thereby facilitating the trade with Croatia, Hungary, Slavonia, and Bosnia. At that time the trade was very important, and its decline is owing entirely to the period of innovation, and to the policy under which the building of railways was inaugurated in Austria. For many years Fiume was left out of the question. Under the all-ruling monopoly of the Südbahn, a line has lately been built, connecting Sissek (on the Save) and Agram with Steinbrück, lying on the main line, Vienna to Trieste. Thus, the whole trade, which to that time had concentrated at Fiume, was diverted to Trieste; and thus Fiume, totally disregarded, remained without any railway communication till 1873.

When the dawn of the new constitutional era at last broke upon Hungary (1868), and gave the impulse which aroused the country to remedy the neglect of her national interests during the reign of absolutism, the authorities eagerly undertook the task of filling up gaps in the system of communication; but they did so with an energy hardly commensurate with the resources of the country. Fiume having at the same time been assigned to the Hungarian crown, one of the favourite schemes was establishing direct railway communication with the sea, and thus opening an export trade *viâ* Fiume, then confidently expected to become the successful rival of Trieste. The connection of Fiume by rail with the two nearest points of the existing network of the Südbahn was considered the most rational and inexpensive course; one of the chief features of the scheme being also a plan for the extension of the port. The railway lines in question had already been under consideration, and the tracings, made many years previously, consisted of:—

1. A western line, joining the Südbahn at St. Peter, on the main line, Vienna—Trieste, 44 English miles distant from Trieste, and 35 miles from Fiume.

2. An eastern line, joining the Südbahn, at Karlstadt, 33 miles from Agram, and 109 miles from Fiume.

The concession for the first line was granted to the Südbahn, 5 per cent. interest being guaranteed by the Austrian and Hungarian Governments on the outlay; but the second project, on account of its length and the expense resulting from engineering difficulties, was carried out by Government.

The Fiume-St. Peter line was already under consideration in 1857, but excepting the tracing, nothing was done for more than twelve years, nor was it opened before June 25, 1873. It descends from St. Peter (1,830 Austrian feet above sea-level), through the valley of the Reka, on a gradient varying from 1 : 500 to a maximum of 1 : 40; there are two principal and a number of smaller tunnels, one at Maloberze, 1,975 ft. long on a gradient of 1 : 70, and the other at Rakavac, 1,000 ft. long. The total length of the line is 54½ kilometres, or close upon 35 English miles, consisting of:—

75 curves, measuring	77,830·88	Austrian feet.	
rectilinear „	94,642·09	„	„
Total ..	172,472·97	„	„
Minimum radius of curves	750	„	„
Average „ „	1,303	„	„
Average radius of the whole line..................	2,887	„	„

The gradients are:—

1 in 500 — 1 in 89	70,411·19
1 in 81	26,992·40
1 „ 80	11,769·30
1 „ 60	480
1 „ 41	5,065
1 „ 40	37,309·24
	152,027·13
Horizontal	20,445·84
Austrian feet ..	172,472·97

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* The old building, a villa to the north of the town, is still shown. —R. F. B.

The earthworks, embankments, dams, cuttings, &c., are estimated at 2,767,833 cubic metres. The annual goods traffic amounts to about 80,000 tons.

The Karlstadt line, opened in October 1873, is a more considerable work than the St. Peter, on account of its greater ascent (836·2 metres) and other difficulties. One cannot help admiring the way in which the obstacles have been overcome, and how technical science has contrived to construct an efficient working line, with due regard to economy. These results have been attained by the rare combination of ingenious tracing, and by the boldness which characterises the whole works. Starting from Karlstadt the line crosses the Dugadraga (valley) by an embankment,* measuring 70,000 cubic metres; it then passes the Kulpa by a 3 R. span iron bridge (middle arch = 39·6 metres, 2 sides, each 32 metres), and the torrent Globornica by a viaduct 29 metres high (middle span 24 metres, and 2 side spans each 20 metres). Two embankments, one in the Bistrica valley (140,000 cubic metres), and the other at Touin (120,000 cubic metres) lead to the Ogulin station. From that point the following works are noticed:—1. A single-arched iron bridge over the Dobra (28·6 metres; 2. The double track tunnel of Ticeva (158 metres); and 3. The double track tunnel of Gomirze (230 metres). Thence (4) crossing the Dobra a second time by a single span iron bridge (28·6 metres), are 4 tunnels with double tracks near Verbovsko (134 metres, 70 metres, 43 metres, 60 metres); 5. Third iron bridge across the Dobra (23·6 metres); and 6. A fourth similar (28·6 metres) over the same river, till Cameral Moravice is reached. Here finishes the valley line, the maximum ascent having been hitherto 1 : 143, from this point the mountains have to be assailed, and the gradient increases to 1 : 60. Leaving Skrad, the following works are passed:—1. The Kupjak tunnel (1,245 metres), and dam (220,000 cubic metres); 2. The Susica tunnel (367 metres); 3. The Besnyak tunnel (168 metres), passing the stations Delnice and Lokve, and reaching, 4, the tunnel (274 metres), which traverses the mountain Sleme, this being the highest point of the line, 836·2 metres above the level of the Adriatic.

The descent now begins on an increased gradient of 1 : 40, crossing the Licanka by a double-span iron bridge 24 metres high, each span measuring 35 metres. Thence reaching the station, Fuzine, the gradient decreases to 1 : 60, as far as Lic, 816 metres above the sea, which station is reached after passing the tunnel of Kobiljak (521 metres). From Lic the gradient again increases to 1 : 40, and passing the station Zlobin, and a cutting in the mountain Obesenjak (90,000 cubic metres), the line reaches the station Plase in a southerly direction; thence turning north north-east, it skirts Mount Sveto and makes Meje, the station. After this it again bends round to south south-east, and running along an embankment (160,000 cubic metres) arrives at the Buccari station.

Here the line crosses the Draga valley by an embankment (210,000 cubic metres), passes Mount St. Anna by a cutting (95,000 cubic metres) and after another embankment at Podvezica (170,000 cubic metres) reaches the coast on the edge of the foot hills, which it descends till the terminus. The Recina (Fiumara) valley is crossed by a viaduct twelve metres high, five arches each measuring seven metres, and one arch of two metres, with an iron bridge across the river, spanning 35 metres. From this point Fiume is reached, after passing through a double track tunnel 417 metres long.

The whole line is constructed for a single track, with the exception of a few tunnels specially mentioned; they have been so laid out that a double line may be added.

The gradients are as follows, starting from Karlstadt:—

Metres.

	Ascent.	Descent.
1 in 2,000 — 1 in 500	4,606·97	250·
1 in 500 — 1 in 200	16,278·34	2,997·02
1 in 200 — 1 in 100	43,245·24	1,106·55
1 in 66⅔	136·06	140·
1 in 62½	28,950·42	—
1 in 59	—	50·
1 in 55	—	403·63
1 in 50	—	937·17
1 in 47	—	960·
1 in 40	—	35,093·84

Ascent, 93,217·03 metres; descent, 41,938·21; horizontal, 40,015·13; total, 175,170·37=108·78 English miles.

The average gradient of the descent to Fiume is therefore somewhat over 1·50; the minimum radius of curves is 275 metres, and the stone and earthworks of the whole line are set down at 7 millions of cubic metres. The cost of construction amounted to about 28 million florins (£2,333,000). In comparison with this outlay, an annual goods traffic of some 70,000 tons, on a daily average 20 vans, each loading 10 tons, must appear disproportionately small to the most casual observer. It is hardly to be wondered at that the line does not pay even its working expenses, especially as on one of this description, the wear and tear of the rolling stock is much more considerable than is the case of ordinary railroads.

I will now endeavour to point out the cause of this failure, and at the same time to seek the remedy.

When our double-line of rail was opened, Fiume was, and is still, dependent upon the following principal railways connecting her with the Hungarian interior, viz:—

1. St. Peter, Pragerhof-Budapest, 375 English miles, belonging to the Südbahn.

2. Fiume-Karlstadt, 109 miles; Karlstadt-Agram, 33 miles; Agram-Zakany, 63; Zakany-Budapest, 155; total, 360.

Now the two lines, Fiume-Karlstadt, and Agram-Zakany (172 miles), belong to the Hungarian States railways, and the remaining 188 miles to the Südbahn.

3. Fiume-Agram-Sissek, 173 miles, of which the line, Fiume-Karlstadt (109 miles), belongs to the State railways, and the remaining 64 miles to the Südbahn.

4. Fiume-Zakany-Essegg, 334 miles, of which the lines, Fiume-Karlstadt, and Agram-Zakany (172 miles), belong to the States railways, and the remaining 162 miles to the Südbahn.

Thus we see that all these systems are owned more or less by the Südbahn. No. 1, over its whole course; No. 2, over 188 miles; No. 3, over 64 miles; and No. 4, over 162 miles. The "Great Southern" can therefore dictate, as far as suits its own interests, what terms it likes with regard to the Fiume traffic. As a matter of fact, the chief exports and imports from the east (Sissek, Essegg, &c.) are still diverted by preferential tariffs to Trieste; similar and other means, such as vexatious regulations with regard to the re-loading of goods passing off their own lines and on to the States railways, control effectually enough the traffic to Fiume by the Karlstadt line, and turn it in favour of the longer line, *viâ* St. Peter, which is entirely in the hands of the Südbahn. It is clear that Fiume has not benefited by railway communication to the extent that might have been anticipated under ordinary circumstances, and that it is entirely dependent upon, and at the mercy of, the Südbahn, whose sole interest it is to favour Trieste.

This is, however, a state of things which might, and which ought to have been foreseen, and opposed by the Government before going to the expense of building the line to Karlstadt. It has, on the contrary, played into the hands of the Südbahn, by consolidating and increasing the value of its network.*

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* This part of Austria is the classical land of huge and wasteful embankments, which ought to have been viaducts; and that near Fiume is one of the worst of its kind. By way of rendering it more dangerous, in a place were the Bora blows furiously, it is provided with a sharp curve.—R. F. B.

* What can Governments do in these days, when the whole power of finance and capital is brought to bear upon them? Enough to say, that the house of Rothschild rules the Südbahn.—R. F. B.

What is most needed is the opening up of the so-called frontier railways (*Grenzbahnen*) along Bosnia, and forming a continuation of the line Fiume—Karlstadt to Essegg, on the Drau, by way of Sissek. It is needless to point out the importance of this line, not only to Fiume in particular, but also to the general trade of Hungary; the fact is generally admitted by all who can speak with authority on the subject. It would bring Fiume within 276 English miles of Essegg, or some 60 miles nearer than by the present roundabout way *viâ* Zakany; and this important centre is situated on the Drau, close to its confluence with the Danube, where the bulk of the trade with Servia and Slavonia is concentrated. Thence railway communication is already established with Zombor, and the Francis Canal system, and Szegedin, in the heart of the Banat, the "granary of Hungary;" the distance from Essegg to Szegedin being 104 miles. The latter place would not be more than 380 miles distant from Fiume, and the whole line would be independent of the Südbahn.

The first tracing of the frontier works dates as far back as the year 1845, thus showing the importance which even then was attached to them; and, curiously enough, they were sanctioned by the Hungarian Parliament in 1870. Notwithstanding this, Government has not thought fit to carry out the project, a neglect the more surprising, considering that, in a financial point of view, the cost would be covered by the proceeds of the frontier state-forests, which have relatively no value, until this road is built. The opposition which the opening of the line meets at head-quarters may be partly due to strategetical reasons; the more obvious causes are partly the all-powerful influence of the Südbahn, whose interest it is to prevent competition, and mainly the centralisation policy which has guided the Hungarian Government in all railway matters. The object is to make the Danube the highway of the commerce with the East, and Budapest the emporium and the central point, whence the trade of Hungary and of all its railways is to radiate.

Thus, whilst opposing the frontier lines, Government has been anxious to secure a railway from Budapest along the left bank of the Danube, to Zombor and Neusatz, where, crossing the Danube, it will be continued to Semlin, and there will effect a junction with the contemplated Servian lines. There is no doubt that this route must be considered in many respects strategetical, but one of its chief objects manifestly is to attract the trade of the lower Danube, of Turkey, and of the East to Budapest, in view of the junction with the Servian lines and the short sea route *via* Salonica. Hence Government is anxious to see the plan carried out, despite the financial difficulties and the problematic success of the scheme, whilst the frontier lines are doomed to delay. The question is of the greatest importance at a time when its solution is so intimately connected with the great military and political question of the day.

In the present state of affairs the Budapest-Semlin scheme has been shelved, pending more favourable circumstances, both political and financial, and it is impossible to say whether or not the frontier lines will, meanwhile, remain on paper. It is, however, to be hoped that Government may relinquish a policy so dubious as that of trying to impose a given channel on trade, and of refusing to carry out a measure acknowledged by the sanction of Parliament to be of prime importance, affording a short and natural outlet for exports to reach the sea.

Presently, the all-dominant influence of the Südbahn will have to be dealt with, and a settlement of this question arrived at, as soon as the carrying out of the frontier lines is determined. Thus, Sissek must be looked upon as an important junction, owing to its position on the River Save, the chief, and, at present, only channel for the Bosnian trade, and will become even of greater value, as the nearest junction point with the Bosnian railways now in course of construction, and terminating at Salonica. In this respect the prolongation of the line Fiume-Karlstadt to Sissek would be of primary importance to Fiume, were it not for the fact that the position is already held by the Südbahn. Thus we explain how the trade is now diverted from Sissek, *viâ* Agram and Steinbrück, to Trieste. On the same principle it would still be so diverted, even if the line Karlstadt-Sissek were built, although Fiume would then lie some 54 miles nearer to Sissek than Trieste does. The Hungarian Government also refuses its sanction to the junction of the Hungarian with the Bosnian lines (which would be effected at the frontier town of Novi, by the construction of a line, Sissek-Novi) as long as the position of the Südbahn continues to form an *imperium in imperio*. The former justly fears that the traffic with the East would be diverted by the Südbahn to Vienna, to the exclusion of Budapest. This is a further reason for Government favouring the junction with the Servian railways, by means of the Budapest-Semlin line, in preference to the junction with the Bosnian lines at Novi, which is naturally favoured by the Viennese authorities, including the Südbahn.

The only course calculated to remedy the present intolerable state of things would be for Hungary to buy up, or to rent, at fixed annual payments, the network of the Südbahn in Hungary, in the same way as was lately done by the Italian Government in respect to the Lombardo-Venetian lines of the same company. Thus the obnoxious monopoly would, at a single stroke, once and for ever, be abolished.* Our Goverment recognises the necessity of some such radical measure, and this will probably be one of the first financial railway problems which will have to be solved, as soon as political and economical circumstances permit its being discussed with a chance of success. The sale of the Lombardo-Venetian lines to Italy was effected on the basis of an annuity payable to the Company according to its revenue for 1875, and it amounted to 29½ million francs in gold (£1,180,000), besides which the Company received 127 millions francs cash (£5,080,000), and the rolling stock was taken over at a valuation.

The sale having been proposed for the ratification by the Austrian and Hungarian Governments combined, the Südbahn being formally an Austro-Hungarian Company, the consent of the Hungarians was granted, under the reserve, that they should consequently acquire the right of purchasing on similar terms the Hungarian lines of the Südbahn. The Hungarian network, a total length of 98½ German (= 459 English) miles cost the Company 66 millions florins; but the purchase on the basis of the sale to Italy would involve a State outlay of at least 80 millions (£6,666,000), or an annuity of six millions (£500,000). It is, however, probable that the financial position of the Südbahn may tend to facilitate the necessary agreement. Whilst pointing out what has become a measure of prime necessity from the Hungarian point of view, the Government should be warned at the same time against the error of an extensive policy in favour of what it considers national interests. The wisdom of this system lies open to the same grave doubts as the present policy of the Südbahn monopoly, which it is so anxious to displace. What is to be feared is, that, the independence of the Südbahn once removed, much as the step would benefit Fiume, it will make way only to a greater monopoly on the part of the State, a monopoly upheld by preferential tariffs, in order to favour a circuitous route *viâ* Budapest. Such a course would, doubtless, favour individual interests, but it would be unjustifiable from the point of view of all recognised principles of political economy. The irretrievably bad effects of a combined policy of centralisation and of trade-protection are so generally admitted in our days, that it would be mere presumption to enlarge upon them.

It will be interesting, as indeed, it is indispensable, in order to substantiate these arguments, to give a few figures as to the relative position of Fiume and Trieste. The distances are as follows :—

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* Meanwhile, where is the money to come from?—**R. F. B.**

	Kilometres.
Trieste-Pragerhof-Budapest	618
Fiume-Zakany-Budapest	579
Trieste-Steinbrück-Sissek	337
Fiume-Agram-Sissek	279
Trieste-Pragerhof-Essegg	603
Fiume-Zakany-Essegg	538

Taking the uniform rate of a penny per ton per English mile, this gives an advantage in favour of Fiume over Trieste of, 2s. per ton to Budapest; 3s. per ton *viâ* Agram to Sissek and 3s. 6d. per ton *viâ* Zakany to Essegg; an advantage which is obviated at present by the preferential tariffs of the Sūdbahn. If the frontier lines were carried out, the advantage in favour of Fiume would increase to 8s. 4d. per ton to Essegg, and 4s. 7d. per ton to Sissek; thus showing the importance of these lines, not only to Fiume, but to the general trade of lower Hungary, and proving that the Südbahn has a direct interest in opposing their construction.

The following figures show the desolate state of the Karlstadt - Fiume, and the Agram - Zakany railways from a financial point of view. The total length of the two lines is 279·15 kilometres, at an outlay to the state of 37 million florins, which involves an annual charge of 2,220,000 florins. The working of the lines gives the following results:—

	1876. Florins.	1875. Florins.	Difference. Florins.
Gross receipts ..	709,054 ..	803,329	— 94,275
i.e., per kilomètre ..	2,540 ..	2,877	— 337
Gross expenses ..	922,550 ..	838,446	+ 84,104
i.e., per kilomètre ..	3,305 ..	3,004	+ 301
Loss on working ..	213,496 ..	35,117	+ 178,379
i.e., per kilomètre ..	760 ..	126	+ 634

The regulation of the River Kulpa is the first measure required in order to feed the Karlstadt-Fiume line. It might be carried out at a comparatively small cost, especially if combined with the organisation of the the chain-navigation system, which does away with the necessity of locks, requiring only a small depth of water, and which can be carried on, as actual trial has shown, at minimum rates of freight. The distance from Semlin to Karlstadt by the Save and the Kulpa being 730 kilometres, the cost of organising chain-navigation along the whole route, including 13 stations, and as many steam-tugs, might be effected at £250,000; and the freightage, based upon the experience afforded by other rivers, would not exceed, for the whole distance, 16 kreutzers per cwt., or 5s. 4d. per ton.

This would be a boon for the raw produce of Bosnia, of Servia, and of Southern Hungary, including the timber of the military frontier. An annual goods-traffic not exceeding 300,000 tons, by no means an exaggerated estimate of what might be expected, would not only make the concern itself pay, but also would enable the Karlstadt-Fiume Railway and the Fiume harbour works to make some returns upon outlay.

To be continued.

CORRESPONDENCE.

KOENIG AND APPUNN.

In the *Journal of the Society of Arts* for 3rd August, p. 864, there was inserted a long letter from me respecting the discrepancy between Koenig's and Appunn's determinations of musical pitch, and I concluded by saying that I found the necessity of further examination, and would communicate the results.

During the whole month of September, I was diligently occupied in examining Appunn's tonometer, with the aid of a ship chronometer, rated to lose one second in twenty-four hours. The result was a conviction that Koenig's objections were groundless, that the instrument had been correctly tuned, and that the beats had been properly counted.

It remained to account for the discrepancy between the results obtained from two different tonometers by Dr. Preyer, of Jena, and by myself (which are practically identical), and those obtained by Prof. Mayer and McLeod, and quite recently by Lord Rayleigh (which agree with Koenig's very closely). I had devised a series of experiments for this purpose; but, as they required the use of two separate tonometers, and two different and distinct blow-tables, a considerable delay ensued before I could commence them. To-day, for the first time, I experimented on two such tonometers for four hours, with the following important and rather unforeseen results, which must be taken as preliminary and very rough, requiring confirmation and correction by the whole series of experiments, which will occupy me for several weeks, as they are of a very laborious and tedious nature.

By taking the beats between two reeds in the same and two reeds in different tonometers, and combining them properly, it appears that the confined space of air in which the reeds beat, affects the number of the beats produced, and accelerates them, so that about one per cent. more beats are produced in a given time than would be heard if the beats took place in an open space.

If this result is confirmed, Appunn's numbers will have to be reduced by about one per cent., and this will make them very nearly agree with Koenig's. The tables, therefore, on pitch which I gave in my paper of 25th May, will require correction. As I have made arrangements for receiving copies of the forks measured for the French commission, I shall be able to measure them myself by Appunn's scale, and give them in the corrected form. I hope to present the corrected table to the Society of Arts at the end of the coming session. In the meantime I hasten to give the above important and novel acoustical result, which, while it reconciles apparently irreconcilable statements, in nowise impugns the accuracy of the workmanship of Appunn and Koenig, or of the other observers.

Alex. J. Ellis.

25, Argyll-road, Kensington, W.,
November 3rd, 1877.

MEETINGS FOR THE ENSUING WEEK.

Mon.... Institute of Surveyors, 12, Great George-street, S.W., 8 p.m. Opening Address by the President, Mr. E. J. Smith.

Royal Geographical, University of London, Burlington-gardens, W., 8½ p.m. 1. The President's Opening Address. 2. M. Broyon, "Mirambo's description of Unyamwesi, and the Best Route thither from the East Coast of Africa."

Tues. ... Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. Mr. Alfred Holt, "Review of the Progress of Steam Shipping during the last Quarter of a Century."

Anthropological Institute, 4, St. Martin's-place, W.C., 8 p.m. 1. Mr. H. H. Howorth, "The Spread of the Slaves." (Part I.) 2. Capt. R. F. Burton, "Mori Castellieri."

Wed.... Society of Public Analysts, Bnrlington-house, W., 8 p.m. 1. Mr. J. Carter Bell, "Milk Analysis." 2. Mr. Otto Hehner, "The Analyses of Five Mineral Waters."

Thur.... Linnean, Burlington House, W., 8 p.m. 1. Mr. R. McLachlan, "Report on the Insecta collected by Capt. Feilden and Mr. Hart during the Recent Arctic Expedition." 2. Dr. Edward L. Moss, "The Surface Fauna of the Arctic Seas as observed in the Recent Arctic Expedition." 3. Dr. W. C. McIntosh, "The Annelids of the English North Polar Expedition (1875-76)." 4. Mr. Charles Stewart, "Certain Organs of the *Cidaridæ*."

Chemical, Burlington House, W., 8 p.m. 1. Prof. Odling, "Gallium." 2. Dr. Wright and Mr. Luff, "First Report of the Chemical Society on some Points of Chemical Dynamics. 3. Mr. M. M. P. Muir, "The Influences Exerted by Time and Mass in Certain Reactions in which Insoluble Salts are Produced." 4. Mr. C. T. Kingzett and Dr. Paul, "Two Fatty Acids of the Series $C_nH_{n_2}O_2$."

South London Photographic (at the House of the Society of Arts), 7.30 p.m. Popular Meeting.

Sat...... Working Men's Club and Institute Union (at the House of the Society of Arts), 4 p.m.

JOURNAL OF THE SOCIETY OF ARTS.

No. 1,304. Vol. XXV.

FRIDAY, NOVEMBER 16, 1877.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

NOTICE TO MEMBERS.

The 124th Session of the Society will commence on Wednesday, November 21st, when the opening address will be delivered by Mr. William Hawes, F.G.S., Deputy-Chairman of the Council, in the absence, owing to the state of his health, of Gen. Cotton, Chairman of Council.

Candidates proposed for election as members are privileged to attend on this occasion.

Evening Meetings of the Society will be held on the following dates, subject to any alterations which may be found necessary:—

The Annual General Meeting will be held on June 26th, at four o'clock.

Ordinary Meetings.

The following arrangements for the Wednesday evenings before Christmas have been made.

November 21.—Address by Deputy-Chairman of the Council, W. Hawes, Esq., F.G.S. [In the absence, from ill-health, of Major-Gen. F. C. Cotton, C.S.I., Chairman of the Council.]

November 28.—"The Telephone," by Prof. Graham Bell.

December 5.—"The Weak Points of the Elementary Education Code, with Suggestions for its Revision," by the Rev. E. F. M. MacCarthy. Sir Charles Reed Chairman of the London School Board, will preside.

December 12.—"Freedom in the Growth and Sale of the Crops of the Farm considered in its bearings upon the Interests of Landowners and Tenant Farmers," by J. B. Lawes, Esq., F.R.S.

December 19.—

Cantor Lectures.

Courses of Cantor Lectures will be given on Monday evenings, at eight o'clock. The First Course will be on "The Manufacture of Paper," by William Arnot, Esq., F.C.S.

	CANTOR LECTURES.	ADDITIONAL LECTURES.	AFRICAN MEETINGS.	ORDINARY MEETINGS.	CHEMICAL MEETINGS.	INDIAN MEETINGS.
	Mondays.	Mondays.	Tuesdays.	Wednesdays.	Thursdays.	Fridays.
1877.						
November	— — — 26	— — — —	— — — —	— — 21 28 —	— — — —	— — — —
December	3 10 17 —	— — — —	— — — —	5 12 19 — —	— — — —	— — — —
1878.						
January	— 14 21 —	— — — 28	— — — 22	— — 16 23 30	— — — —	— — — —
February	— — 18 25	4 11 — —	— — 19 —	6 13 20 27 —	— 14 — 28	1 — 22 —
March	4 11 18 25	— — — —	— — 19 —	6 13 20 27 —	— 14 — 28	— 15 — 29
April	— 8 15 —	— — — —	— 16 — 30	3 10 — — —	— — — —	— — — —
May	6 13 20 27	— — — —	— 14 — —	1 8 15 22 29	9 — 23 —	3 — 17 —

The Chair will be taken at Eight o'clock at each of the above Meetings.

Lecture I.—November 26th.

Introductory, Historical, Descriptive, and Statistical.

Lecture II.—December 3rd.

Raw Fibrous Materials; their characteristics and treatment preparatory to pulping.

Lecture III.—December 10th.

Washing, Bleaching, Beating, Loading, Sizing, Colouring.

Lecture IV.—December 17th.

Paper made by hand and by machinery. The Fourdrinier machine. Surface sizing. Drying machinery. Finishing.

Lecture V.—January 14th.

The Chemicals used in the paper mill; their nature, economical use, and methods of valuation. The recovery and re-use of soda as an economical process and in its sanitary bearings. The disposal of washing and machine waters, so as to minimise the pollution of streams.

Lecture VI.—January 21st.

The various classes of Paper; characteristic differences. The determination of the ash or loading. Water supply. General arrangement and construction of the mill.

The Second Course will be on "The Application of Photography to the Production of Printing Surfaces and Pictures in Pigment," by Thomas Bolas, Esq., F.C.S., and the Third Course on "Some Researches on Putrefactive Changes, and their Results in relation to the Preservation of Animal Substances," by B. W. Richardson, Esq., M.D., F.R.S.

Additional Lectures.

A Course of Three Lectures, on "Explosions in Coal Mines," will be delivered by T. Wills, Esq., F.C.S., on the three following Monday evenings, at eight o'clock, January 28th, February 4th, and February 11th.

Lecture I.—January 28th.

The nature of the Coal Measures. Mining for coal. Ventilation of mines. Composition of coal. Occurrence of fire-damp or marsh gas in mines. Nature and properties of fire-damp. Dangers connected with its presence.

Lecture II.—February 4th.

After-damp or choke-damp. Methods adopted to allow of safe working in fiery mines. Various appliances for lighting mines. The nature of the safety lamp. Different forms of this lamp.

Lecture III.—February 11th.

Connection of the variations of atmospheric pressure with explosions in coal mines. Dangers attending blasting operations in coal mines. Action of coal-dust in certain classes of explosions. The use of the safety lamp as an indicator of the presence of fire-damp, also as a means for its quantitative estimation.

Juvenile Lectures.

A short Course of Two Lectures, suitable for a juvenile audience, will be delivered during the Christmas holidays, by Prof. Barff, M.A., on "Coal and its Components." Special tickets will be issued for these lectures.

African Section.

Meetings of this Section will be held on Tuesday evenings, at eight o'clock.

Chemical Section.

Meetings of this Section will be held on Thursday evenings at eight o'clock.

Indian Section.

Meetings of this Section will be held on Friday evenings, at eight o'clock.

Papers to be read in the above Sections will be announced in the *Journal*.

Admission to Meetings.

Members have the right of attending the above meetings and lectures. They require no tickets (except for the Juvenile Lectures), but are admitted on signing their names. Every member can admit *two* friends to the Ordinary and Sectional Meetings, and *one* friend to the Cantor Lectures. Books of tickets for the purpose have been issued to the Members, but admission can also be obtained on the personal introduction of a Member.

MISCELLANEOUS.

FIUME AND HER NEW PORT.

By George L. Faber,

H.B.M. Vice-Consul at Fiume.

(Continued from p. 1038.)

Section IV.—*Harbour Works.*

A plan of Fiume, dating 1670, shows the town surrounded by walls, forming a limited quadrangle, whose two sea-facing sides, eastern and southern, were subtended by a moat, apparently fed by the Recina river, flowing on the east of the settlement, and entering the sea to the west. These curtains were strengthened by bastions, of which the strongest was on the shore, and their remains are still visible at the upper end of the town. The limits of the old walls on the sea side are shown by the gateway, now turned into a clock-tower. It is distant some 250 yards from the present quay, and this reclaimed space now forms part of the modern town. The only accommodation for shipping in the ancient plan is apparently a wooden pier, some 20 or 30 yards long; at that time Fiume was an open roadstead. The first approach to a harbour was the mouth of the Fiumara, the course of the river having been purposely changed by providing a shorter outlet eastwards. Its original bed was deepened, and supplied with quays and a dam seawards; thus it afforded some accommodation for coasting vessels and small craft, by which it is still used. The extension of trade, however, called forth greater requirements, and the commencement of the present harbour was inaugurated by the Archduke Palatine Stephen, in the year 1847. The new structure consisted of a breakwater, 269·7 metres long, and 5 metres broad, extending from east to west by north; the shore quays formed a rectangle, each side measuring 180 metres, and the landing pier (Molo Adamich)* extended from the shore facing the breakwater to a length of 70 metres by 20 broad. The area of the harbour covered 12½ acres.

This accommodation has hitherto met the requirements of trade, but in the year 1868, under the new *régime*, it was thought necessary to follow the example of Trieste, and to provide a larger harbour, with a superficies of 80 acres. The plan was to be carried out by lengthening the breakwater (*diga* or *hafendamm*) to 1,170 metres, thus giving it a total of 1,441·7. The plan shows it inclining slightly seawards for the first 770 metres, and thence running parallel with the sea-shore for the remaining 670. It was further proposed to extend and regulate the shore side of the harbour, which at that time measured only 180 metres facing the breakwater. This was to be effected by building quays to a total length of 936 metres, with two moles (landing-piers), marked in the plan Nos. 1 and 2, each 150 metres long, by 80 broad, while the third or outer mole (No. 3) was to run 210 metres by 36. The harbour entrance was to be formed by this last mole (*Abschluss molo*), and by a spur pierlet, disposed at right angles, extending 250 metres from the outer end of the breakwater, and leaving a ship passage of 100 metres. This plan afforded four basins for the accommodation of shipping, the total length of the harbour being about 1,180 metres, and the breadth between quay and breakwater 385 metres at the outer end, narrowing to 300 metres in the middle, and to 180 metres at the inner end. The space between the breakwater and the ends of the moles, Nos. 1 and 2, measured 175 metres and 235 metres respectively. The dimensions of the four basins, exclusive of the space between the pier ends and the breakwater, may be given as follows:—Inner basin (old harbour), 150 metres by 140 metres; 2nd basin, 280 metres by 150; 3rd basin, 250 metres by 150; and outer basin, 250 metres by 180.

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* So called from one of the worthies of Fiume, to whose exertions the modern town owns most of its improvements.—R. F. B.

The extent of quay and pier accommodation for the loading and unloading of vessels, exclusive of the breakwater, thus represents an aggregate length of 2,200 metres and more. This plan was worked out by M. Pasqual, chief engineer of the Marseille harbour, who was also engaged upon the Trieste harbour works. The details and estimates were taken in hand by Government, and the latter were provisionally set down at 13 millions of florins (about £1,100,000). A portion of this work, consisting of 800 metres of the breakwater of the quays extending as far as mole No. 2 (not included); and, lastly mole No. 1 (*Molo Zichy*), was given to the "Entreprise générale de Chemins de Fer et Travaux Publiques," a French Company, which took the contract for the sum of 5,016,973 florins (about £420,000). The work comprised in this section has proceeded satisfactorily. Meanwhile, and fortunately before the original form of the plan had been further developed, the authorities could not help recognising, while financial difficulties afforded a convenient pretext, the fact that the great expectations of Fiume had, at all events, in as far as her immediate future is concerned, been highly exaggerated. This consideration rendered unadvisable the immediate outlay of the whole estimate; and presently it led to a modification of the original plan. The Government, about the middle of last year, resolved to adopt more modest proportions, and these are still more than adequate for present requirements, whilst they can be increased to the original extent whenever circumstances may demand. The reduced scale on which these important and admirably executed works are now being carried out will, when completed, contain a superficial area of 57½ acres. Mole No. 1 (*Molo Zichy*) will be built as originally planned, and a second, or outer mole (*Abschluss Molo*), 150 metres by 40, will take the place of mole No. 2 (original plan), while the breakwater (*Hafendamm*) will be limited to the 800 metres already provided for in the provisional contract. The modified estimates were thus reduced by nearly one half, or to 6,876,504 florins. This sum included about 800,000 florins for the necessary harbour-fittings and appliances, which were not inserted in the original estimates; such as a lighthouse at the port entrance (100,000 florins); steam tug for harbour service (40,000 florins); a floating fire engine (8,000 florins), a *sanità*, or quarantine-house (2,000 florins); an astronomical clock and midday-signal (4,000 florins), 9 buoys with Mitchell screws, and 12 buoys on the chain system (together 198,000 florins). The preference was given, although more expensive than the moveable cranes, of which, also, a smaller number would have sufficed, to fixed hydraulic cranes, on account of their greater safety from fire. Besides the six fixed hydraulic cranes (88,910 florins) there will be a floating crane of 30 tons lifting power (30,000 florins), a running crane (4,000 florins), and a small crane for petroleum (800 florins). Lastly, the railway accommodation on the quays is laid down at 85,500 florins. The works are to be completed by the end of 1879,[*] and with these appliances ships of 1,200 to 1,500 tons will be unloaded in three days.

The harbour will then consist of three basins, viz.:—(1) The inner basin, or old harbour, with quay and pier accommodation of 430 metres in length, and an area of 21,000 square metres; (2) the middle basin, with quay and pier accommodation of 580 metres, and an area of 42,000 square metres; (3) the outer basin, with quay and pier accommodation of 550 metres, and an area of 37,500 square metres. The total length of the quay and pier accommodation is thus 1,560 metres, the area of the three basins measures 100,500 square metres (against 230,000 square metres of the whole harbour), and thus 100 large vessels can be accommodated.

The harbour works are being carried out by the French company, under the direction of M. Sivel, and the immediate supervision of the Hungarian Ministry of Public Works, represented by their engineers, Messrs. Eisinger and Pünkösti. To the latter gentleman I am chiefly indebted for the information here given.

The first step was to find suitable quarries within easy reach; and this was not a difficult matter, as hard nummulitic limestone forms the Carso. A convenient site was fixed upon at Martinschizza, in a small bay some four miles distant on the eastern coast, inclosed by rocky hills of the required material. The analysis of this rock is:—

Carbonate of lime	92·5
Oxide of iron and clay	5·
Carbonate of magnesia	1·5
Insoluble	1·
	100
Specific gravity	2·7
Hardness	2·9

The principal quarry lies at the bottom of the bay, and the barges are loaded by means of a wooden pier 225 metres long, whose end is 1,000 metres from the furthermost part of the quarry. Appleby cranes (eight horse-power) lift the blocks and load the trucks, which have to pass over the scale, and which are worked to and fro by means of two locomotives. As a rule, 550 trucks full of material are worked per diem, and this number increases to 700 during summer. The 17 barges for rubble, with flap-doors, are 23 metres long by 6½ broad, and have a loading capacity of 160 tons. There are also 20 barges of peculiar construction, which will presently be described. Their loading capacity ranges from 180 to 280 tons, and they transport the stone to Fiume, the service being carried on by five steam tugs.

On an average 800 labourers are employed on these works. The dimensions of the stone are of three sizes:—

No. 1 weighs............	2— 26 cwts.
„ 2 „	26— 80 „
„ 3 „	80—180 „

A cubic metre of the nummulitic rock weighs 52 cwts., and of rubble 33 cwts. The average cost of working the rock, including the blasting, and all the labour till sunk in the harbour, is 1 florin 60, or 2s. 8d. per cubic metre.

A new quarry has now been opened outside the bay, close to the sea shore, and the work is carried on entirely by manual labour, there being insufficient space for mechanical appliances. There the rock is less mixed with earth than in the original quarry, and there is accordingly less waste of labour. The blasting is done by common gunpowder, and its effect is found to be less damaging to the rock than dynamite. Ignition is effected by a Brequet electro-magnetic battery, which has never yet failed to work, in combination with a peculiar and a novel kind of fuse.

On an average 4,500 tons are sunk per diem in the harbour. The operation is as follows:—The *enrochement*, or supporting base, is made with rubble in pieces not under 6 lb., and ranging to 2 cwts. in weight. The slope is 1 in 2 in the piers, and 2 in 3 in the breakwater; this angle has been found sufficient, and has required

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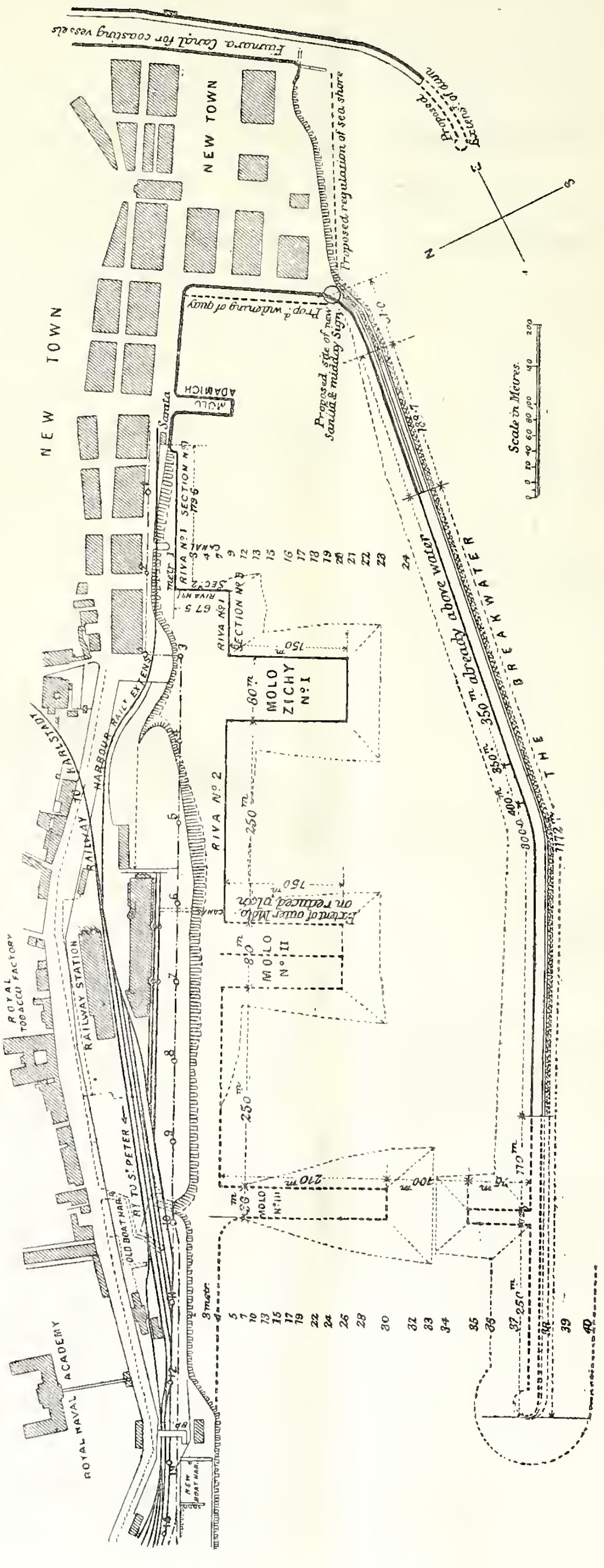
[*] I cannot see the least prospect of this being done before 1880.—R. F. B.



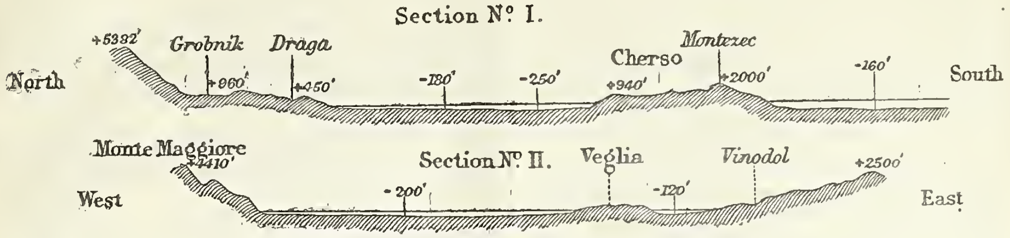
PLAN OF THE NEW PORT OF FIUME.

Extent of old harbour ....

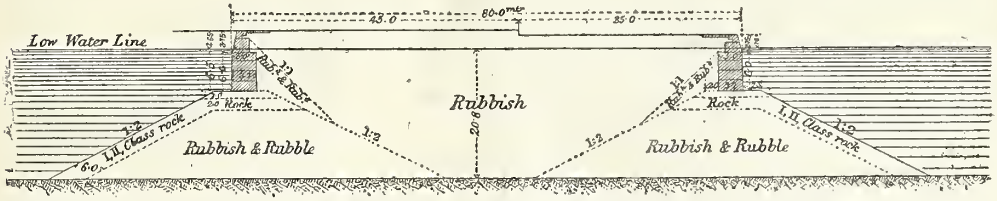
Work included in contract ....

Extent of original plan ....

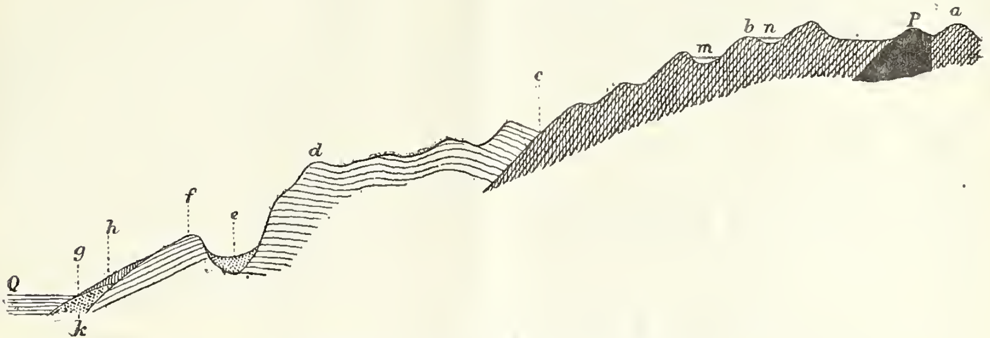
The numbers show the depth of water in metres.



Section No. I of Quarnero, from North to South; Section No. II of Quarnero, from West to East; showing Height of Coastland (+) and Depth of Water (−) in Austrian Feet, according to Dr. J. R. Lorenz.

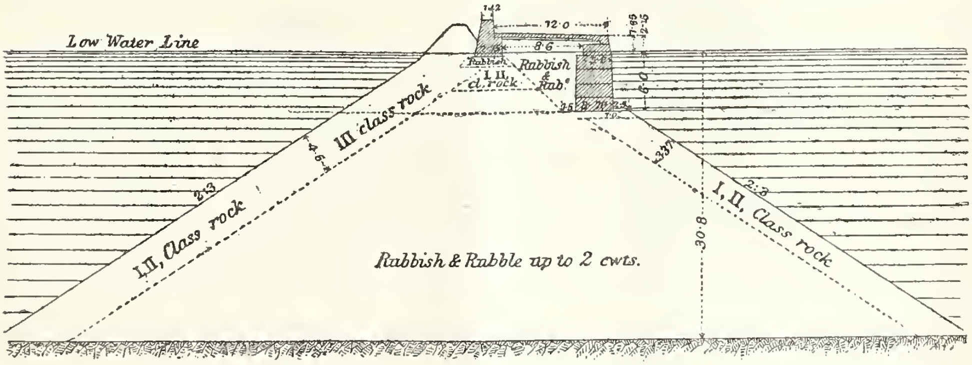


Section of Molo No. I (Molo Zichy). Dimensions in Metres.



Section of Carso, by Dr. J. R. Lorenz.

a-b, plateau; *b-c*, upper slope; *c-d*, middle slope; *d-e-f*, valley gap; *f-g*, lower slope; *Q*, Quarnero; *a-b-c*, tertiary formation; *P*, volcanic deposit near Fuzine; *m-n*, local diluvium; *c-d-f*, limestone; *e* and *k*, nummulitic sandstone (*tassello*); *h*, nummulitic lime.



Section of Breakwater. Dimensions in Metres.

no change. At Trieste, it was necessary to increase it to 1 in 4, on account of the treacherous, muddy ground, which would not retain the stone: the same cause also necessitated much dredging there, whereas at Fiume it was possible altogether to dispense with the costly and dilatory work. The base, when formed, is revetted on the waterside with a layer of blocks, varying in thickness from 3 to 5 metres; in the quays, moles, and inner, or harbour side of the breakwater, these blocks are of the 1st and 2nd category, ranging in weight up to 4 tons. The outer side of the breakwater is covered with blocks of the 1st and 2nd classes to within 10 metres of the water line. The crest is formed by the heaviest blocks, weighing from 4 to 10 tons, extending from 10 metres below to 4 metres above the water line, on a level with the outside wall of the breakwater. When the base is finished, six months are allowed for settling and consolidation; these amount to 1·20 metres before the artificial blocks are laid, 1 metre afterwards, and 0·20 metres in consequence of the superstructure, making altogether $2\frac{1}{2}$ metres to be allowed for. When the foundation is sufficiently secure, and is laid level with small rubble and concrete, the artificial blocks are built up into a wall four tiers high, forming the base of the quays. The superstructure is then provisionally weighted with two additional tiers of artificial blocks (*Belastungsblöcke*) rising above water, and they are left *in situ* about six months, in order to consolidate the whole mass.

The artificial blocks are built up with the normal limestone and Santorin earth. The dimensions are:—Length, 3·70 metres; breadth, 2 metres; height, 1·50 metres; cubic contents, 11·1 metres; weight, $22\frac{1}{2}$ tons. Each block is provided with two grooves, which serve to swing it; and the total cost, when sunk in the harbour, is 120 florins. Altogether, 3,600 are required by the provisional contract, and of these about 1,800 have already been placed in position, about 600 remaining on stock. The Santorin earth—used in the blocks, and generally on the whole works—is a natural cement, imported from that island. It costs only 20 shillings per ton: it is preferred to Portland and other cements, and it has hitherto been found to answer all requirements. It requires more time to dry than the Portland, but it offers the advantage of not having to be used immediately the concrete is made, and also of hardening when submerged. It takes a minimum of 30 days to attain the proper degree of hardness, and the artificial blocks are not moved before they are at least three months old.*

When the weighting blocks (*Belastungsblöcke*), have done their duty, they are removed, and the work can be brought to an end—

1. By filling up with rubble (*remblai*).
2. By building the superstructure above water.

The operations above described have hitherto proved successful, with one exception, viz., on quay (Riva) No 1, section No. 3. In this case the foundation gave way along the whole extent of 80 metres, after the weighting blocks had been placed *in situ*; and one morning the whole structure bodily disappeared, the artificial blocks having imbedded themselves in the ground, under the rock layer, sunk for their support. By this mishap 120 sank, and settled in all kinds of positions, except horizontal. The danger is now being obviated by substituting for the parapet of artificial blocks, a concrete wall of Santorin earth; it is built in caissons, after sufficient time has been given for the sunken mass to settle properly; and the foundation is further strengthened seawards by natural blocks. The success of these measures are chiefly due to the binding property of santorin earth under water, even when placed in contact with old masonry. The depth of this concrete wall varies from two to eight metres, thus showing how uneven is the surface under water which it became necessary to fill up. This part of the concrete requires at least 900 cubic metres, of which about 600 are completed.

The French Company began operations on December 18th, 1872. Its contract comprises about 3,200,000 tons of material sunk under water (*enrochement*), and 550,000 tons are required for filling up (*remblai* or *terrassement*), besides the artificial blocks, and the superstructure.

A statement is appended, showing the state of the works at the end of March, 1877; it is based upon the accounts kept between the Company and the Government, and settled monthly.

The material is first weighed on the trucks at Martinschizza, and then in the barges, each of which is fitted with a gauge to test its load. By this means a double check is kept; and the Company is paid according to a fixed scale of prices on the material delivered from month to month, a certain per-centage being retained as caution money. The following is the scale of prices:—

120·	florins	(£10)	artificial blocks.
0·76	,,	(1s. 3d.)	per ton rubble.
1·40	,,	(2s. 4d.)	per ton rock No. I.
1·60	,,	(2s. 8d.)	per ton rock No. II.
1.80	,,	(3s. 0d.)	per ton rock No. III.
40	,,	(66s. 8d.)	per cubic metre for cut stone blocks for the superstructure.
65	,,	(108s. 4d.)	per cubic metre for steps of cut stone.

The present state of the works may be described as follows:—Breakwater. The old Diga, which had a length of 269·7 metres has been widened from 5 to 12; and it is now being raised 1 metre, in order to bring it up to a uniform height of 1·65 metres above low water. Of the 800 metres forming the continuation of the breakwater, one-half is completed under water, and the artificial blocks are laid and weighted up to within 50 yards of that point; the remaining 50 yards will be finished by the end of the present year, leaving 400 metres to be done by the end of 1879. Of these 400 the submarine part has been taken in hand for some time past. The great depth of water (26-30 metres) renders progress necessarily slow. Moreover, it must be considered that the basement of this structure measures 120 metres in breadth, and that the amount of stone required under water only, amounts to $2\frac{1}{2}$ millions of tons. Seawards, the breakwater is protected by a stone parapet, and outermost by large rough blocks of the third class.

The landing platform for goods, measuring 12 metres, is provided with metal rings, and with stout posts for making fast cables. When completed, a double line of rails will be laid, in communication with the railway station, extending all round the harbour quays.

Riva No. 1 extends from Molo Adamich to Molo Zichy, and comprises three sections; No. 1, 179·6 metres; No. 2, 67·5 metres; and No. 3, 80 metres (vide plan.) Of these the first section is finished, as well as the greater part of the second. The former is already in use for large steamers, of which two can be along the first section broadside on. The completion of sections two and three, retarded by the accident already alluded to, will probably be brought to an end about the close of this year.

Mole No. 1 (Zichy).—About 83 per cent. of the *enrochement* under water, and some 75 per cent. of the *remblai* are completed; the quay walls of artificial blocks are now being laid by degrees, as the foundation settles sufficiently, and they will then be weighted by the *Belastungsblöcke* when the filling in can be completed. The base of this structure requires 440,000 tons of stuff, and the stuffing 241,000 tons.

When this pier is completed, large bonded warehouses, one for and by the Austro-Hungarian Lloyd's Steamship Company, will be built upon it. Government will also raise warehouses or iron sheds, estimated to cost 100,000 florins (£8,000).

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* The mixture used as cement is composed of $10\frac{1}{2}$ parts santorin earth, 4 parts lime, 1 part sand: the concrete is made of equal arts of cement and gravel.

Riva (quay) No. 2, extending between Mole No. 1 and Mole No. 2, and measuring 250 metres, comprises 84,000 tons of *enrochement*, of which only 45 per cent. is done; and 300,000 tons of filling, of which two thirds are completed; ten per cent. of the artificial blocks are also laid.

The construction of the outer pier (*Abschluss Molo*) has not yet been definitely decided upon; at all events it is not put up to contract; probably it will be built before long, the only question being whether a dry dock, which is more needed, ought not to be built first. The estimated cost of the outer mole would be 800,000 florins (£66,666).

Besides these main works, several of minor importance are either completed or projected. For instance, a small boat harbour for the Naval Academy, finished last year, cost 50,000 florins (£4,200); the improvement of the sea-shore, fronting the railway station, between the boat harbour of the Naval Academy and Mole No. 3, ending in 1875, cost 118,000 florins (£9,800).

Finally, among the works still contemplated may be mentioned:—

1. Widening by 10 metres the quay of the old harbour, which runs parallel with the piers.
2. Raising to 1·65 metres the Molo Adamich, which is now only 1·35 metres above low water line; estimate, 16,000 florins (£1,333).
3. Improvement of the sea shore between the harbour and the Fiumara mouth, where a quay is proposed, measuring 260 metres.
4. Lengthening the dam of the Fiumara canal by 100 metres; the estimates for the two latter (Nos. 3 and 4) being 186,000 florins (£15,500).

Section V.—*Industrial Establishments.*

A few words remain to be said on the industrial establishment of Fiume, foremost amongst which must be mentioned the fish-torpedo factory of Mr. Robert Whitehead, and the paper-mill of Messrs. Smith and Meynier. The latter is worked partly by water, and disposes altogether of 850 horse power. The annual exports of paper amount to upwards of 30,000 cwts.

Further may be mentioned the royal tobacco factory, employing upwards of 3,000 hands, and turning out upwards of 200 million cigars and cigarettes, besides smoking tobacco. The consumption amounts to upwards of 12,000 cwts. Virginia, 8,000 cwts. Turkish,* and 16,000 cwts. Hungarian leaf; the steam flour-mill turning out upwards of 15,000 tons annually, consuming of late years almost exclusively Danubian and Russian wheat, instead of Hungarian, thus showing the anomalous state of present circumstances; and the chemical factory, producing chiefly sulphuric acid and sulphate of soda, of which 1,600 tons are annually made. Besides these may be mentioned several ship-building establishments, which launch from 15 to 30 vessels annually, mostly of about 600 tons burden. There are also several tanneries and rope manufactories.

Section VI.—*Concluding.*

From these pages it may be seen that Fiume, in many points of view, may lay claims to consideration, and even to distinction; that something has been and is still being done by the present administration, and that much more is wanted, in order to secure for it that prominence and pre-eminence in the world's trade which its splendid natural position demands. If success has hitherto fallen short of expectation, the failure is due only to the optimism of those who based all their hopes upon a harbour and a railway; and, although so much remains to be done, success, in course of time, will not be wanting if the authorities and the citizens will come to a sense of what is required, in order to consolidate the rough work whose foundations, as I have shown, have been laid.

After the utter neglect to which the interests of Fiume had for so many years been subjected, it was hardly to be expected that the settled channel of trade could change in a day, and still less so when the work began at the wrong end, a fact which, I think, is now denied by none. Still wanted, above all, is an earnest, disinterested, and patriotic co-operation of public and private interests; but this is impossible so long as both are ruled by a despotic monopoly like the Südbahn.

Such a monopoly, if justifiable in any way, can be so only in the hands of the State where the lieges would have a claim and a right to insist upon the Government carrying out the works required for the general good. As the matter now stands, private enterprise is crippled on the one hand, whilst on the other, every effort of the authorities is paralysed under the effects of the monopoly. By doing away with it altogether, private enterprise would be stimulated instead of being checked, and what benefits individuals would eventually benefit the State. This much-desired object once attained, and the frontier-railways at the same time taken in hand, so as to bring Fiume into direct communication with Slavonia and with lower Hungary, success cannot be wanting, and the step will redound not less to the interest of Hungary generally, than to the benefit of Fiume in particular. But the change can be brought about only at the sacrifice of centralisation, that mistaken idea which now guides the policy of Hungary. It is full time, after the dearly-bought experience of the last five or six years, to recognise the fact that Hungary's sole chance of successfully competing with America, with Russia, and with India in the trade of cereals, is by forestalling these most dangerous rivals in the markets of the world. This she is able to do, if all unnecessary expenditure and loss of time are avoided in the transit to the coast. Fiume should look forward to this, nor should she rest satisfied till the measures in question are triumphantly carried out.

Appendix II.

Supplementary Estimates.

	Florins.
Estimates, as per statement	5,016,973
Outer mole	800,000
Projected works in the Fiumara canal ..	186,000
,, ,, on Molo Adamich......	16,000
Lighthouse	100,000
Sanità	2,000
Midday sign	4,000
Steam-tug for harbour work	40,000
Steam-pump (fire-engine)..............	8,000
Nine buoys with Mitchell screws...... Twelve buoys with chains	198,000
Six hydraulic cranes and machine-house	88,910
Petroleum crane.......................	800
Shifting crane........................	4,000
Floating crane (30 tons)	30,000
Warehouses on Molo No. 1	100,000
Rails on quays and breakwater	85,500
Contingencies	196,321
Total	6,876,504

Notes.

According to a recent report of the Under Secretary of State in the Hungarian Ministry of Public Works, M. Von Hieronimy, the length of Hungarian railways in operation in the year 1867, was 295 German (1,375 English) miles. The length of railways constructed between the years 1867-1876 consisted of 574 German (2,675 English) miles, so that at the end of the year 1876 altogether 869 German (4,050 English) miles of railway were in operation in the kingdom of Hungary.

Of the lines built from 1867-1876, the concession for twelve was granted under State guarantee of a sum of 16,205,156 florins per annum; the length of these twelve

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* So-called, I should add.—R. F. B.

APPENDIX I.

Statement showing the progress of the Fiume Harbour-works on the 31st March, 1877.

	Description of Work.		Stone work of basement under water.	Filling, or "remblai," above water.	Parapet wall.	Stonemasonry with cut stone facings.	Masonry for fixing posts for making fast.	Cut stone facings.	Posts for making fast.	Flag-stones and stone stairs cubic metres.	Artificial blocks, cubic metres.	Santorin concrete, cubic metres.	Pavement, square metres.	Dredging, cubic metres.	Wood and iron work, in cubic metres and cwts.	Estimates in florins. Amount paid for work done. Percentage of estimates.	Total.
			50 Kilos.	50 Kilos.	Cubic metres.	Cubic metres.	Cubic metres.	Square metres.	No.								Florins.
I.	Lengthening the Breakwater	Estimate	50,285,230	..	6,447·60	4,004·28	281·60	1,171·44	32	672·04	17,760·00	2,695·68	8,367·20	..	67·07	3,303,319	3,303,319
		Delivered ..	36,213,663	..	533·36	365·74	4·48	125·08	..	30·99	6,279·00	19·33	..	..	10·25	1,683,050	..
		Per cent. done	72 01	..	8·27	9·13	1·59	10·68	..	4·61	35·35	0·71	..	..	15·29	50·95	..
II.	Molo Zichy	Estimate	8,773,350	4,820,000	..	2,016·00	689·13	839·20	50	401·92	8,436·00	..	1,437·6	..	45·20	776,466	776,466
		Delivered ..	7,282,791	3,614,043	..	..	..	..	..	..	1,386·115	2,065·00	..	..	..	490,115	..
		Per cent. done	83·01	74·97	..	..	..	..	..	..	16·40	..	..	..	..	63·12	..
III.	Quay (Riva) No. I..	Estimate	689,650	..	..	1,425·54	418·68	577·74	25	292·00	7,039·62	..	1,223·20	33·000	41·6	229,328	229,328
		Delivered ..	475,486	..	..	818·24	295·09	297·52	10	237·12	7,806·64	138·678	783·271	24·351	24·61	174,235	..
		Per cent. done	68·94	..	..	57·42	70·42	51·47	40	81·2	110·90	..	64·03	73·78	59·15	75 95	..
IV.	Quay (Riva) No. II.	Estimate	1,678,550	6,000,000	..	1,333·54	461·92	554·50	15	260·57	5,550·00	..	974·25	..	29·27	352,973	352,973
		Delivered ..	756,406	4,007,292	..	..	..	..	..	..	555·00	..	..	..	..	163,330	..
		Per cent. done	45 06	66·78	..	..	..	..	..	..	10·00	..	..	..	..	46·27	..
V.	Widening of old breakwater......	Estimate	1,224,306	8,925	2,274·95	..	107·33	..	18	121·68	180·25	743·55	2,120·57	909·40	66·65	194,601	194,601
		Delivered ..	1,071,657	..	2,078·92	..	..	..	..	..	4·25	..	..	..	60·00	126,302	..
		Per cent. done	87·53	..	91·38	..	..	..	..	..	2·52	..	..	..	90·00	64·90	..
VI.	Boat-harbour	Estimate	..	..	..	..	..	..	..	..	..	..	..	..	..	66,747	..
		Delivered ..	..	..	..	..	..	Finishe	d in	1876.	..	..	..	..	..	50,291	50,291
		Per cent. done	..	..	..	..	..	..	..	..	..	..	..	..	..	75·34	..
VII.	Protection of shore between boat-harbour and Molo III.	Estimate	..	..	..	..	..	..	..	..	..	..	..	..	..	97,758	..
		Delivered ..	..	..	..	..	..	Finishe	d in	1875.	..	..	..	..	..	86,828	86,828
		Per cent. done	..	..	..	..	..	..	..	..	..	..	..	..	..	88·81	..
VIII.	Protection of shore between boat-harbour & rly. station	Estimate	..	..	..	..	..	..	..	..	..	..	..	..	..	20,324	..
		Delivered ..	..	..	..	..	..	Finishe	d in	1875.	..	..	..	..	..	23,167	23,167
		Per cent. done	..	..	..	..	..	..	..	..	..	..	..	..	..	114	..

Totals—Estimates, 5,016,973 florins; amount paid for work done, 2,797,318 florins; per-centage, 55·75.

lines being 388·11 German (1,808·59 English) miles, the average guarantee per mile being 42,000 florins per German, or £900 per English mile. The net income of these lines amounted to 2,165,168 florins in 1875 (5,578 florins per German, or £120 per English mile) thus leaving a deficit, as against the Government guarantee, of 14,039,988 florins (or 36,175 florins per German, or £780 per English mile). The gross annual income of the Hungarian network of the Sudbahn is given at 70,000 to 75,000 florins, per German, *i.e.*, £1,600 per English mile; and that of the Fiume-Karlstadt and Agram-Zakany lines, belonging to the State, at about 20,000 florins per German, or £360 per English mile.

At present (October, 1877) grain is going forward in large quantities to England from Trieste, the whole of which comes from Hungary, via Pragerhof and Steinbrück, and would in due order of things be shipped at Fiume, were it not for the advantages held out for Trieste shipments by the Südbahn.

I am much indebted, and feel bound to express my thanks to the Ministerialrath, Mr. H. von Catinelli, for a variety of information which, as chief of the Maritime Department (*Seebehörde*), he has placed at my disposal, and for the unvaried kindness with which he is ever ready to oblige all applicants.

RHEEA FIBRE.*

In 1870 the Government of India offered a prize of £5,000 to the inventor of the best machine or process for the preparation of the fibre of the *Böhmeria nivea* (popularly known under the names of Rheea, Ramic, and China grass), and the terms on which machines would be admitted to competition were widely notified in India, in Europe, and in America. Many persons declared their intention to compete, but ultimately only one machine was actually brought to the place of trial. The machine having been carefully tested at Sahâranpur in the autumn of 1872, was found imperfect in some important respects, and the inventor was adjudged not entitled to the full reward. He was, however, presented with £1,500 in consideration of the partial measure of success he had attained after great perseverance.

2. This machine has not since been adapted by the inventor to practical use, and no improved process of preparing the fibre of the rheea has been yet discovered by other persons. Meanwhile the demand for rheea continues, and the conditions which induced the Government of India in 1870 to offer a prize remain substantially unchanged.

3. His Honour the President in Council, therefore, considers that it is desirable to renew the offer, and it is accordingly hereby notified that a reward of fifty thousand rupees will be paid to the inventor of the best machine or process which will separate the bark and fibre from the stem, and the fibre from the bark, of the *Böhmeria nivea.*

4. A smaller reward, not exceeding ten thousand rupees, will be given to the inventor of the next best machine or process, provided it is adjudged to possess merit, and to be capable without difficulty of adaptation to practical use.

5. What is required is a machine or process capable of producing, by animal, water, or steam power, a ton of dressed fibre of a quality which shall average in value not less than £45 per ton in the English market, at a total cost, including all processes of preparation and all needful allowance for wear and tear, of not more than £15 per ton, laid down at any port of shipment in India, and £30 in England, after payment of all the charges usual in trade before goods reach the hands of the manufacturer. The processes of preparation are to be understood to include all the operations required subsequent to the cutting of the stems from the plants in the field, until the fibre is in a condition fit to be packed for conveyance to the market.

6. The machinery employed must be simple, strong, durable, and inexpensive, and should be suited for erection in the plantations where the rheea is grown. It must be adapted for treatment of the fresh stems, as cut from the plant. The treatment of dried stems offers certain difficulties, and the fibre prepared from them must, moreover, always be much more costly than the fibre produced from green stems. Except during the hot dry weather preceding the rains in Upper India (where rheea grows best), it is very difficult so to dry the stems that no fermentation or mildew shall occur. But during this season the stems are comparatively short, and the crop poor and stunted, unless it is artificially irrigated, and such irrigation greatly increases the cost of cultivation. In the rainy season the plant is in fine condition, but at this season it is almost impossible to dry the stems in quantity without injuring the fibre, unless recourse is had to artificial means of desiccation, which greatly increase the cost of the material. It is, therefore, obvious that the attention of inventors should be given to the discovery of a process for the treatment of the green stems.

7. The trials will be held at Sahâranpur, in the North-Western Provinces, in the months of August and September, 1879. Machines entered for competition should be placed *in situ* and be ready for work not later than the 15th August, the competition commencing on the next day. The judges will be appointed by the Government, and they will watch the whole of the trials. But the machines shall be worked and adjusted by the competitors themselves, and no person shall touch a machine without the consent of the inventor.

8. The Government of India will provide proper shelter and accommodation at Sahâranpur for all the competing machines as well as the motive power required. It will also pay for the transport from the seacoast to Sahâranpur of all machines up to the limit of one ton each, the freight on any excess weight to be defrayed by the owners. The present rate of freight by rail from Calcutta to Sahâranpur is Rs. 3·10 per maund, or Rs. 98·11 per ton, and from Bombay to Sahâranpur Rs. 4·1 per maund, or Rs. 110·9 per ton. A free second-class ticket to Sahâranpur will also be given to any person in charge of a machine.

9. The owner or owners of the successful machine or machines shall not be entitled to receive the reward offered, except on the following conditions, viz:—

(1.) That a complete technical description of the machine, illustrated by plans drawn to scale, shall be prepared and published (Government paying the cost) for the information of the public.

(2.) That after the expiry of three years from the date on which the award is made, the public shall have the right of manufacturing similar machines, on payment to the owner of a royalty of 10 per cent. on the cost of each machine so manufactured.

10. All persons desiring to compete, under the terms and on the conditions specified above, are requested to make known their intention not later than the 31st December, 1878, giving the following particulars:—

1. Name in full, and residence.
2. Profession or occupation.
3. Number of different kinds of machines entered for competition.
4. Brief description of each machine.

Intending competitors will, at the same time, declare themselves bound (under penalty of disqualification of the competing machines and forfeiture of all claim to the Government reward) to conform to all rules which may be prescribed by Government in connection with the conduct of the trials.

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* Notification issued by the Government of India, Department of Revenue, Agriculture, and Commerce.—Fibres and Silk.—Dated Simla, the 31st August, 1877, No. 45.

All notices of intention to compete and applications for information should be addressed to the Secretary to the Government of India, Department of Revenue, Agriculture, and Commerce, Calcutta.

11. A limited quantity of rheea will be grown in the Botanic Gardens, Calcutta, and persons desirous of testing their machines before entering them for public competition may obtain green stems in small quantities from the Superintendent of the Gardens, through this Department.

THE FISHERIES OF FERRARA.

Consul Colnaghi in his report upon the commerce of the province of Ferrara, gives some facts respecting the produce in fish. The lake fisheries (valli da pesca), he states, are situated for two-thirds in the district of Comacchio, and for one-third in that of Ferrara. The lagoons of Comacchio, which include a superficial area of 20,246 hectares, are the most fertile, forming part of the ancient lagoons of the Adriatic; they are now separated from the sea and from the lagoons of Chioggia and Venice by littoral dunes, and the prolongation of the mouths of the Po caused by the fluvial deposits. They are bounded on the east by the sea-shore, which is generally wooded; on the north by the Volano Canal, on the south by the river Reno, and on the west by the Communes of Ostillato, Port Maggiore, and Argenta. The lake waters are partly salt from the regulated admission of the sea water to enable the young fish to enter the lagoons. The level of the lakes, when the canals are open, follows the movement of the tides, their depth, beneath the mean sea level, is between one and two metres.

The fisheries of Comacchio have existed from time immemorial, but the first contract for farming them out to contractors dates from 1566. Were the old empirical practices to be exchanged for the method of artificial fecundation, their importance would not only be greatly increased, but a stop might be put to the waste of young fish, which are caught in the Adriatic in the months of February, March, and April, to stock the private "valli," and which perish in large numbers. The unsatisfactory condition of the fisheries of Comacchio may be traced back to the year 1825, when a great mortality ensued among the fish, caused by the over-saltness of the water, produced by drought. The state of affairs is further complicated by the rights and privileges which custom and its abuse appear to have bestowed upon the inhabitants of Comacchio, who obtain their principal means of existence, legitimate, or illegitimate, from catching and curing the fish on their own behalf, or as attached to the administration of the "valli."

The fisheries which, when the pontifical provinces were united to the kingdom of Italy, became the property of the State, were ceded by the Italian Government to the Commune of Comacchio by the law of July 7, 1868. After a short and unsuccessful experiment of municipal management they were farmed out to private speculators. The present contractors pay an annual rent to the Commune of 185,000 lire. The lakes are divided into three divisions; the first contains five basins and yields the best qualities of fish; the second division, for fish of the second quality, contains nine basins; the third division, with thirteen basins, is devoted to fish of an inferior kind. The "valli" are protected by a system of dykes furnished with sluices. At the entrances the so-called "otele," or "lavorieri," ingeniously constructed of boards and canes, are placed to guide the course of the young fish and prevent their return seawards. The principal fishing seasons are, first, in the autumn, when the nights are dark and stormy; the second, Lent fishing, is in the spring; occasional fishing is carried on throughout the year, constituting an important resource for the poor. The fish are caught by various arrangements of stationary and moveable nets, and by means of fish-spears ("fiocina"). Of the various qualities of fish preserved in the "valli," the eels are by far the most important, they are followed by the grey mullets, "acquadelle," and the "cappe." The average yearly take of fish from 1792 to 1824 was 1,141.806 kilos. This quantity between 1824 and 1870 had decreased to 551,843 kilos., owing to the disastrous season of 1825, when 2,700,000 kilos. of fish died, and to the intense cold of February, 1851, which caused a further mortality. For the three years 1871-72-73, the take of eels alone, in the "valli" of Comacchio, averaged 1,162,836 kilos. annually. For the year 1872, according to the contracting company's accounts, the income from the fisheries amounted to 2,120,947 lire, the expenditure to 1,974,426 lire, leaving the net profits at 146,521 lire. The live eels are carried to market or the curing-houses by sea, river, or canal, in flat, submarine boats, called "burchi," or "marotte," constructed so as to permit the free entrance of the water into the fish chambers. The largest appear to be about 12·50 in length, and to be carrying about 1,600 kilos. of fish.

In addition to the "valli" of Comacchio, there exist other private "valli," called free or open. On the right bank of the Volano, with which they communicate by means of sluices, are the "vallesina" and the "valli" of Stefano, Riva, Cantone, Bertuzzi, Barlamo, and Val Nuova; on the left bank the fisheries of Mesola, partly the property of the Roman hospital of S. Spirito, and in part belonging to private owners. The total yield of these "valli" in 1872 was 385,000 kilos. of fish, of which there were 359,766 kilos. of eels and 26,734 kilos. of "acquadelle." Including all the fish caught in the "valli" of Comacchio, on account of the lessees, in 1872 (1,467,847 kilos.) with that called "delle mani," which, by right, goes for the benefit of the poor (207,705 kilos.), and the yield of the free "valli" mentioned above, the total product amounts to 2,162,052 kilos. To the fisheries of the "valli" must be added the coast fishing and that of the canals and rivers which traverse the province, and especially the Po, where fine sturgeon are caught. The total amount of fish caught in and on the shores of the province per annum, may be calculated at 2,500,000 kilos. That the fisheries are highly susceptible of improvement there is no doubt, when it is considered that while the lagoons of Comacchio yield only 281 kilos. of fish per hectare of superficial area, the "valli" Cantone, Stefano, and others, in the hands of private owners, yield an average of 522 kilos. of fish per hectare. In addition to the persons employed in the fisheries, some 1,700 or 1,800 more find occupation in curing, pickling, and salting the eels and "acquadelle" caught in the "valli." Consul Colnaghi completes his account of the fisheries of Comacchio with a brief notice of the process of curing the fish.

The guild of fish curers (*Ceto dei Fabbricatorio*), has existed time out of mind, and this industry has always been a monopoly of the inhabitants of Comacchio. Like all monopolies it appears not to be free from abuses and to require thorough reform. The eels are prepared for pickling by being first roasted on spits before a large fire, and then packed in barrels which are filled up with vinegar. The "acquadelle" are fried in the fat of eels, and then packed in a similar manner. To salt the eels they are placed in layers in baskets of osier bands, each row being salted in order. The fish are next pressed under heavy weights and the brine exudes through the interstices of the baskets. They are then packed in barrels.

Wild ducks and coots are plentiful in the lagoons, and form the object of an active trade with the neighbouring provinces. The black heron, common heron, little egret, golden plover, &c., are likewise met with. As agriculture extends, hares, quails, woodcocks, and partridges become less numerous, and the preserves of Mesola, at one time so rich in pheasants, hares, deer, and roebucks, have lost much of their former importance from over-shooting, and latterly, owing to the inundations of the Po. The leeches of the Ferrarese are considered of excellent quality, and formerly formed an important article of commerce with France and other countries.

MANUFACTURE AND USES OF BIRD-LIME IN JAPAN.

The following extract, wich is taken from the *Hiogo News*, is inserted by Consul Annesley, in his report upon the trade of Hiogo and Osaka. Although bird-lime may be obtained in small quantities in other countries, still Japan may perhaps be considered the only country in the world in which it is regularly manufactured on a large scale, and as an article of some commercial importance, the production of which gives employment to some thousands of people.

The Chinese characters used to express the word "mochi," sometime called "tori-mochi," to distinguish it from "mochi" (rice-cake), give an excellent idea of the nature of the article, and may be freely translated "bird-catching, sticky substance." It was first manufactured at a place called Yoshino, in the province of Yamato, and the manufacture has spread thence over the whole of Southern Japan, being limited in the locality by the habitat of the trees from which the article is made. The date of its discovery it is certainly difficult, and perhaps altogether impossible to obtain, some placing it 500 years back, and some only 300. It is, however, certain that within the last twenty years, the quantity that has been brought into the market has been perceptibly affected through the destruction of the trees, by denuding them of their bark for its manufacture. The Japanese have made some attempt to arrest this destruction by leaving, in a particular manner, a certain amount of the bark on the trees, with the hope that they might serve a second time; but it is found that the article made from this second bark is of very inferior quality.

Osaka is the great centre of the mochi trade; large stocks of it may be found, anomalously enough, in the hands of the Kane-Cutsaya (dried fruit merchants), who have their head-quarters in and about Tema. Its present value is about 13 yen to 16 yen per picul (133½ lbs.). The best kinds, which are distinguished by being free from bark, of a dull whitish colour, extremely viscid, and having a very gummy consistency, come from the provinces of Yamato, Kischin, Tosa, Aiva, and Igo, an inferior quality being made in Satsuma, Choshin, Bungo, Isé, and Mino, the two latter place being rhe northern limit of its manufacture. All found north of these provinces is imported from Osaka and places south of that port. The best kinds are said to keep good for any length of time. The principal tree from which this bird-lime is made is a dark evergreen, having its habitat in the southern half of Japan; it grows high up the shady sides of deep mountain glens, and is frequently used by the Japanese as an ornamental shrub; in fact it may be seen in the ornamental grounds of the Osaka Railway Station. Its bark is of a greyish brown colour, and roughish texture; the leaves are opposite, smooth, dark green, rather more pulpy than the English holly leaf, ovate-acuminate in form, have an unbroken linear-edge, a very short petiole, and almost imperceptible stipules. Its efforescence is a panicle, centripetal in its development, having small, white, wax-like diandrous and monopetalous florets, which are also slightly cruciform.

The manufacture of bird-lime extends over a period of several months, commencing about June, when the bark of the mochi trees is stripped off and macerated in water for about forty days, after which it is collected and beaten in a mortar, exactly in the same manner in which rice is cleaned. The pestle, however, is of a different make, being shod with iron, the flat under surface of which is armed with spikes projecting downwards. When the pulpy mass under the pestle becomes glutinous, it is taken out and washed in water. This is done to remove as much as possible of the rough outer bark, and the pulp is then again pounded and treated in a cauldron with hot water, on the surface of which it floats. During this treatment it undergoes continual manipulation at the hands of the workman, for the purpose of disengaging the remaining particles of bark, which sink to the bottom of the boiler. This is the most difficult part of the process, as considerable skill and experience are required in the workman to keep the stuff from adhering to his hands. After this it is again washed in cold water, and the pounding, boiling, and washing are repeated until the material becomes sufficiently clean and pure. During the above process about nine-tenths of the weight of the raw material is lost, 250 catties of the latter not turning out more than 25 of good birdlime.

The uses to which this article is put by the Japanese are more extensive and diverse than one would suspect, its principal one being, of course, for the snaring of birds and animals. By its means animals as large as monkeys are caught. When they once get the stuff upon their paws they soon cover themselves with it, and so exhaust themselves in trying to get rid of it that they fall an easy prey. Birds also as large as ducks are taken, and by a very ingenious process. The young shoots of the fugi (*Wisteria*) which attain considerable length, and are strong, light, and flexible, are gathered, dried, and knotted together in one continuous length. This is smeared with birdlime, and floated out to sea, when very often in the morning, as the writer has witnessed on the eastern coast of Choshin, the hunter is rewarded with several birds. It is a very inexpensive method of bagging wild fowl, as the tackle will serve any number of times till the birdlime dries, when it is easily replaced. Small birds are caught in various ways, some by means of a decoy bird concealed near a patch of tempting food, which is plentifully planted with little splinters of bamboo, like large needles, the upper half of which is covered with lime. Others are caught while on trees by means of a long, slender bamboo, the top of which is anointed with the lime, and then stealthily thrust against their feathers. Rats are easily caught by spreading a small quantity on a piece of board or paper, and placing it near their holes. It is spread upon a bamboo leaf, and universally used throughout Japan during summer, for catching flies or other insects. The writer has even seen a flea trap made of it, and used by the Japanese in bed. This trap looked more like an English toast-rack without a handle than anything else, simply a piece of board with the lime spread over its upper surface, while over this semicircles of bamboo were fixed at some distance apart, to prevent the bedding, &c., from getting smeared with lime. Should the vivacious insects happen to get on to this during their nocturnal frolics, their fate is as surely sealed as that of a little fish in the embrace of an octopod.

Another use of birdlime is for medicinal purposes. In certain diseases of the eye it is taken in small pills or dissolved in hot water. It is also used for those complaints of the pelvis which the Japanese call "senke"; it is considered one of the best cures for flesh wounds, cuts, &c., and is almost universally used in the manufacture of plasters. Both water and oil are used in its manipulation, to prevent it sticking to the fingers, but it is generally handled with a stick. It can be purchased at any greengrocer's ("yawoya") store throughout Japan. It might be as well to mention that a very inferier quality of birdlime is made out of wheat by most of the "fuga" (makers of wheaten food); it soon loses its properties and becomes useless.

It is announced that a special exhibition will be held at the Champ de Mars, for collecting the results of the scientific missions granted by the French Government in 1867.

AGRICULTURAL IGNORANCE IN LANCASHIRE.

The following facts are taken from the first report of the Commissioners appointed to inquire into the best means of preventing the Pollution of Rivers, as far back as 1870:—

Nearly one-third of the live stock of this country is mankind! In 1869 there were in England 20,658,599 of "man," and he consumes not only the produce of 23,370,502 acres and of all the cattle (3,706,641), sheep (19,821,863), and pigs (1,629,550), which are maintained upon them, but imported food as well, to the extent of two-fifths of the estimated quantity of our home-grown wheat, and probably one-twentieth or more in excess of our home-grown meat. A creature of such great powers of consumption ought according to all the analogies and scientific facts, to be of corresponding agricultural value as a fertiliser (p. 72). . . . Man ought to be the very best farm-stock we have. . . . A sheep builds its whole weight of body out of the food of 18 months. The average age of man in England is rather more than 40 years, and the weight of his body at death is all that he has saved of all the food he has consumed during the whole period of his life. . . . The sheep is the very best live-stock known to English agriculture, and man is virtually good for nothing. . . . The excrement of a sheep is worth at least five shillings a year to the farmer. In South Lancashire the excrement of a man does not realise fivepence per annum individually. . . . The agricultural worthlessness of the immense stock of man in the Mersey basin, folded on the land, becomes a perfect scandal (p. 73). . . . One-eighth of the population of England is congregated in South Lancashire; one-eighth of the food produced in England or imported to it, is here consumed. . . . Nowhere is pollution more injurious, nowhere, it may be safely said, is the contrast between the means of fertility and their result so shameful. . . . Three hundred and forty thousand tons of dirty ashes are carried out from a population of one-and-a-quarter millions living in the nine towns mentioned (including Liverpool, Salford, and Manchester). Not one-seventh of the excrement of man is carried to the field; the liquid part drains directly to the sewer, or sops the land on which the houses stand, and even the solid part, mixed with the ash waste with which it is carried to the manure depôt, first receives a washing which soaks most of its valuable part away. And all this is permitted, and indeed defended, in a district containing thousands of acres of waste moss-land and peat-bog on its lower levels, large tracts of second-rate pasture land below the level of many of its towns, and abundance of poor land higher up, all of which would well repay the application of manure.

CAPE OF GOOD HOPE INTERNATIONAL EXHIBITION.

It has been officially announced from the Cape that a second International Exhibition is to be opened in Cape Town in April next. It appears that the success of the first Exhibition was sufficient to cause a demand for a repetition on a larger scale, especially as regards machinery, implements, and other matters employed in agriculture. The subject was, therefore, laid before the Assembly, a committee was appointed to examine the petition and statements presented, and in reporting thereon it recommended the Government to subscribe a sum not exceeding a thousand pounds, in aid of the coming Exhibition:—"It being of opinion that the enterprise and energy which has accomplished so much for the colony should be encouraged and assisted," ending with the recommendation above quoted as "in return for the advantages already derived."

During the last few years there has been a marked increase in the commerce of the Cape, for it appears that the imports of the colony increased in value from less than two millions sterling in 1866, and little more than two and a half millions in 1871, to £5,731,319 in 1875, while the exports had grown in the same time from two and a half to nearly four and a quarter millions, and as there are no manufactures of any importance carried on in the colony, the exports consisting of raw material, horses, cattle, and sheep, copper ore, tallow and skins; and from Natal, sugar, arrow-root, pine apples, indigo, coffee, &c., there seems no probability of this rapid growth of the trade with our South African colonies being arrested.

The figures referring to reports given above do not include diamonds, which are principally sent in letters or parcels, and of which there are no Custom-house returns: the amount to the present time is estimated at about twelve millions.

The Exhibition of the coming year is introduced under the special patronage of Sir Bartle Frere, Governor of the colony. Its programme includes almost every article of export:—Class 1. Preserved meats, fruits, vegetables, &c., condiments, preserves, wines, beer and spirits, corn, flour, &c. Class 2. Chemicals, perfumery, medicines, surgical appliances; oils, soaps and candles, paints, colours, inks, varnishes, glue, starch, blue, blacklead, &c.; surgical and dental instruments and appliances; tanning matters, disinfectants, insect destroyers, &c. Class 3. Furniture and upholstery of all kinds; glass, porcelain, earthenware, household utensils, and small wares of all kinds; sewing, washing, and other domestic machines; toys and games; writing-desks, work-boxes, &c.; shop fittings, show cases, &c. Class 4 includes all kinds of clothing and fabrics, watches, plate, and jewellery. Class 5. Vehicles, tents, and anything connected with travelling, emigration, and camp life. Class 6. Tools, cutlery, and needle goods. Class 7. All the machinery and materials of construction. Class 8. Agricultural implements and materials of all kinds. Class 9 is devoted to science and education, and includes books, maps, printing machinery, &c., instruments, apparatus, and materials. Class 10 embraces tobacco, cigars, &c.; aërated water apparatus, beer engines, &c.; ropes, cordage, boats, &c.; fire-extinguishers, and papier-maché ornaments.

CORRESPONDENCE.

TRIESTE.

As Capt. Burton has challenged some remarks of mine (see *Journal*, page 1029), I must request to be allowed to say that when writing the observations he has quoted, I was not referring to the competition between Trieste and Fiume, but to the tabular statements printed last year, from the pamphlet of M. Rziha, the tendency of which was to show that Austria had year by year derived an increasing portion of her supplies of tropical produce from the countries situate to the north and west, and that the trade of Trieste had suffered in consequence.

I am not at all unwilling to believe that the practical monopoly enjoyed by the Südbahn has been productive of evil, nor that certain advantages would result from the construction of the new lines recommended by M. Rziha and by Mr. Faber. I only venture to point out that when trade is found to increase in certain channels and to diminish in others, it will not do to confine our attention to the causes which affect the latter prejudicially; we must also consider the nature of the advantages which the former may possess.

My own idea would be to inquire in Vienna and in Prague as to the direction from which wholesale dealers have in former years, and latterly, procured their stock, and what were the inducements which led them to favour the German, Dutch, Belgian, and French importers rather than to deal with their countrymen at Trieste. It might prove that no advantages attach to the northern and western markets which could not be outweighed by a moderate saving on the present cost of carriage from Trieste. But, on the other hand, it might become apparent that a narrow market like that of Trieste could never present attractions equal to those of the wider and more competitive markets near the German Ocean.

If some shipowner or merchant could furnish us with information as to the numbers of vessels which annually call at Suez, at Queenstown, or at Falmouth, for orders, the comparison would be instructive. With the help of the telegraph, it is, no doubt, possible to search the whole of Europe for the best market for a given cargo; but the English merchant seeking a purchaser is, perhaps, unable to effect much saving in freight by ordering a vessel to Trieste rather than to Havre or Hamburg, and he has more time in which to negotiate, in case he determines not to arrest her progress until she is about to enter the English Channel.

As for cargoes simply "consigned" for sale on best terms, few of these, I should suppose, have ever been directed to the Austrian ports. The London market is a common refuge for unsold goods, mainly because it is so vast that a cargo more or less makes but a slight impression on prices.

I notice that the word "buy," in page 1,029, line 14 from the top, is printed "try," but this does not much affect the sense.

In conclusion, I must acknowledge the courtesy shown me by Capt. Burton, and I trust he will see that there is nothing antagonistic in the sentiments with which we respectively approach the subject.

Thos. S. Welton.

6, Offerton-road, Clapham, 12th November, 1877.

BAMBOO AS A PAPER-MAKING MATERIAL.

As my name has been prominently mentioned in "Dr. King's report on the Calcutta Botanical Gardens" referred to in last week's issue of the *Journal*, I beg space to make a few remarks thereon, inasmuch as it might be inferred, from the tenor of the report, that the successful employment of bamboo for paper-making was dependent solely on the continuous growth, and the continuous cropping of the young stems or shoots.

I will not attempt to discuss the botanical issues of the question with so eminent an authority as Dr. King, but will admit that the parent clump or stool may not bear cutting down in its entirety, also that the shoots are only produced once a year, and that during a limited season, until, indeed, we learn from Dr. King's next annual report the result of his further experiments confirming or modifying his present conclusions.

Assuming, therefore, that the experiments now being conducted under Dr. King's direction should not be successful, it fortunately happens for the paper trade, and those, like myself, interested in extending the supply of suitable paper-making materials, that, practically, an inexhaustible extent of bamboo jungle exists in many districts in India, from which the stems can be collected in the regular season, without having recourse to any plantations, or to cutting down the whole young growth from one clump simultaneously, as I learn from excellent authority that if only, say, one-half of the season's growth of young shoots is cut, the stock is not injured, but rather improved thereby.

My great difficulty hitherto, in communicating with the numerous authorities and correspondents in India, has been to explain what I meant by young stems and shoots, and to clearly define the proper stage of growth at which they should be cut, previous to their developing too prominent a woody character; and this difficulty still exists, as the growth of the stem necessarily is determined by the variety of the bamboo, the locality, soil, and climatic influence, &c., and as the character of the stem, and its suitability for the manufacture of "paper stock" and paper, must, mainly by governed by these conditions, to lay down a hard and fast line would obviously be out of my power.

Now, in discussing the laying out of a plantation (*vide* my pamphlet on the subject of "Bamboo Cultivation," page 8) I assumed, as a mere matter of calculation, "that allowing the stems to be 2 feet apart, and only 12 feet high, 40 tons might be estimated as the yield per acre." I am very much afraid that Dr. King's experiment in cutting has been conducted under some misapprehension in this direction, and that he assumed this growth of 12 feet only in height should not be exceeded, as in the tabular statement in the report 50 stems are shown to weigh 680 pounds only, an average of 13·6 lbs. each, this giving not more probably than 10 feet of stem available for fibre, and that also too young and immature, as Dr. King speaks of "wet" young shoots probably containing 80 to 85 per cent. of sap, being the result of only one month's growth, viz., "starting from the 10th to the 20th June, and all cut down the 21st July." Had they been allowed to grow till near the termination of the rains, they would probably have attained a height of from 20 to 30 feet, most of which would have been available for fibre, and necessarily also have materially affected the tonnage per acre.

In collecting, however, from the jungle or native forest, the yield per acre is hardly a question to be considered; proximity to a river or stream by means of which bamboos can be readily conveyed to a factory for manufacture into stock is the main point, and as I learn lately from British Burmah where these facilities exist, that stems of the season's growth can be laid down at Rangoon or Mouemlin at 15 rupees, say 30s., per mille, each mille nearly equal to the production of one ton of merchantable "paper stock," in this part of India, at least, plantations would not be needed, and I doubt not, under proper organisation, this cost might be further reduced.

I will, with your permission, resume the discussion of this subject in a future letter.

Thos. Routledge.

Clanheugh, Sunderland,
November 5th, 1877.

NOTICES.

MEETINGS FOR THE ENSUING WEEK.

Mon.... British Architects, 9, Conduit-street, W., 8 p.m. Mr. W. H. White, "Middle Class Houses in London and Paris."

Tues.... Civil Engineers, 25, Great George-street, Westminster, S.W., 8 p.m. "Discussion on the Progress of Steam Shipping."

Zoological, 11, Hanover-square, W., 8½ p.m. 1. The Marquis of Tweeddale, "Contributions to the Ornithology of the Philippines." (No. II.) "The Collection made by Mr. A. H. Everett in the Island of Zebu." 2. Dr. O. Finsch, "A Collection of Birds from Eoa, Friendly Islands.' 3. Prof. Garrod, "The Taenia of the Rhinoceros of the Sunderbunds (*Plagiotaenia gigantea*)." 4. Prof. Garrod, "The Anatomy of the Chinese Water Deer (*Hydropates inermis*)."

Royal Colonial, 15, Strand, W.C., 8 p.m. Mr. R. H. Elliot, "Indian Famines, and how to Modify the Causes that lead to them."

Wed.... **SOCIETY OF ARTS**, John-street, Adelphi, W.C., 8 p.m. Opening Address by Mr. W. Hawes (Deputy-Chairman of Council).

Meteorological, 25, Great George-street, S.W., 7 p.m. Hon. Ralph Abercromby, "The General Character and Principal Sources of Variation in the Weather at any part of a Cyclone or Anticyclone." 2. Capt. A. Schuck, "The 'Arched Squalls' of the Neighbourhood of the Trade Winds." 3. Mr. Robert H. Scott, "A Remarkable Barometric Oscillation on January 30th, 1876."

Geological, Burlington House, W., 8 p.m. 1. Mr. C. Lapworth, "The Moffat Series." 2. Mr. W. Shone, "The Glacial Deposits of West Cheshire, together with lists of the Fauna found in the Drift of Cheshire and adjoining Counties" 3. Mr. A. B. Wynne, "Notes on the Physical Geology of the Upper Punjab, India."

Fri....... Volunteer Sick Bearers' Association (at the House of the Society of Arts), 7 p.m.

CONTRIBUTIONS TO THE READING-ROOM.

The Council beg leave to acknowledge, with thanks to the Proprietors, the regular receipt of the following Transactions of Societies and Periodicals during the year:—

DAILY.

Sheffield and Rotherham Independent.

WEEKLY.

Agricultural Gazette.
American Journal of Gas Lighting.
Architect.
Athenæum.
Bombay Gazette, Overland Summary.
British Architect.
British Journal of Photography.
Builder.
Building News.
Builders' Weekly Reporter.
Capital and Labour.
Ceylon Times, Weekly Summary.
Chamber of Agriculture Journal.
Charity Organisation Reporter.
Chemical News.
Colliery Guardian.
Colonies and India, The.
Cotton.
Draper.
Empire.
Engineer.
Engineering.
Engineering and Building Times.
English Mechanic.
European Mail.
Farmer.
Financial Opinion.
Furniture Gazette.
Gardeners' Chronicle.
Gardeners' Magazine.
Gas Lighting, Journal of.
Herapath's Railway Journal
India, Times of.
Irish Builder.
Iron.
Land and Water.
Local Government Chronicle.
Medical Examiner.
Metropolitan.
Mining Journal.
Mondes, Les.
Moniteur des Arts.
Musical Standard.
Musical World.
Nature.
Papermakers' Circular.
Pharmaceutical Journal.
Photographic News.
Polytechnic Review.
Produce Markets' Review.
Queen.
Railway Service Gazette.
Sanitary Journal of Scotland.
Sanitary Record.
School Board Chronicle.
Schoolmaster.
Social Review.
Social Science Association, Sessional Proceedings of the.
South African Dominion Budget.
Staffordshire Sentinel.
Temperance Record.
Warehousemen & Drapers' Journal.
Whitehall Review.
Workmen's Club Journal.

FORTNIGHTLY.

Brewers' Guardian.
Jeweller & Metal Worker.
Publishers' Circular.

MONTHLY.

Annales du Génie Civil.
Applied Science, Journal of.
Atlantic Monthly.
Bayerisches Industrie- und Gewerbe-Blatt.
Bookseller.
Brewers' Journal and Wine Trade Review.
British Mail.
British Mercantile Gazette.
British Trade Journal.
Chemical Society, Journal of the.
Chemist and Druggist.
Education, Journal of.
Educational Times.
Foreman Engineers and Draughtsman, and record of their Associations.
Franklin Inst., Journal of the.
Geographical Magazine.
Horological Journal.
Horticultural Society, Journal of the.
Industrial Art.
Industrie Nationale, Bulletin de la Société d'Encouragement.
Ironmonger.
Leather Trades' Circular.
Monatsschrift für den Orient.
Moniteur Scientifique.
Musée de l'Industrie, Bulletin du.
National Education League.
National Life Boat Institution, Journal of the.
Nautical Magazine.
Pharmaceutical Society, Journal of the.
Photographic Society, Journal of the.
Pottery and Glass Trades' Review.
Printing Times and Lithographer.
Presse Scientifique des Deux Mondes
Quekett Microscopical Club, Journal of the.
Revue Maritime et Coloniale
Société Imperiale, Zoologique d'Acclimatation, Bulletin.
Sugar Cane.
Symons' Meteorological Magazine.
Telegraphic Journal and Electrical Review.

QUARTERLY.

Asiatic Society, Journal of the.
East India Association, Journal of the.
Geological Society, Journal of the.
Geologists' Association, Proceedings of the.
Linnæan Society, Journal and Transactions of the.
Mental Science, Journal of.
Meteorological Society, Journal of.
Naval Science.
Paper and Printing Trades' Journal.
Royal Agricultural Society, Journal of.
Royal Geographical Society, Proceedings and Journal of the.
Royal Society, Proceedings of the.
Royal United Service Institution, Journal of the.
Statistical Society, Journal of the.
Victoria Inst., Journal of the
Zoological Society, Proceedings and Transactions of the.

ANNUALLY.

Archæologia (Transactions of the Society of Antiquaries).
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Civil Engineers, Minutes of the Proceedings of the Institution of.
Engineers in Scotland, Transactions of the Institution of.
Engineers, Society of, Transactions of the.
Gas Managers, Report of the Proceedings of the British Association of.
India, Geological Survey of, Memoirs, Records, and Palæontologia Indica.
Indian Meteorological Memoirs.
Iron and Steel Inst., Journal of the.
Naval Architects, Transactions of the Institution of.
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